Soldering Process Improvement of Critical SMT Connectors and for the Retention of Press-fit SFP Cages

Tho Vu, Anil Kumar, Raymond Tran, Stephen Chen, Zhen (Jane) Feng Ph. D., Greg Ruiz, Murad Kurwa
FLEXTRONICS International Inc.
1007 Gibraltar Drive, Milpitas, CA 95035, USA
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Abstract

As Original Design Manufacturers (ODM) adopt the use of finer pitch connectors, with increased pin count on PCB assemblies. It becomes challenging for Electronic Contract Manufacturing Services (EMS) to build with very low or zero defects in the Printed Circuit Board Assembly (PCBA) operations.

In this paper we will share our experiments for improving the SMT process with these connector types: 1. Samtec's SEARAY™ (AEAM/AEAF Series) connectors with 500 leads which have a unique solder charge design. The leads themselves are on a 50 x 50 mils pitch from row to row. 2. Two Press-fit SFP Cages with different lead lengths, 1 with protrusion and 1 with no lead protrusion on an 18 layer fab (2.5mm thickness).

Case1. Samtec's SEARAY™ (AEAM/AEAF Series) connector
The connector leads have a solder charge (pre-tin), and the minimum stencil thickness requirement is 6 mils. However the assembly supports a mixture of component technology for this product, where many components need the use of a 4 mils stencil thickness. The fab thickness is 40 mils. There are two main SMT process improvements which we did to eliminate defects: 1. Use 6 mils stencil thickness with a Step-Down to support the 4 mils thickness requirement of other components on the assembly, and replaced the use of a Mini-stencil for the connectors to solve operator handling issue that have been causing damage to the solder charge and others; 2. Based on experimental data, we also adjust the profile for optimization of the solder joints of the connector. With new stencil and oven profile, the defects reduced from 15% to < 0.5% for the connector.

Case2. Two Press-fit SFP cages with different lead lengths
Because there were issues with these Press-fit SFP cages failing mechanical drop test. The customer requested us to add solder to the peripheral row of pins of the SFP cages, for a stronger retention to the fab. We couldn't make all pins have a good solder joint with a Non-modified wave fixture, and wave as a normal process. Therefore, we have new process designs (a. Modified wave fixture, add flux on the top side of PCB, and wave as a normal process for the 2 different vendor's components; b. A non-modified wave fixture and add flux on the top side of PCB and wave as a normal process; c. Modified wave fixture and wave as normal process). All these Selective Wave process methods are working: these cages now have good retention with the fab, passing mechanical drop test, and no defective pins for current boards were building. We use 2DX with tilting angle detector to check the solder joints of the cages.

We used 2DX machine to identify boards with critical connectors by optimized method.

Introduction

Connectors are commonly used in system interconnect more widely today. It is challenging to the PCBA process to have reasonable yields, and zero defects. In this paper, we would like to report our experience to improve SMT process with two types' of connectors: Samtec's SEARAY™ (AEAM/AEAF Series) connectors with 500 leads, and Molex and Tyco Press-fit SFP cages.

With SMT and wave process improvements for these two connectors, we have reduced the number of defects significantly: less than 0.5% for Samtec's SEARAY™ connectors, and zero defects for Molex and Tyco Press-fit SFP cages. We use 2DX with tilting angle detector to evaluate solder joints of the connectors.

Components

1. **Samtec's SEARAY™ (AEAM/AEAF Series) connector**

The connector leads have solder charges which are offset making the leads appear to be in pairs. The leads themselves are on a 50 x 50 mils pitch, but solder charges are poisoned back to back because the lead orientation alternates from row to row[1]. Figure 1 shows solder charge location on adjacent rows from an end view, and Figure 2 shows its orientation alternates from row to row. The minimum stencil thickness requirement for the connector is 6 mils.

