



*The Institute for
Interconnecting
and Packaging
Electronic Circuits*

IPC-TR-465-3

Evaluation of Steam Aging on Alternative Finishes

Round Robin Test Program Phase IIA

IPC-TR-465-3

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

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OBJECTIVES

The purposes of this round robin test were to

1. Determine the effect of steam aging exposure on components employing a variety of solderable finishes other than hot solder dip over a copper substrate.
2. Provide data to support refinement of the standards.
3. Compare the effect of steam aging to other solder test variables, such as different testers and new vs. degraded samples.

INTRODUCTION

The purpose of this round robin test program is to determine the effect of the steam aging environment at fixed temperatures on the various metals and platings used on electronic components and printed wiring boards.

Many studies have been performed by various industry representatives. This round robin capitalizes on this work to help establish correlations between various testers in order to verify the effect of steam aging on solderability and explore test repeatability and reproducibility.

TEST PHASES

Because of the complexity of the test plan, the original Round Robin test program was divided into phases.

Prior to beginning the evaluation of test samples, the steam agers were tested for temperature stability and control. The results of this study were reported in IPC-TR-465-1, *The Round Robin Test on Steam Ager Temperature Control Stability*. This study showed that steam agers could hold $\pm 3^{\circ}\text{C}$, if carefully calibrated and maintained.

Phase I steam aging testing was intended to evaluate the repeatability of steam aging between test sites. The samples were hot solder coated copper wire and copper sheet. Phase II was similar, except the samples were solder coated copper leaded integrated circuits. The phase I and II results were documented in IPC-TR-465-2, *The Effect of Steam Aging Time and Temperature on Solderability Test Results*. In summary, this report concluded:

- A 25% reduction in all solderability responses was observed after a 2 hour, 150°C pre-conditioning bake.
- The wetting balance test results displayed a maximum steam aging temperature impact at 93°C . Visual and use test results showed no significant difference in solderability between components steam aged for 8 hours at 93°C and 97°C , but both temperatures were more severe than 87°C .

The testing discussed in this report is considered to be Phase IIA in this series. This test is intended to evaluate the effect of steam aging on a variety of solderable finishes and basis metals. Both components and printed wiring boards are included. These results will be compared to a simulated use test to validate the results.

CONCLUSIONS

The steam age conditioning had a measurable effect on all the components. The hot solder dipped TO-99 style packages passed the test in the “unaged”, “as-received” condition, but failed when preconditioned or steam aged due to anomalies noted in the micro-sections on the “as-received” hot dipped solder surface over the plated nickel substrate.

The steam age conditioning on the PWB solder float test had a marginal effect on the “as-received” samples, but added on average 4% dewet area to degraded samples. The aging had a marginal effect on “as-received” or degraded solder float test results.

For both the component and PWB measurements, variation in test results among the various test locations was larger than the effect of steam aging. This was caused by misinterpretation of the requirements, different visual examination techniques, measurement error and differences in test equipment. This effect was large enough to have caused some lots to have been alternately accepted or rejected, if these had been Acceptance Test results.

A small production simulation using preconditioned and “as-received” samples was performed. In a total of 2000 joints, no defects were noted. Based on this sample the defect rate for this simulation would probably be 350 ppm or less. Based on these results, the solderability test did not predict production simulation performance. This was the case even for Specimen D, the TO-99 style package, which clearly failed the solderability test after preconditioning.

RECOMMENDATIONS

1. Under current component standards, 8 hours of steam aging could be used for solder plated components, gold plated components, and PWB edge dip coupons.
2. Verify that hot dipped solder over nickel substrates is compatible with 8 hour steam aging.
3. Reduce variation between test locations by improving the steam aging and solderability test procedures. Include better descriptions of pass/fail conditions, and enhanced standard operating procedures.
4. Review solderability test conditions to improve the ability of the test to predict production performance.

TEST SAMPLES

A variety of test samples were employed in this test. The samples are summarized in Table 1.

Table 1 - Test Samples

Sample	Type	Surface Layer	Barrier Plating	Substrate	J-ANSI/-STD	Test	Response
A	PWB	Reflowed solder	None	Copper	-003	Edge Dip	% defect area
B	PWB	Reflowed solder	None	Copper	-003	Float	Holes filled
C	TO-99	Gold	Nickel	Kovar	-002	Visual	% defect area
D	TO-99	Hot Solder Dip	Nickel	Kovar	-002	Visual	% defect area
E	CERDIP IC	Hot Solder Dip	None	Alloy 42	-002	Visual	% defect area
F	CERDIP IC	Plated Sn/Pb	None	Alloy 42	-002	Visual	% defect area
G	SOIC	Plated Sn/Pb	None	Copper	-002	Visual	% defect area

All test sample types were produced at a single source, and each component style was represented by a single fabrication run.

