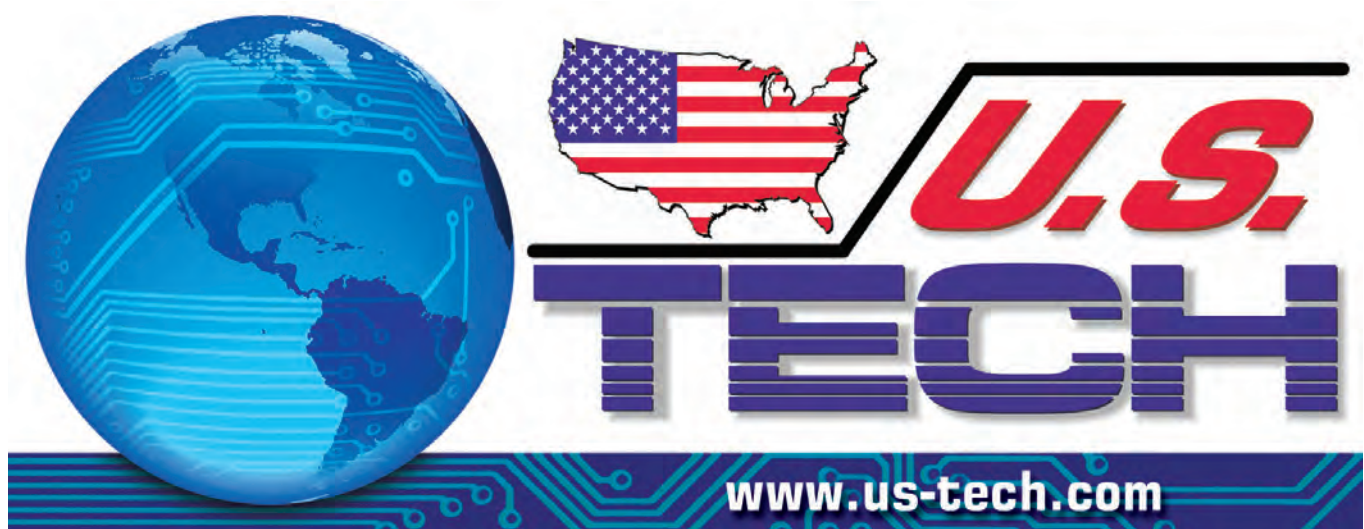


Next Issue Focus:
**Components
and Assembly**

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ASMPT Defines Success in Transformative Times

ATLANTA, GA — At a time when economic uncertainty and geopolitical tension weigh heavily on global sentiment — particularly in Europe — the electronics manufacturing sector continues to demonstrate resilience and momentum. According to ASMPT, the long-term fundamentals of the industry remain strong, driven by digitalization, electrification, and an accelerating pace of innovation.

In a wide-ranging conversation with *U.S. Tech*, Guenter Lauber, group executive director at

ASMPT, shared his perspective on where electronics production is headed, the challenges reshaping global manufacturing, and how technology, people, and collaboration will determine success in the years ahead.

Structurally Attractive Industry

Despite near-term volatility in some regions, Lauber describes the outlook for electronics and semiconductor manufacturing as fundamentally positive. Demand for innovative solutions continues to grow across nearly every industry.

“The world needs innovation, innovation needs electronics, and electronics need our manufacturing technology,” Lauber said. “That applies to virtually every sector.”

From automotive to consumer electronics, the role of electronics has expanded dramatically. Vehicles that once required minimal electronics have evolved into software-driven, data-intensive systems, particularly with the rise of electric and autonomous platforms. ASMPT’s technologies, Lauber noted, play a role in the development and production of nearly

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Guenter Lauber, group executive director, ASMPT.

SASinno Offers Full Line of PCB Assembly Machines

WASHINGTON, MO — SASinno Americas will showcase its complete portfolio of printed circuit board (PCB) assembly solutions during the 2026 APEX Expo, taking place March 17-19, 2026, at the Anaheim Convention Center. The exhibit will feature a fully integrated lineup of equipment designed to increase production speed, improve accuracy, and simplify manufacturing workflows.

Visitors to the booth will see a broad range of systems in operation, beginning with the IIS-120-460XL insertion indicator station, which ensures precise component placement. Material handling efficiency is supported by the BT-400-510XXL tilt conveyor and CYC510XXL reject conveyor, which help streamline board flow and defect man-

agement throughout the line.

