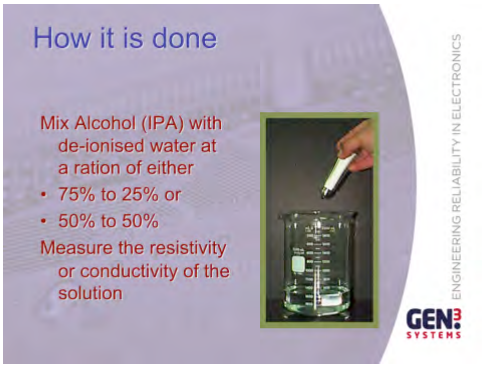
CM Series CONTAMINOMETER
NEW MACHINE DEVELOPMENTS

Background:

For over 40 years, the electronics industry has been seeking ways to determine an answer to the thorny old question: How clean is clean?

Meanwhile, others were plotting ways that they could monitor the quality of their production process with specific regard to the presence of ionics (salts) that conspire to cause circuit failure.

They figured that using a blend of alcohol with de-ionised water would be an ideal medium, measuring its conductivity before and after.

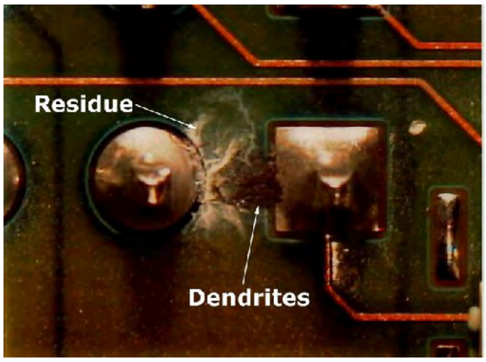


Why Alcohol? Because conventional rosin based fluxes used at that time were soluble in alcohol.
Why water? Because salt dissolves in water.

So, mix 75% propan-2-ol (IPA) with 25% de-ionised water and use a mixed resin filter (a mixture of Cation, Anion and Chelate) to "strip out" ionics as they pass through the medium.

Clean the test tank and its contents to a determined Conductivity level, expressed as micro-Siemens (µS); put the object to be tested into the tank and measure the change to the conductivity. Extrapolate the result as an equivalence of NaCl – plain salt – and, Hey Presto! you have a record of the amount of ionics your process leaves on, or puts on, the circuit assembly.

The names employed for this test are: ROSE or SEC:
ROSE = Resistivity of Solvent Extract
SEC = Solvent Extract Conductivity



Those seeking better process control had found an ideal tool – a measurement of ionics that might be present on a selected sample. Then, during the working day, changes in the level detected would be a really good indicator that the process was in or out of control.

Ionics take several forms and from many and various process steps, some are more soluble than others. If they are present on your circuit and are exposed to moisture in the presence of electricity, then an electrolyte is formed, electro-chemical reactions occur, and that results in dendrites – inter-metallics between the cathode and anode that provide a path of lower resistance leading to short circuits and/or circuit failure.

In the 1970's the US DoD considered that this might be a useful test to control cleanliness in production and established a "Pass/Fail" at a level of 3.1µg/cm^2 (20µg/inch^2) of NaCl equivalence with "Dynamic" Testing and 1.56µg/cm^2 (10.06µg/inch^2) of NaCl for "Static" Testing.

This was not such a good decision for two reasons:

1 Because, by logical extension, it indicated that you could safely leave UP TO that amount of measurable ionics (SALT) on your assembly surfaces.

2 There is no difference between Dynamic and Static, both test methods now require 1.56$\mu g/cm^2$ NaCl equivalence and the dictum remains: “it’s OK to leave that amount of salt on my assembly.”

As many have found to their considerable cost, it is not.

Important Issues to Consider:

Test Time

This is important because exposing any circuit assembly to a mixture of alcohol and water for 15 minutes or more significantly increases the risk of other ionics leaching out of the laminate and onto the surface (Swedish Institute for Production Engineering Research - IVF report 1990).

Hot or Not?

It has been suggested that the test solution may be used heated to 40^0C or more.

We strongly disagree. Apart from the fundamental changes in conductivity, and its effect upon test accuracy, it significantly increases the risk of sub-surface ionic leeching as well as posing an explosion risk. Note that the test solution flash-point is19^0C at ambient temperature.

Static v Dynamic what’s the difference?

IPC-TM-650 2.3.25 & 2.3.25.1 permit the use of either Static or Dynamic test methods.

Whilst both methods should yield the same result, good test methods should have only 1 variable being the item under test. The Dynamic Test method, by its very nature, has an additional variable in that it behaves more like a cleaner with the test solution passing the conductivity probe, the filter and back into the tank. In this way the test solution is being continuously cleaned during the test. The Static Test, by contrast, re-circulates the test solution via the conductivity sensor but bypasses the ionic exchange filter thereby removing this important variable.

Saturation – is this a problem?

Some talk about a “Saturation” problem with Static testing. Given that:

- The Test System may commonly be calibrated up to 30 $\mu g/cm^2$ of NaCl equivalence
- The pass/fail level is 1.56 $\mu g/cm^2$ of NaCl equivalence

If your process was producing boards that had a contamination that was going to send the solution into saturation it would be well above 30 $\mu g/cm^2$ – You should be more concerned about stopping your production process than worrying about the solution saturation!

