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Contact person: Graham Naisbitt
Title: Managing Director
Phone: +44 (0)12 5252 1500
Fax: +44 (0)12 5252 1112
E-mail: graham.naisbitt@gen3systems.com
Website: www.gen3systems.com



GEN3 SYSTEMS LTD
Unit B2, Armstrong Mall,
Southwood Business Park,
Farnborough, Hampshire,
GU14 0NR, UK
T: +44 (0)12 5252 1500
F: +44 (0)12 5252 1112
E: sales@gen3systems.com

IEC, IPC highlight inadequacies of traditional test methods for ensuring reliability of lead-free electronic assemblies

Gen3 Systems' Managing Director Graham Naisbitt, member of both the IEC and IPC test standards committees, says lead-free implementation has exacerbated the need for manufacturers to draw a distinction between solderability and 'soldering ability' tests to avoid undermining the integrity of electronic assemblies used in critical applications

FARNBOROUGH, UK – July 20, 2006 – Gen3 Systems Limited MD, Graham Naisbitt, has today called attention to the need for manufacturers to draw a clear distinction between solderability – a quantitative measurement of how well molten solder wets component joints and PCB pads indicating the robustness of the surface finish – and soldering ability – a term used to describe how well a specific combination of flux and solder work together to solder a component to a PCB.

While this isn't a new problem, it has become more critical as lead-free solder becomes the norm after the EU's Restriction of Hazardous Substances (RoHS) deadline and the release of updated International Electrotechnical Commission (IEC) and Association Connecting Electronics Industries (IPC) soldering standards.

Previously, manufacturers using tin/lead alloys could compensate for poor solderability by tuning the soldering process – thus improving the soldering ability of the assembly. However, this is no longer an option for lead-free solder because it is a much less forgiving process. Consequently it is now critically important for manufacturers of high reliability electronics to determine the solderability of components and PCBs prior to assembly.

"Solderability testing now needs a much higher level of precision, repeatability and reproducibility to take account of unforgiving nature of the high tin content alloys that have been recommended by IEC and IPC," explains Naisbitt. "While tweaking the soldering process might have been acceptable to overcome poor solderability and improve soldering ability for some assemblies using familiar lead alloys, it just won't work with lead-free solder alloys – particularly in no-clean processes. Unreliable solder joints would be almost inevitable.

"Assemblers need to know for sure that they are using boards and components of known acceptable solderability that will always solder satisfactorily in their established and optimised process without any form of tweaking or adjustment," Naisbitt continues.

"The higher soldering temperatures and thermal issues of lead-free allied with unproven on-board electrochemical and contamination reactions between various other process chemistries are just too complex and poorly understood to let the soldering process be changed at will," Naisbitt concludes.

After extensive soldering analysis involving 30,000 individual tests, imminent new IPC standards recognise that wetting balance force measurement and globule testing is better than traditional 'dip-and-look' manual judgements for quantitatively determining

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solderability to the precision required so that adjustment to the soldering process becomes unnecessary.

The main problem with the traditional dip-and-look technique – which is highly popular, quick and inexpensive – is its lack of adequate Gauge Repeatability & Reproducibility (or Gauge R&R for short). This is a measure of how repeatable and reproducible tests are when performed by different people at different times.

According to the IPC: “Users who believe that the ‘dip-and-look’ methodology has a respectable Gauge R&R would be in for an extreme shock. The IPC committees have also voted that no new solderability test methods will be introduced into the standards without a demonstrated, industry acceptable Gauge R&R value.”

“The IEC recommends wetting balance force measurement and globule testing and we are attempting to harmonise standards documents, to provide acceptable Gauge R&R to its defined methodology.”

Defining new test methods is critical because the reliability of electronics hinges on the performance of the solder. “There are compelling environmental reasons for switching to lead-free solder alloys,” explains Naisbitt. “Unfortunately this does mean changing from tried and trusted tin/lead alloys to alternatives that have not been subject to such intense performance analysis.”

“Consumers might not feel so comfortable about moving less tried and tested alloys if their lives are reliant on it, for example, if they are a passenger on a large aircraft. Our mission is to reduce, or if possible remove, all doubt; but that won’t be a trivial task,” he adds.