Sample A consisted of a double sided FR-4 laminate material and prepreg. The solderable portion of the sample was 1 inch long and 0.25 inches wide. A shoulder on one end was provided for mounting into a test fixture. All samples were Sn-Pb plated and fused.

Sample A consisted of a double-sided FR-4 laminate material and prepreg. The solderable portion of the sample was 1 inch long and 0.25 inches wide. A shoulder on one end was provided for mounting into a test fixture. All samples were Sn-Pb plated and fused.

Some Sample A coupons were microsectioned. Figure 1 shows photomicrographs of the cross-sections and Table 2 shows the thickness measurements.

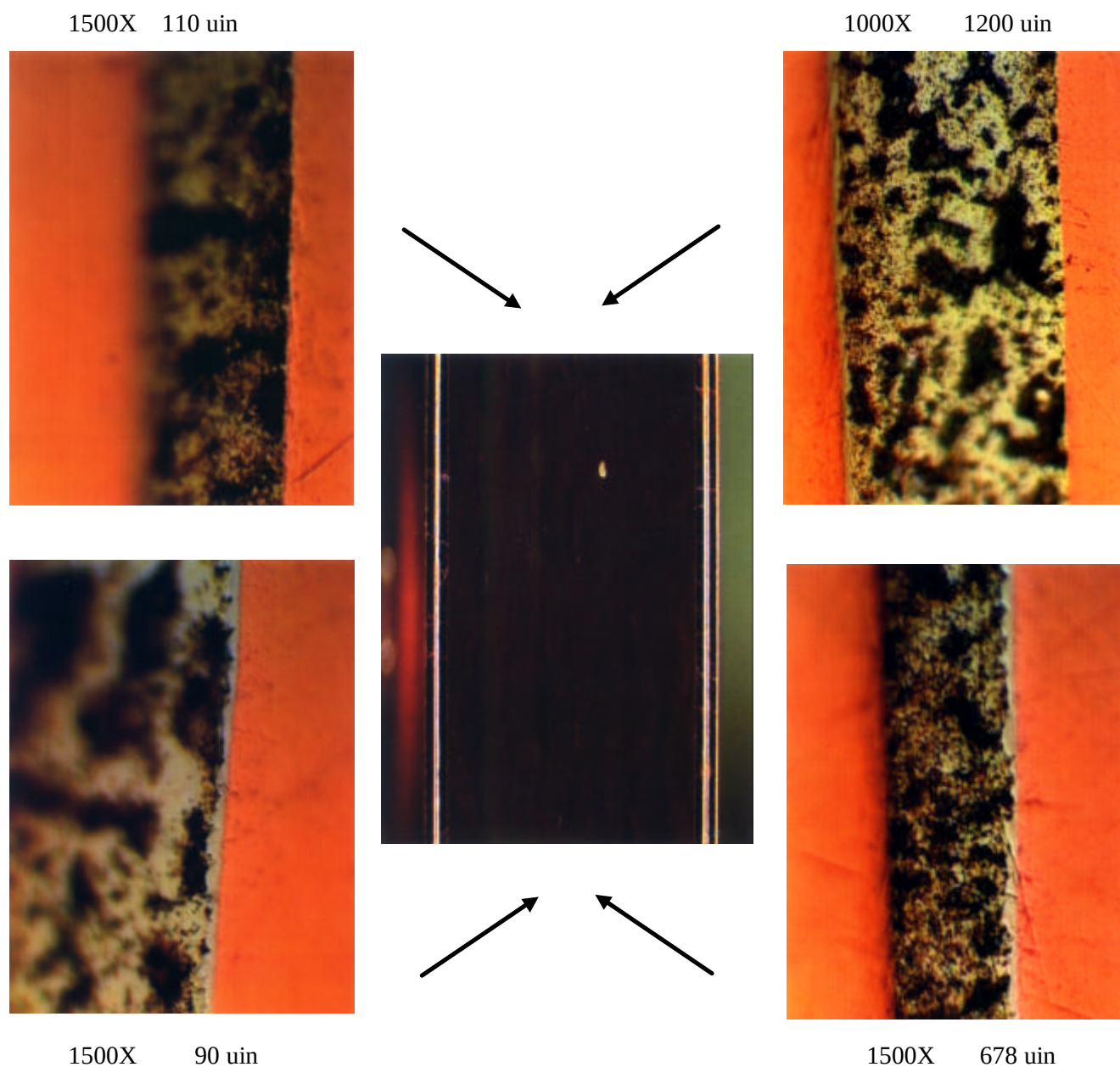


Figure 1 - Microsection of Sample A PWB, reflowed Sn-Pb over copper, "as-received" condition.