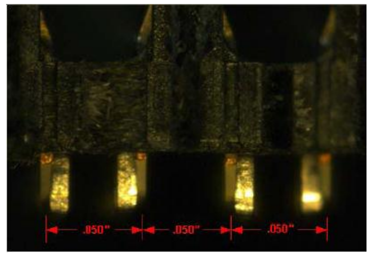

Figure**1. Solder charge location on adjacent rows – end view**

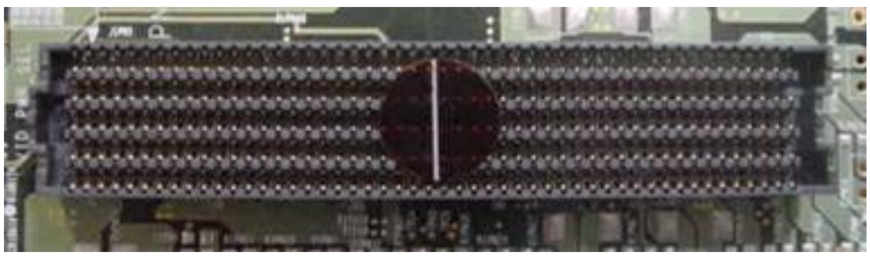

Figure2. 50 mils x 50 mils pitch: its orientation alternates from row to row

2. **Molex and Tyco Press-fit SFP cages**

The only variation is component pin length: they are 2.05 mm and 3.05 mm for Tyco and Molex respectively. These three new process designs of experiment (DOE) are described in Figure 3.

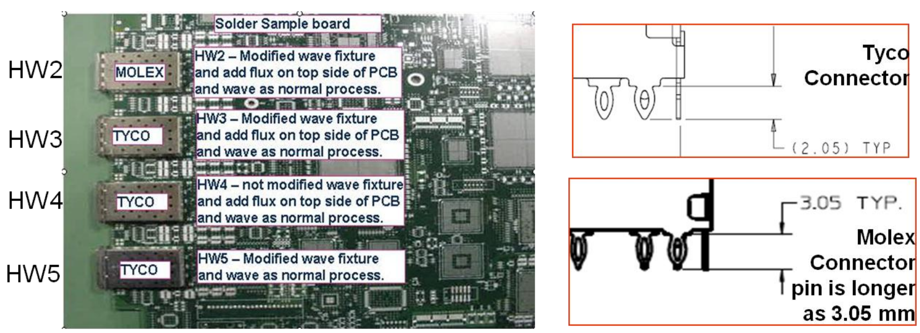

Figure3. Connector Type & Process Type

Improvement Procedure and Analysis

1. **Samtec's SEARAY™ (AEAM/AEAF Series) connector**

Our previous process to meet the connector minimum stencil thickness requirement 6 mils is:

- Paste 4 mils solder to the board

Note: from the time of paste printing, the assembly must be processed through the reflow oven within 30 min.

- Load board into SMT carrier

- Hand print additional paste to the device using mini stencil
- Hand load connector to board
- Process thru reflow with adjusted and approved profile
- Screen for defect visually and with 5DX/Dage
- Report out on any additional observations

The solder is Lead Free: Senju M705 GRN360-K1-MK-VS Sn3Ag0.5Cu. The profile Peak Temperature is 231 to 233 °C; Reflowing time above melting point, 220 ℃, is between 46 – 57 seconds. And soak time is about 99 seconds; Ramp rate is 1.75 ℃ per second. However we had open defects for boards, and Table 1 listed 10 boards information. Most of defects are open which is verified with Dage 2DX machine.

Table 1 – 40% boards failed at SMT and 5DX

Board #	SMT	5DX
1	Pass	Pass
2	Fail	Fail
3	Fail	Fail
4	Pass	Pass
5	Pass	Pass
6	Pass	Pass
7	Pass	Pass
8	Pass	Pass
9	Fail	Fail
10	Fail	Fail

The main stencil improvement is using a 6 mil thickness with a 4 mil Step-Down thickness for other components. Stencil type is stainless steel and laser cut. The stencil aperture is 35 mils, and its pad diameter is 35 mils. The stencil Area ratio is 1.46, and Aspect ratio is 5.83.

Lead free solder is same as previous. However we modified Peak temperature to 241-243 °C. Reflowing time above melting point, 217 °C, is about 65 seconds. The soak time is about 100 seconds with a ramp rate of 2.12 °C per second. Table 2 listed parameters of oven profiles for the original and modified process (current).

Figure 4 is 2DX images for the connector pins which shows good solder joints. The key operation is to find the right tilting angle to check solder joints with the Dage 2DX machine[2]. With new stencil (step-down 6 to 4 mils), the defects reduction went to < 0.5% from 15%. This is a big savings! The SMT process time reduction ($70/hour X 0.05 hour/board): represents a cost savings of about $6500 alone for six months. Table 3 lists time savings from the previous to the current process; Table 4 lists improvement of the current process.

