



CRITICAL • CLEANLINESS • CONTROL

Executive Summary: C3 Purpose & Operation

Foresite developed the C3 Localized Cleanliness Tester out of an industry need to evaluate specific areas of circuitry or sensitive components that could hold concentrated pockets of contamination. These areas are overlooked by standard industry tools and testing methods that examine the total board. Methods such as ROSE testing and ion chromatography with standard total board extraction take a measurement of the average cleanliness of the board, thus overlooking pockets of contamination that can potentially cause quality concerns and field failures.



The C3 serves two main purposes:

To perform as a production floor cleanliness monitoring tool that provides an immediate 'clean' or 'dirty' test reading for the 0.1 in² area where the extraction is taken.

To serve as an extraction tool for use in ion chromatography testing which will determine the exact type and quantity of ionic species present on a board or component area.

Operation Principles

The C3 uses a deionized steam extraction system to collect a 2.2 mls sample from a 0.1 in² area of circuitry. The system produces a microburst of steam that is allowed to soak for 20 seconds and is then aspirated into a collection cell. This steam is applied 8 times to achieve effective residue removal from the area of analysis. After 9 collection cycles, an electrical test is performed across a sacrificial y-pattern electrode to check for electrical leakage. 10v of electricity is applied, and the C3 makes a determination after 60 seconds as to whether or not the sample is 'clean' or 'dirty'. The current threshold for considering a sample clean is 500 μ A, and is based on 13 years of ionic analyses performed by Foresite. The electrical test continues to run for two minutes after the cleanliness determination is made, and current readings are recorded in the C3 testing program. The extracted sample can then be used for ion chromatography analysis to determine the type and quantity of the localized contamination.

C3 Clean/Dirty Limits & Foresite's Recommended Ion Chromatographic Limits for Reliable Field Performance

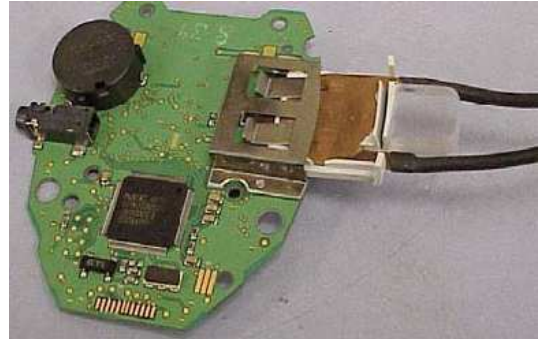
Based on Foresite's 13 years of ion chromatography based failure analysis, we have taken into account the average thresholds for common ionic residue species that cause reliability concerns. Taking into account our database of ion chromatographic readings, the following table indicates recommended limits for some of the more common ionic species causing field reliability issues:

We utilized our database of residue limit findings to establish the corresponding 500 μ A current limit for the C3 electrical test to achieve a leakage event. This current limit has been extensively tested and found to correspond with ion chromatography readings that are indicative of contamination related performance problems.

Foresite Recommended Levels for Ionic Residue Species				
<i>All values are in μg/in²</i>				
Ionic Species	Bare Board	Component	No-clean Assembly	Cleaned Assembly
Chloride (Cl ⁻)	2.0	1.0	3.0	6.0
Bromide (Br ⁻)	6.0	0	12.0	12.0
Sulfate (SO ₄ ²⁻)	3.0	3.0	0	0
WOA	0	0	150	150

C3 Field Usage Report 1: Portable Devices with Draining Batteries

One customer of Foresite's had an issue with occurrences of draining batteries in portable devices only two weeks after assembly and packaging for shipment. Foresite analyzed the failing products using ion chromatography with both standard total board extraction and a C3 localized extraction. Standard extraction ion chromatography showed acceptable levels of ionic residue species that should not be causing such failures; however, the C3 extraction samples showed high levels of chloride and sulfate around the 0805 capacitor area of the boards, and corresponded with a 'dirty' reading in the C3 electrical test. We recommended that the customer add a neutralizing rinse after plating to eliminate sulfate residues, and be more vigilant in handling to eliminate the chloride residues. After implementing our recommendations based on the readings and analyses of the C3 electrical testing and extraction technology, this customer solved their reliability challenge and was able to resume production.



C3 Field Usage Report 2: Servers with Localized Visible White Residues

A second customer of Foresite's was manufacturing servers and experiencing intermittent field failures. They noticed a visible white residue in the VHDM connector area. Because some of their parts were moisture sensitive, this customer wanted to isolate the VHDM area for analysis to determine if the white residue was conductive. Using the C3 Localized Cleanliness Tester, the customer tested boards in the VHDM area and received a 'dirty' reading from the C3 tester. Other samples without the visible white residues were tested, and were found to be 'clean' based on the C3 electrical test reading. Based on the C3 readings, this customer was able to determine which samples needed to be sent for ion chromatography analysis and potentially cleaned. Foresite performed ion chromatography on the 'dirty' samples, as well as some samples that had 'clean' C3 readings for control. We found high levels of chloride and weak organic acid residues in the VHDM area of the 'dirty' samples that were introduced through selective hand soldering, and were facilitating the field failures. The 'clean' samples were verified as clean with ion chromatography readings below Foresite's recommended limits for reliable performance.

