



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®

IPC-TR-583

An In-Depth Look At Ionic Cleanliness Testing

Reprinted with the direction of the Ionic Conductivity/Ion Chromatography
Test Task Group (5-32a) of the Cleaning and Coating Committee (5-30)
of IPC

Users of this standard are encouraged to participate in the
development of future revisions.

Contact:

IPC
2215 Sanders Road
Northbrook, Illinois
60062-6135
Tel 847 509.9700
Fax 847 509.9798

ACKNOWLEDGEMENTS

This research was a cooperative effort between the Electronics Manufacturing Productivity Facility (EMPF) and the IPC-Association Connecting Electronics Industries (IPC). The EMPF would like to thank the many people from the IPC Ionic Conductivity Task Group (ICTG) who were involved in the planning and implementing of this research. Together, the EMPF and IPC would like to thank all of the equipment vendors who donated the use of their equipment as well as some of the materials used in this study:

Alpha Metals
Kester Solder
London Chemical
Protonique
Westek

The statistical design was engineered by Jon Andell of Motorola and Jeff Vannoy and Steve Durdle of Qualstat. Steve spent several hours, both at work and at home, so that the data could be presented on time at various EMPF and IPC meetings. Steve is also responsible for writing the "Design of Experiments: Overview" that appears in Appendix A of this document.

The technician responsible for most of the laboratory work was Julie Kukelhan. This test required someone who was very meticulous and dedicated while conducting what was at times, very repetitive research. I personally would like to thank Julie for her understanding and determination when things didn't quite go right and I said "I've got an idea. Let's try....."

Thank You.

Tim Crawford
EMPF

Table of Contents

EXECUTIVE SUMMARY	1
INTRODUCTION	5
BACKGROUND	5
Resistivity vs Conductivity	7
Units of Measure	8
TEST PROCEDURE	9
Objective	9
Equipment	9
Test Vehicle	11
Flux Types	12
Variables	13
INITIAL OBSERVATIONS	14
Test Coupon Preparation	23
PRESENTATION OF DATA	24
Statistical Design	25
"IN SOLUTION" TEST RESULTS	28
ZERO ION	40
IONOGRAPH 500M	46
IONOGRAPH 500SMD	52
CONTAMINOMETER CM5 (dynamic)	58
OMEGAMETER 600R	64
OMEGAMETER 600SMD	70
IONEX 2000	76
ICOM 5000	82
CONTAMINOMETER CM5 (static)	88
STATIC VERSUS DYNAMIC	94
BOARD AND COVER PLATE TEST RESULTS	97
ZERO ION	109
IONOGRAPH 500M	120
IONOGRAPH 500SMD	131
CONTAMINOMETER CM5 (dynamic)	142

OMEGAMETER 600R	153
OMEGAMETER 600SMD	164
IONEX 2000	176
ICOM 5000	187
CONTAMINOMETER CM5 (static)	199
CONCLUSIONS	209
APPENDIX A	213
DESIGN OF EXPERIMENTS: OVERVIEW	214
REFERENCES	220

EXECUTIVE SUMMARY

Testing performed at the Electronics Manufacturing Productivity Facility has shown that as technology advances and printed wiring assembly (PWA) surface areas get smaller, surface residues will become harder to measure accurately. On small surface areas, variables such as probe limitations, solvent volume, and even carbon dioxide from the air will influence ionic contamination measurements.

Most systems have what is termed a "deadband". The resistivity probe used in each system has a maximum measurement capability. For example, if the maximum capability of the probe is 100 megohm-cm and the resistivity of the solvent is actually 150 megohm-cm, the display will continue to read 100 megohm-cm. Any ionic residues that lower the resistance of the solvent from 150 to 100 megohms-cm will not be measured. Resistivity, however, is not linear, and the amount of residue it takes to drop the resistivity from 150 megohm-cm to 140 megohm-cm is much less than the amount of residue it takes to drop the resistivity from 50 megohm-cm to 40 megohm-cm. It has been argued that the amount of ionic residue it takes to drop the resistivity from the deadband to the visible range is insignificant in most cases. This argument would depend on surface area as well as the need for accuracy. To maintain accuracy, it is important that the operator of the cleanliness test equipment not leave the system in a clean/filter mode for an extended period of time. If the operator inadvertently deionized the solvent to a higher than normal level, the solvent should be artificially contaminated and then recleaned to an acceptable level.

Carbon dioxide can dissolve in water to form carbonic acid. This can weakly ionize into H^+ and HCO_3^- ions which can/will then affect ionic readings. The presence of this ionic build-up during a static extraction will contribute to the overall ionic reading. In most instances, such contributions will be small, representing only a relatively small error in the measured results. If, however, we are measuring a small sample in a large volume of extracting solution, the effective total micrograms of NaCl represented by the CO_2 build-up in solution will be divided by the smaller surface area of the sample giving rise to a larger relative error in the reading expressed as $\mu g/in^2$. Extractions which are made for longer times will also show higher CO_2 errors, since more CO_2 will dissolve in the longer period of exposure to the atmosphere. Testing indicated that the problem was not detectable for all of the static systems; and there did not appear to be any correlation for spray versus no spray, or spray