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Pinted Board Assembly Cleanliness Evaluation

Purchase Order #: 0000011
PAL Report Number: 1000-002 Data Only

A Good Company
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Somewhere, IN USA 40000

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SMART Engineering Division

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Date: May 2, 2005

Approved By:

A handwritten signature in black ink that reads 'Joseph M. Rousseau'. The signature is written in a cursive style and is positioned above a horizontal line.

Joseph M. Rousseau
Process Analyst

Objective

The client desired to evaluate six printed board assemblies (PBA's) processed with one of three candidate solder pastes using two different reflow profiles. The client also provided one unprocessed printed board (PB) and the components to baseline the starting cleanliness prior to assembly. The PB, Components and PBA's were analyzed using ion chromatography in accordance with IPC-TM-650, method 2.3.28.

Sample Identification:

1000-002-01: Bare PB plus components; No solder paste; D/C 2307

1000-002-02: PBA processed with solder paste 1; D/C 2307

1000-002-03: PBA processed with solder paste 2; D/C 2307

1000-002-04: PBA processed with solder paste 3; D/C 2307

1000-002-05: PBA processed with solder paste 1 using a special profile; D/C 2307

1000-002-06: PBA processed with solder paste 2 using a special profile; D/C 2307

1000-002-07: PBA processed with solder paste 3 using a special profile; D/C 2307

Photo Documentation:

Insert Picture of Test Sample

PWB sample as sent by the client

Equipment and Materials Used:

Dionex ICS2500 Ion Chromatograph with Chromeleon software
18 Megohm-cm Deionized Water
NIST Traceable Anion Standards (PAL Lot #: PAL-AN5-104)
ACS Traceable Organic Acid Standards (PAL Lot #: PAL-AN5-104)
Clean Monoject 3cc Syringes
Omni-Solv 99.9% HPLC Grade Isopropanol (PAL Lot #: PAL-EX-1018 and 1019)
500 Series Kapak[®] 4mm Heat-sealable pouches
Precision[®] High Temperature Circulating Water-bath
Clean powder-free Vinyl Gloves
Dionex AS14 analytical column/AG14 guard column/ASRS Self-Regenerating Suppressor
3.5mM Sodium Carbonate/1.5mM Sodium Bicarbonate Eluent (Lot #: AN-EL-1062)

Ion Chromatography Procedure:

1. The samples were handled with ionically clean, powder-free vinyl gloves.
2. The samples were removed from their protective bags, visually inspected, and one unit was photo documented.
3. The samples were placed into clean Kapak heat-sealable pouches.
4. Thirty (30mL) milliliters of 75% isopropyl alcohol and 25% deionized (DI) water (v/v) was added to each Kapak pouch containing the individual boards. The entire area of each board was extracted. The surface area was estimated as follows:

For Samples 1 – 7

$$\text{Surface Area (in}^2\text{)} = [(8.50\text{in})(6.00\text{in})][2 \text{ sides}][1.1 \text{ population factor}] = \underline{112.20\text{in}^2}$$

5. Each sample was extracted in an 80°C circulating water bath for one hour.
6. After the hour expired, the samples were removed from the bath and allowed to cool down within their respective Kapak pouches.
7. The samples were then removed from their Kapak pouches and allowed to air dry.
8. The Ion Chromatograph was calibrated using NIST traceable chromatography standards as described previously.

9. The anion calibration was verified for accuracy using a validation solution.
10. Three milliliters of the sample extract solution was drawn into ionically clean syringes and injected into the ion chromatograph for analysis per IPC-TM 650, method 2.3.28.

Ion Chromatography Data:

Table #1: PAL Recommended Bare Board and Assembly Cleanliness Guidelines
- Anions

Condition	Chloride Cl ⁻	Bromide Br ⁻	Nitrate NO ₃ ⁻	Phosphate PO ₄ ³⁻	Sulfate SO ₄ ²⁻	Organic Acids
Bare Board (Non-HASL)	< 1.0	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	PI
Bare Board (HASL)	< 2.0	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	PI
No Clean Assembly						
Surface Mount Only	< 2.5	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	5 - 20.0
Mixed Technology	< 2.5	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	20 - 50.0
Through Hole Only	< 2.5	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	50 - 100.0
Post-Assembly Cleaning						
Surface Mount Only	< 4 - 5.0	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	5 - 20.0
Mixed Technology	< 4 - 5.0	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	20 - 50.0
Through Hole Only	< 4 - 5.0	< 12.0	< 3 - 5.0	PI	< 3 - 5.0	50 - 100.0

*All values in the table are in micrograms per square inch (µg/in²). Non-HASL refers to ENIG, immersion Ag, immersion Sn and OSP board finishes. PI means the component is treated as a process indicator, as no industry guidelines currently exist. **Please note that the various residue levels shown in the table are only a recommended starting point, they should not be construed as industry limits.***

Table #2: Numerical Anion Chromatography Data - Samples

Sample Number	Sample Description	Fluoride F ⁻	Chloride Cl ⁻	Bromide Br ⁻	Nitrite NO ₂ ⁻	Nitrate NO ₃ ⁻	Phosphate PO ₄ ³⁻	Sulfate SO ₄ ²⁻
Standard Profile								
1000-002-01	PB + comp.	0.00	0.21	0.10	0.07	0.00	0.00	0.72
1000-002-02	Paste #1	0.00	12.36	0.63	0.40	0.00	0.00	11.34
1000-002-03	Paste #2	0.00	0.76	0.38	0.09	0.00	0.00	7.15
1000-002-04	Paste #3	0.00	1.71	0.08	0.12	0.00	0.00	1.60
Special Profile								
1000-002-05	Paste #1	0.00	12.38	0.41	0.00	0.00	0.00	17.74
1000-002-06	Paste #2	0.00	0.55	0.04	0.16	0.00	0.00	10.57
1000-002-07	Paste #3	0.00	2.64	0.04	0.16	0.00	0.00	2.58

Table #2: All ion values reported in the table are in micrograms per square inch (µg/in²). All bag blank contaminants were subtracted from the sample amounts.