Table 2 – Parameters for Original and Modified Oven Profiles

Item	Original Profile	Modify Profile
Temperature Peak @ 220 °C	**231.1**	**243.17**
Time (Second) above @ 220 °C	**46**	**65**
Soak Time (Second) @ 150 - 220 °C	**99**	**100.3**

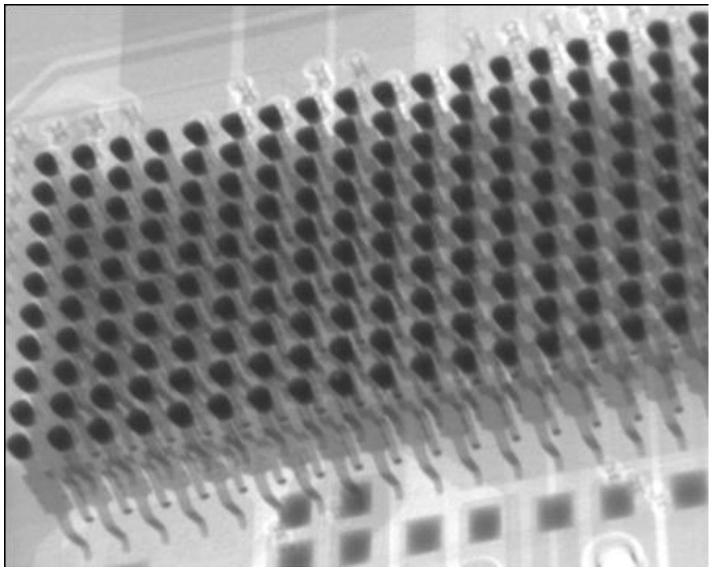

Figure4. 2DX Images shown connector's pin have good solder joints

Table 3 – Time Costs for Previous Process

Step	Process	Time needed (s)
1	remove connector from tape reel	10
2	inspect solder charge	10
3	place connector on fixture holder	15
4	align mini stencil of connector	20
5	print solder stencil	60
6	remove mini stencil	15
7	remove connector with solder pase	10
8	inspect solder paste and solder charge	30
9	install connector on board	10
	Total time needed	180

Table 4 – Comparison of Previous and Current Process

Stencil Type	Previous: 4 mils + mini stencil 4 mils	New: Step - down 6 to 4 mils
Total Connectors loaded	5648	1870
Defects %	15	0.50%
Total defective connectors	848	10
Total process time (second)	1,016,640	336,600
Total time added (hour)	282.4	93.5

2. Molex and Tyco Press-fit SFP cages

Because there were issues with these Press-fit SFP cages failing mechanical drop test. The customer requested us to add solder to the peripheral row of pins of the SFP cages, for a stronger retention to the fab. These two different manufacturer SFP cages have different lead lengths. The assembly uses a .093 thick fab, the Molex part has a .021 lead protrusion, and the Tyco part has no lead protrusion with this fab thickness, which is fine for the press-fit process, but our concern was getting enough barrel fill during the wave process to ensure part retention. We couldn't make all pins have a good solder joint with a Non-modified wave fixture, and wave as a normal process. Therefore, we have three new process designs (a. Modified wave fixture, add flux on the top side of PCB, and wave as a normal process for the 2 different vendor's components; b. A non-modified wave fixture and add flux on the top side of PCB and wave as a normal process; c. Modified wave fixture and wave as normal process). Therefore we use three different process methods for the experiments (Figure 3). As listed in the figure 3, the Molex SFP cage on HW2, and Tyco SFP cages are on HW3, HW4, and HW5. The wave fixtures were modified as Figure 5 shows; and Table 5 lists the Original and Modified Wave Fixture Dimension.

The wave process different for HW2, HW3, HW4, and HW5 are listed here:
HW2: Modified wave fixture and add flux on the top side of PCB and wave as normal process (Molex SFP cage)
HW3: Modified wave fixture and add flux on the top side of PCB and wave as normal process (Tyco SFP cage)
HW4: Not modified wave fixture and add flux on the top side of PCB and wave as normal process (Tyco SFP cage)
HW5: Modified wave fixture and wave as normal process (Tyco SFP cage)

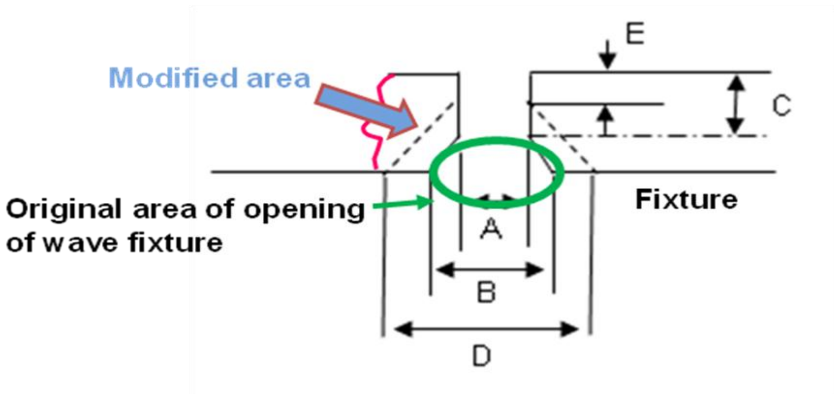

Figure5. Modified Wave Fixture

Table5. Original and Modified Wave Fixture Dimension

Original Fixture Dimension (mil)			Modified Fixture Dimension (mil)	
A	B	C	D	E
172.5	412.5	155	696.5	90