Gen3 Systems manufactures the MUST SYSTEM Solderability Tester for wetting balance force measurement and globule testing. The equipment is ideal for both tin/lead and lead-free alloy testing and has been used by the industry for many years. The company has also produced a lead-free bath and globule set and lead-free accessories kit to allow existing MUST Solderability Tester owners continuing use of their equipment.

To support the transition to lead-free alloys, new standards for the MUST Solderability Tester (IPC-J-STD 002 & 003) and its award winning Auto-SIR (IPC 9201A SIR Handbook & IPC-TM-650, 2.6.3.7) are due to be published during the (northern) summer.

More information on lead-free solderability testing is available from Gen3 Systems’ website (www.gen3systems.com).

Further information: The transition to lead-free solder

The electronics industry has grown up with tin/lead solder. The IEC defines these alloys as Sn60Pb40A, Sn63Pb37A or Sn62Pb36Ag02B. Over four decades the long-term performance of tin/lead alloys has been intensely studied. The IEC and IPC have issued comprehensive documentation, standards and test methodologies that allow manufacturers to ascertain the reliability of their electronics assemblies.

Lead is now banned from electronics assemblies and intended for sale in the EU. Legislation of a similar nature is likely to be introduced in Japan, California and China. Both IEC and IPC committees are working hard to try and ensure that revisions to the existing standards are published as quickly as possible, but neither group will have published documents until late 2006. However, both the IEC and IPC are recommending high tin alloys as the best replacements for tin/lead.

Specifically, the IEC states: “The preferred alloy composition should be either Sn96.5Ag3.0Cu0.5 or Sn99.3Cu0.7. An alloy consisting of 3-4% Ag and 0.5-1% Cu with the remainder made up of Sn may also be used instead of Sn96.5Ag3.0Cu0.5. A solder alloys

comprising 0.45-0.9% Cu with the remainder made up of Sn may be used instead of Sn99.3Cu0.7.”

IPC states: “The solder composition shall be tin (Sn)96.5 silver (Ag)3.0 copper (Cu)0.5 (SAC305) as defined by J-STD-006”. The IPC does allow other lead-free solder alloys if agreed between user and vendor.

High tin alloys have not been as well characterised as traditional tin/lead solders. While the IEC and IPC have been rapidly assimilating data on the long-term performance of lead-free alloys it will be some time before comprehensive information is available. Accordingly, both the IEC and IPC are defining thorough testing regimes – with acceptable Gauge R & R - for manufacturers whose products will be used in safety critical applications.

About Gen3 Systems

Gen3 Systems is dedicated to tackling the demanding electronics reliability challenges of lead-free assembly and further electronics miniaturisation. The company is a specialist manufacturer of test and measurement equipment used to predict the reliability of electronic circuits and systems in the field. In addition, the company designs and manufactures conformal coating process equipment in both in-line and bench-top formats.

Gen3 Systems’ Managing Director Graham Naisbitt is a member of the IEC’s TC91 WG3, the working group that formulates test standards for the assembly industry. Naisbitt is also Leader of Solderability Testing Standard IEC 60068-2-69, Co-leader of Solderability Testing Standard IEC 60068-2-54, and Member of IPC-J-STD 002 and IPC-J-STD 003.

Gen3 Systems is founded on the former Concoat Systems Limited. Concoat Systems and its company slogan “Engineering Reliability in Electronics” (which has been retained by Gen3 Systems) was a familiar name in Europe, Asia and much of North America. The new company was launched by its family owners after former sister company Concoat Limited was sold to US firm Chase Corporation in 2005.

Gen3 Systems operates from new premises near Farnborough Business Park, on the M3 corridor and just 30 minutes from London’s Heathrow Airport. The company has an entirely new management team focused on the needs and requirements of its customers around the world.

Gen3 Systems also provides training, equipment and expertise for manufacturers requiring assessment of their electronic products’ reliability. The company also assists with standards development via both the IPC and IEC.

The company’s product range and services include:

- AUTOSIR Surface Insulation Resistance Testing System
- MUSTSYSTEM2+ Solderability Testing System
- SOLDAPRO Thermal Profilers
- CMSERIES Cleanliness Testing Systems
- SCSERIES Spray Conformal Coating Systems, batch & in-line
- DCSERIES Dip Conformal Coating Systems, batch & in-line
- TESTSERVICES for Circuit Reliability, Solderability & Cleanliness

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