First-Ever Temperature Stable Solder Paste Unveiled

Major Development in Solder Paste Formulation Set to Change Market Paradigms

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The refrigerated transport and storage of solder paste materials – not to mention stability management on the production line – has long been something electronics assembly specialists have wanted to change. The shipping and logistics not only introduce the costs of cold packing and overnight freight, but the added concern of intermittent supply chain quality. Once at its destination, conventional solder paste must be stored between 0°C and 10°C until it is needed for production. On average, solder paste materials can be cold stored for up to six months before they are discarded, as product quality cannot be guaranteed after the six-month window.

When solder pastes arrive on the production line, they have to be kneaded and brought up to room temperature on the stencil printer before use. This process introduces throughput challenges, as start-up times can range from four to 24 hours. A solder paste material's abandon time can be anywhere from one to four hours and, as a safeguard, most manufacturers dispose of any remaining solder paste at the end of a shift. Printing and reflow performance are also areas where process engineers have voiced the need for improvement. Assembly specialists want lead-free, halogen-free solder pastes that offer consistent transfer efficiency with Area Ratios above 0.6 and reflow capability that provides good coalescence on 0201, 01005 and 0.3 mm CSP components with and an expanded reflow window. These manufacturing challenges and the aspirations (**Figure 1**) of today's engineers and operators pushed one of the industry's leading materials suppliers to develop a solution. In what customers and market veterans are calling a true development breakthrough, The Electronics Group of Henkel has formulated and commercialized the first-ever temperature stable solder paste technology.

New, Game-Changing Technology

Over four years in development with nearly 1,000 formulation iterations, the new temperature stable solder paste, LOCTITE GC 10, is built on an innovative flux system that delivers exceptional temperature stability both in transit and in production. The lead-free, zero halogen solder paste is stable at 26.5° C for one year and at 40° C for one month. While transport and logistics become far less complex and costly with the elimination of overnight shipping and cold packing, LOCTITE GC 10's production performance is what truly has manufacturers taking note. Not only was the new material tested extensively in a lab environment, but has been Beta

tested at over 20 customers worldwide, subjecting the new solder system to various manufacturing conditions, challenging environments and multiple equipment sets.

LOCTITE GC 10 is available in the same particle size distribution as current solder paste materials – Type 3, Type 4 and Type 5, – is a SAC305 alloy and the flux is ROL0 classified under the IPC ANSI/J-STD-004 specification. This, however, is where the similarities with conventional solder paste materials end. (**Figure 2**) Henkel's temperature stable solder paste's performance is unprecedented.

Exceptional Printing Capability

The temperature stability of LOCTITE GC 10 enables new levels of printing consistency and predictability, in addition to cost reductions from the ability to fully utilize the solder paste investment. Because the material is stored at room temperature, it requires zero start-up time and allows manufacturers to maximize throughput and production run rates. LOCTITE GC 10 can be opened, placed on the stencil and is immediately ready for use. This is in sharp contrast to conventional solder paste materials where bringing the paste temperature to production-ready can take anywhere from four to 24 hours.

Once in use on the printer, LOCTITE GC 10 maintains its integrity and robust print performance for an exceptionally long time. The stencil life of the material ranges from 16 to 72 hours and abandon times are between 8 and 24 hours. The ability to leave the paste on the stencil after a shift has ended and resume production the following day with no detrimental effect on the material offers tremendous cost savings. LOCTITE GC 10's on-line paste utilization of upwards of 95% in comparison to traditional materials' average utilization of 75% delivers a greater return on investment.

Evaluated on multiple aperture shapes and dimensions, LOCTITE GC 10 shows consistent print transfer efficiency performance on even the smallest device geometries and after having been idle on the printer for over 24 hours. Components ranging from 0201s, 01005s and 0.3 mm CSPs and varying aperture shapes (square, rectangular, circle, rounded rectangular) were printed with LOCTITE GC 10. Area Ratios ranged from 0.66 to 1.2. Consistently, print transfer efficiency was robust – regardless of open time – and material volume on the pads exhibited Cpk's in excess of 2.00. (**Figure 3**)

Extended Reflow Window with Superb Wetting on Challenging Surfaces

With LOCTITE GC 10, the solder reflow window has also been effectively extended and delivers on one of the key aspirations of assembly specialists. The material has consistent reflow performance and coalescence through both linear and long-hot soak profiles, with the soak temperatures ranging from 150°C to 200°C. Alternatively, conventional solder paste materials generally have a peak soak temperature of 180°C.

In addition, LOCTITE GC 10 has shown reduction of solder balling occurrences irrespective of reflow profile type, and the material has best-in-class wetting onto difficult substrates such as CuNiZn, which is often used for RF shield attach. Finally, the solder joints produced by LOCTITE GC 10 – a lead-free and zero halogen material – are as shiny as previous-generation tin-lead solder joints. (**Figure 4**).