Test Tank Size – is it important?

When selecting a Test System, it is important to use the smallest possible tank size for the circuit under test. As outlined in IPC-TM-650 2.3.25.1:

6.10 There is some concern regarding ROSE tester cell size. Testing a 2 cm x 2 cm [0.79 in x 0.79 in] board in a 20,000 mL cell causes such a severe dilution as to cause the signal to be lost in the noise. A recommended cell size is 5000 mL or less. Smaller cell volumes will allow for a more measurable result. If a smaller cell, or running with a smaller test volume, are not an option, then the number of bare boards can be increased, all extracted separately, and the extract solutions all tested at once.

Equivalency Factor – is this an issue?

In a further attempt to destroy any arguments regarding that most heinous subject: The "Equivalency Factor". There is no such thing!

If the test system is working correctly, during calibration you put a quantified amount of NaCl solution into the test tank and the system should be capable of recording the amount – precisely. If it doesn't, then there is something fundamentally wrong with the machine.

From IPC-TR-583 An In-Depth Look At Ionic Cleanliness Testing:

> Once the test method and the pass/fail criteria were established, equipment manufacturers began designing and building systems to do this type of testing. Due to efficiency, or perhaps the slightly different measuring process, it was noted that the new equipment would typically give higher results than that of the beaker/funnel technique. In 1978, a second study was performed at NAWC[4] to establish "equivalency factors" for some of the new equipment which would be incorporated into various military standards, such as MIL-P-28809 and WS-6536. The theory behind the "equivalency factors" was that the same PWA that measured 10.06 $\mu g/in^2$ using the beaker/funnel test would have measured 14.00 $\mu g/in^2$ in a static system, and 20.00 $\mu g/in^2$ in a dynamic system under the conditions of the study. As the years progressed, more advances were made to the equipment such as the incorporation of solvent heaters, microprocessors, and sprays. As the efficiency of the systems increased, it became increasingly apparent that the equivalency factors established for the 1978 equipment did not apply to current equipment. In addition, equipment introduced to the market after the study are not mentioned, even in the revised standards, and erroneously not considered as accepted test equipment by potential users.

System Considerations:

Good cleanliness test systems need to be:

- Accurate
- Reliable
- Repeatable
- Simple to use
- Easy to maintain

They also need to:

- Reduce test time to a minimum
- Take account of
    - temperature,
    - circuit volume
    - atmospheric absorption of iogenic gasses
- Avoid polarisation effects between electrodes

If you are making a purchasing decision on a system keep in mind:

- Does it use "curvefitting" algorithms that reduce test time
- Use a pure gold sensor to improve accuracy and reduce maintenance
- Measure at accuracies of better than 0.005µS

You should ignore any

- suggestions of using heated test solution
- suggestion that there is a difference between Dynamic and Static Testing – there's isn't any
- suggestions of saturation effects – it is irrelevant as the level of contamination to achieve that condition would be so great.

The NEW Gen3 CONTAMINOMETER (CM Series)

Features a solid gold measuring cell, ballistic amplifier and a vigorous pumping system to achieve superior measurement accuracy even at very low conductivity values:

- The sensor or conductivity measuring cell is a solid 999/1000 (24k) gold bifilar (parallel wire) construction ensuring high accuracy and zero drift.
- These pure gold wires will not corrode and need a minimum of maintenance.
- The output from the measuring cell is fed to a ballistic amplifier specially developed to measure conductivity values of less than 0.005µS-cm with high precision.
- The ballistic amplifier is used to avoid polarisation effects between the electrodes, as might occur when using DC test currents. In this way, error signals caused by both DC and AC currents are eliminated and high accuracy is ensured even at low conductivity values.

Our unique CM60 features Auto-Fill, Auto-Drain and the special Volumetric Measurement Cell (VMC):

Using the VMC - To test, simply input the circuit length and width, put the item into the tank and push the button – it's as simple as that.

The VMC automatically and precisely calculates the displaced test solution that determines the surface area (volume) that is about to be tested. All other test cycle operations are fully automated allowing the use of unskilled personnel with a minimum of training.

Our software features "curve-fitting": a complex mathematical algorithm that is widely used to simplify and reduce the time required to run the full calculation.

Our unique use of this in our software permits our system to test in full compliance of the test methods yet in a fraction of the time; generally less than 5 minutes compared to the test time of 15 minutes without it. Our software also automatically compensates for ambient temperature, circuit volume and atmospheric absorption of iogenic gases.

CONTAMINOMETERS from Gen3 Systems come in 4 different models and 4 different tank sizes because when selecting a Test System, it is important to use the smallest possible tank size for the circuit under test.

	Tank Size
NEW – CM11+	250 x 300 x 36 mm (10" x 12" x 1.4") = 2.7 litres
NEW – CM22	250 x 350 x 60 mm (10" x 14" x 2.3") = 5.25 litres
NEW – CM33 with 2 tank options:	1 - 500 x 350 x 60mm (19.7" x 13.8" x 2.4") 2 - 610 x 610 x 90mm (24" x 24" x 3.6")
CM60 with 2 tank options: NEW – CM66 late 2010	1 - 500 x 350 x 60mm (19.7" x 13.8" x 2.4") 2 - 610 x 610 x 90mm (24" x 24" x 3.6") CM66 ONLY