Inspection and soldering capabilities will also be highlighted, including the AD-65MP THT components AOI system with a 510 mm inspection width, along



iWA-3/60TN wave soldering machine.

with the IWA-3/60TN wave soldering machine and MWN510-XXL wave solder unloading conveyor for high-reliability soldering applications. Additional material handling solutions on display include the TRE510XXL elevator conveyor and the

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Why High-Mix is the Future

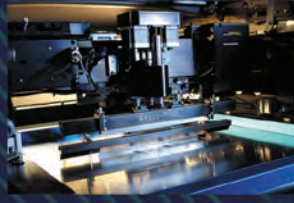
PHILADELPHIA, PA — For decades, scale was the defining competitive advantage in electronics manufacturing. The ability to run long, stable production volumes at the lowest possible unit cost separated market leaders from the rest. Today, that equation is changing. As product lifecycles shorten, customization increases, and supply chains fragment, high-mix manufacturing has emerged as one of the most valuable capabilities in the electronics industry.

This shift is being driven by customers as much as by manufacturers. OEMs are launching more product variants, targeting niche markets, and updating designs more frequently to keep pace with rapid technological change.

High-mix manufacturing rewards flexibility over sheer

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Special Features: Assembly and Automation



The Move to Silver-Free Solder is Well Underway

By Keith Sweatman, Senior Technical Advisor, Nihon Superior

In his review of developments during 2025, solder alloy innovator and president of leading solder manufacturer, Nihon Superior Co. Ltd, Tetsuro Nishimura, has observed that a distinguishing feature of the year has been the move away from silver-containing solder alloys. In his own company he has seen significant growth in the sales of Nihon Superior's flagship silver-free, lead-free solders, SN100C and SN100CV as electronics manufacturers realize that they are not getting value from the premium they are paying for the 3-4% silver alloys they have been using. Nishimura is expecting this trend to accelerate as the silver price rises to a level that reflects its value as a "critical material" in the rapidly developing technologies on which the global economy increasingly relies.

An Inevitable Trend

Nishimura has always seen this trend to zero silver as inevitable. Since the very early days of the changeover to lead-free solders, he has been an advocate for silver-free solders. Even at the time of implementation of the EU RoHS Directive on July 1, 2006, the cost of silver was a serious concern for an industry that had gotten used to relying on a solder in which the relatively expensive tin was diluted by more than a third by cheap lead. The increase in cost resulting from the increase in the tin content to more than 95% was a challenge even before the cost premium added by the addition of 3-4% silver.

Nishimura responded to that challenge with the development of an alloy, that, instead of being based on the tin-silver-copper eutectic, is based on the tin-copper eutectic, with a precisely controlled addition of nickel that brought the performance of the alloy, in terms of soldering processes and the appearance of the resulting solder fillets, up to the standards the industry had come to expect from the tin-37% lead alloy that had been the benchmark. That alloy, SN100C, delivered a solder that satisfied the RoHS requirements without compromising performance in soldering processes, the appearance of the solder joint and, importantly, reliability in service. The iNEMI Alternative Alloy Project confirmed that SN100C outperformed or at least matched the performance of tin-37% lead in even the most severe accelerated thermal cycling regimes.

Why Silver?

In the late 1990s, when the electronics manufacturing industry first became aware of moves in the U.S. and Europe to remove toxic ingredients such as lead from the solders on which they relied, the understanding of the performance of solder in soldering processes and their reliability in service was less advanced than it is now after 30 years of intensive study and practical experience.

The 183°C melting point of the tin-37% lead alloy was considered to be the most important property for a lead-free replacement to match. Because of its proven non-toxicity and its unique ability to react with and wet the copper- and iron-based substrates joint substrates, the starting point had to be tin. However, the 232°C melting point of pure tin was considered too high for electronic assem-

highlighted but the trade-off was a 3°C increase in the liquidus temperature, which means that solidification occurs over a temperature range, 217 to 220°C rather than at a single eutectic point but consequences were judged as acceptable and the tin-3.0% silver-0.5% copper was endorsed by what was then the IPC (now Global Electronics Association) as, "the lead-free solder alloy of choice for the electronics industry."

Silver's Reliability Bonus?

In the evaluation of lead-free solder alloy alternatives by industry consortia it was found that solder joints based on the tin-silver-copper eutectic had a longer life in thermal cycling, one of the recognized methods of evaluating the reliability of electronic assemblies. It seemed that replacing lead with silver had yielded a bonus of a significant increase in reliability. Microstructural studies revealed that the increase in the time to failure in thermal cycling could be attributed to the strengthen-

As silver prices rise and its role as a critical material grows, its use in solder alloys becomes increasingly difficult to justify.