Proven Performance

In practice, LOCTITE GC 10 is already having an impact. As part of the Beta testing, several global customers evaluated the material and were intrigued by its performance. Brian Steelglove, President of Illinois-based EMS firm, Accelerated Assemblies, said this about LOCTITE GC 10: "Our initial evaluation of the new Henkel LOCTITE temperature stable solder paste yielded great results. We were able to hold jobs on the line for as long as two days and had absolutely excellent reflow performance even though the paste had been exposed for an extended period of time. This capability completely eliminates any guesswork as to whether or not the material is still usable – it is! The paste also prints well and, given its projected online utilization, we anticipate that we will significantly reduce paste waste while realizing excellent process performance."

Xiao Tong, General Manager of Hangzhou Digit Technology in Hangzhou, China, evaluated the new solder paste and was very enthusiastic about its in-process performance. "LOCTITE GC 10 is a product with good printability, bright solder joints, and good control of solder balling and wetting properties," he said. "What makes us most excited is its super-long print life; this feature will help us reduce scrap-related costs."

Since its market introduction in late February 2015, over 500 LOCTITE GC 10 sample requests have been received.

Figure 1: Solder paste performance aspirations of the industry.

Improved Printing:	Improved Stability:	Improved Reflow:	Improved Paste Management:
• Abandon Time > 8 hours	• On-line stencil stability: 3 days @ 80% RH	• Excellent coalescence for 0201, 01005 and 0.3mm pitch	• On-line paste utilization
• Stencil Life > 16 hours	• Paste stability: 12x over conventional	• After 3 days @80% RH, zero dewetting on long soak	• Eliminate end-of-day paste scrapping
• High yield paste volumes with lowest aspect ratio	• Elevated temp stability: 100x over conventional	• Minimal hot slump @ 182°C	• Eliminate refrigerated warehouse storage
• Industry leader in paste-transfer efficiency	• Improved shipping logistics management	• Shiniest solder joints in the industry on long soak	• Eliminate ice pack shipping

Figure 2: Novel temperature stable paste is available in multiple paste types and a traditional SAC alloy just like conventional materials, but its stability and performance are dramatically different than current pastes.

Attributes	Current Technology	Temp. Stable Paste
Particle Size Distribution	Type 3, 4	Type 3, 4, 5
Alloy	SAC305 (97SC)	SAC305 (97SC)
Flux	ROL0	ROL0
Storage:		
Performance Stable at 26.5°C	1 month	1 year
Performance Stable at 40°C	1 day	1 month
Process:		
Abandon Time	1-4 hours	24 hours
Soak Temperature (Reflow)	150-180°C	150-200°C
On-line Paste Utilization	75%	95%
Start-up Time	4-24 hours	0 hours

Figure 3: LOCTITE GC 10 delivers consistent and robust print transfer efficiency on a variety of aperture shapes and sizes.

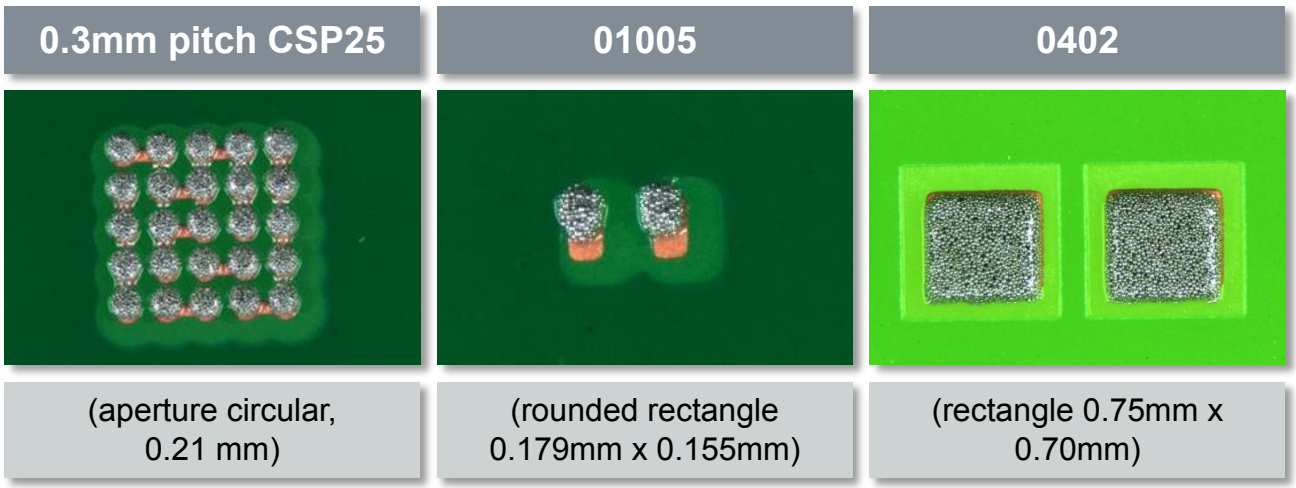

Figure 4: LOCTITE GC 10 produces very shiny solder joints similar to the appearance of traditional tin-lead solders.