Company Article
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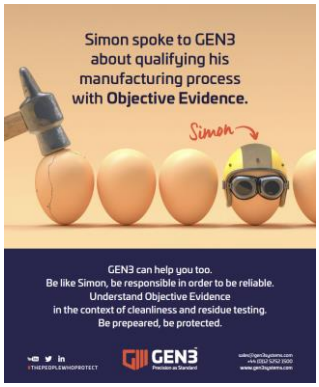
GEN3 Discuss
"Objective Evidence" in the Context of Cleanliness and Residue Testing

Take advice from 'Simon' who came to GEN3 to ensure he was always prepared and protected.

By Andy Naisbitt, CEO, GEN3



Objective evidence is defined by lawyers as "evidence that is not subject to bias and is quantifiable and able to be independently confirmed and verified by using analytical or other tools." In other words, objective evidence is based on facts that can be independently examined, evaluated and verified.

The resistivity of solvent extract (ROSE) test measures the presence and average concentration of soluble ionic contaminants, for example on a printed circuit assembly. It was developed in the early 1970s as a means of process monitoring, when it corresponded with design rules, process materials and operating environments typical of that period. The test result was expressed as a single pass-fail value, in terms of a sodium chloride equivalence that related to the whole assembly, and was not representative of its actual cleanliness level.

Technology moves on: Line widths and spaces decrease, as do component stand-off heights. Fluxes and solder paste formulations change. Printed circuit assemblies are expected to reliably withstand harsh operating environments. Consequently new standards for cleanliness testing have been developed. Although it can still be used for process monitoring, the ROSE test is no longer considered appropriate for process qualification; alternative methods must be used to determine a meaningful cleanliness level and to provide objective evidence that residues left on the assembly will not lead to failure under conditions of temperature, humidity and voltage bias, typically as consequences of electromigration or dendritic growth.

What are the current international standards, and what sort of objective evidence do they provide?

IEC 61189-5-501:2021 is used to quantify the deleterious effects of flux residues on surface insulation resistance (SIR) in the presence of moisture.

IEC 61189-5-502:2021 is used for evaluating the changes to the surface insulation resistance of a pre-selected material set on a representative test coupon and quantifies the deleterious effects of improperly used materials and processes that can lead to decreases in electrical resistance.

IPC J-STD-001 describes materials, methods and verification criteria for producing high-quality soldered interconnections. The latest revision is J-STD-001H, which has a new section on cleanliness and residue testing.

The aim is to establish a qualified manufacturing process, in the knowledge that different types of assembly will have different critical cleanliness requirements, and assess how well it is controlled. A manufacturing process cannot be qualified through chemical analysis alone, and must be determined by testing using temperature/humidity/voltage-bias techniques.

Testing now has therefore to include objective evidence to indicate whether any of the chemical species remaining on the assembly will affect its electronic reliability in environments where it is subject to temperature differences or humidity differences. Ionic cleanliness testing in itself is effectively only a chemical test. But provided it can be related to the electromigration of the ionic species causing harmful effects, it can be used as a route to creating objective evidence to qualify a process.

Any substantial change in the process will require re-qualification, with objective evidence based on data derived from tests to demonstrate that residual chemical species do not adversely affect the reliability of the assembly. The data could be generated using SIR testing in combination with ionic cleanliness testing or other functional testing as agreed between user and supplier. Typical major changes could include flux, solder, cleaning agent, solder mask type, solderable finish, change of PCB supplier, etc.

Objective evidence will also be required to qualify changes in such process settings as reflow profiles and cleaning parameters that are outside the process windows defined in the qualification of the process.

Sampling frequency and control limits for process monitoring will have been established as part of the process qualification procedure, and these should be statistically based. Traditionally, ROSE testing was used for process monitoring. A contemporary development of this test, process ionic contamination testing (PICT), as detailed in IEC 61189-5-504, provides a fast and effective method of process control.

The next article in this series will explain the methods used to obtain the objective evidence necessary to meet the requirements of the current standards.

About GEN3

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GEN3. Testing and measuring the electronics industry for over 40 years. For three generations, GEN3 have designed, engineered, manufactured, and distributed their test and measurement equipment into the electronics industry to shield their clients from failure in the field.

Their reputation for excellence has grown to a global scale. The team is made up of industry experts who work to set the standards around circuit testing, measurement, and compliance. They collaborate with key industry associations, offering our unique experience and expertise to educate all on what it takes to succeed. For product protection the preferred way is GEN3, where precision comes as standard, acting as a mentor and knowledge partner.

In the high-reliability arena, there is too much at stake to allow room for error. Testing must be finite and flawless. GEN3 understand the need for precision. Get closer to perfection by minimising your risk.

GEN3. Precision as Standard.

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