SN100CV solder paste.

bly. And the mechanical properties of pure tin are constrained by its body-centered tetragonal crystal structure which has limited slip planes available for accommodating the stress to which solder joints are subjected in service.

An obvious first addition was copper and there is a tin-0.7% copper eutectic with a melting point of 227°C. Given the constraints imposed by the RoHS Directive the next addition considered was silver and there is a tin-3.8 silver-0.7 copper eutectic with a melting point of 217°C.

With no other non-toxic additions that could significantly reduce the melting point further, the tin-silver-copper eutectic was widely endorsed as the best RoHS-compliant solder alloy for electronics assembly. Patent issues prompted the introduction of a tin-silver-copper alloy with only 3% silver. The cost benefit of the lower silver content was also

ing effects of fine, closely-spaced particles of the intermetallic compound, Ag₃Sn, which formed in the tin phase during the solidification of the tin-silver-copper eutectic phase.

The early rounds of the iNEMI Alternative Alloys project appeared to confirm the benefit of silver in a solder formulation. The Characteristic Life, which, in the Weibull analysis is the measure of reliability, showed an almost linear relationship with the silver content of the solder. However, that first round of testing was done with a thermal cycle of -40 to 125°C and 10-minute dwells at each temperature. When, in subsequent tests the dwell time was increased to more realistic levels, 30 minutes and 60 minutes and to higher peak temperatures, the benefit of the silver declined to the point that there was little difference between the characteristic life of silver-containing and silver-free solder alloys.

Studies at Auburn University found a similar decline in the strength of silver-containing solder alloys even if there was a delay

Continued on next page

The Move to Silver-Free Solder is Well Underway...

Continued from previous page

of only a month of room temperature storage between soldering and testing. Metallurgical science already had an explanation for that behaviour and also the strengthening effect of the Ag₃Sn. When closely spaced, particles act as barriers to the movement of the dislocations, the defect in the crystal lattice of metals that makes it possible for them to deform in response to relatively low stress. However, small particles with a large surface area to volume ratio are thermodynamically unstable with atoms migrating to the larger particles in the process known as Ostwald ripening.

The strengthening effect of the particle is explained by the Orowan mechanism that defines the relationship between the strengthening effect and the size and spacing of the particles. The strengthening effect is at its maximum when the particles are small and closely spaced. When, as a result of Ostwald ripening, the particle size and the space between particles increase their effectiveness in blocking dislocation movement fades.

Silver-Free Solders Available

Even at the time that the EU Directive came into force, the Nihon Superior silver-free RoHS-compliant alloy SN100C was being widely used in wave soldering and evidence of the reliability of the electronics assemblies manufactured with that alloy was accumulating. Assemblies manufactured at that time went on to deliver long service lives confirming that in actual application they could at least match the reliability of the silver-containing alternatives. The excellent performance in wave soldering and later in selective soldering justified the slightly higher solder temperature required to achieve optimum hole fill and fillet formation.

A More Stable Strengthenener

A question that has to be asked about the first round of lead-free solder alloy development is why the strengthening mechanism that delivered the reliability that is so highly regarded in tin-lead solder was ignored. That mechanism is solid-solution strengthening, in which the dislocation movement in the tin matrix of the solder joint is restrained by atoms of another element that distort the crystal lattice through which the dislocations have to move.

In tin-lead solders both the lead phase and the tin phase benefit by solid solution strengthening: tin dissolved in the lead and lead dissolved in the tin. Options for RoHS-compliant elements that have solid state solubility in tin are limited but non-toxic bismuth stood out as a promising option.

In recognizing the potential of bismuth as an additive to his SN100C alloy, Nihon Superior's Tetsuro Nishimura understood the need to set the level of the addition to less than the solid solu-

bility limit in tin at service temperatures.

The precipitation of bismuth from supersaturated tin during the cool part of a thermal



Tetsuro Nishimura, president, Nihon Superior.

cycle, and its redissolution at the temperature increases introduces an instability into the microstructure that can compromise reliability. Because of the solid solutions' strengthening by bismuth, SN100CV, can at least match the reliability of tin-silver-copper solders. As a bonus, because the bismuth addition lowers the melting temperature range, SN100CV paste can be reflowed with the same profile used to reflow tin-silver-copper solder paste.

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With silver prices having risen, our Silver-Free solders are available for :

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