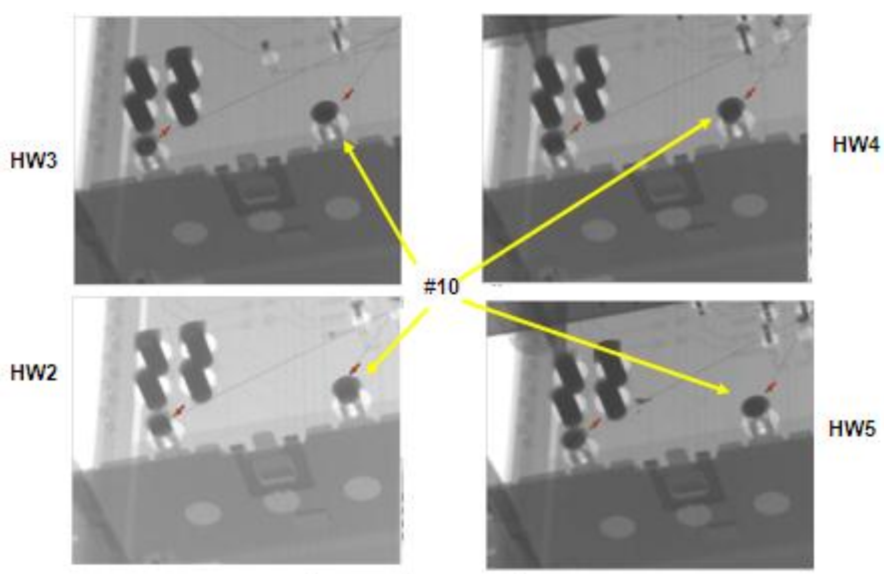

Figure6. 2DX images of connector pins (#10 & #11) for HW2, HW3, HW4 and HW5

It is working with the new wave process methods, these connectors have good retention to the fab, and no defective pins for current boards we are building. We use 2DX with tilting angle detector to check the solder joints of the SFP cages. Figure 6 is 2DX images of connector pins #10 and #11 for HW2, HW3, HW4 and HW5. There is no significant different between solder joints for HW2, HW3, HW4 and HW5. The 2DX Rotation angle is 105 degree; and its Oblique angle is 52 degrees for these images taken.

We also used a Pull test to examine the amount of force before solder joint failure, utilizing the Chatillon Digital Force Gauge - Model DFIS 200. The speed is 500 mil /second. Table 7 is our documented Pull test results. The Pull test data also show these three methods work well. HW2 and HW3 is the same method with different connector pin length from different vendor. It is no surprise that HW2 has almost 3 times full force as HW3 because HW2 has longer pin as shown in Figure 3. As a result of this process modification we have had zero defects on several hundred boards that have been built with the HW2, HW3, HW4 and HW5 process.

Table7. Pull Test Results

Connector Name	Process ID	Pull Force (lb)
Molex	HW2	45.6
Tyco	HW3	15.8
Tyco	HW4	19
Tyco	HW5	16.8

Conclusions

1. Samtec's SEARAYTM (AEAM/AEAF Series) connector

There is signification yield improvement for Samtec's SEARAYTM connector with new stencil design, oven profile.

- New stencil (step-down 6 to 4 mils) reduced defects to 0.5% from 15%.
- Modified Peak Temperature is about 243 ^{o}C. Reflowing time above melting point, 220 ^{o}C, is about 65 seconds. And soak time is about 100 seconds. Ramp rate is 2.12 ^{o}C per second.
- SMT process time saving 3 minutes for each board (3.5 per board); and the defective pins reduced to 0.5% from 15%.

2. Molex and Tyco Press-fit SFP cages

Part retention improvement was successful, and passed structural test, with the use of the wave solder process implement for all three methods: modified wave fixture and add flux on the top side of PCB and wave as normal process; or not modified wave fixture and add flux on the top side of PCB and wave as normal process; or modified wave fixture and wave as normal process.

Acknowledgement

Flextronics Engineering & Production teams at Milpitas of California; and Intel & F5 Engineering teams. Teresita Villavert, Hung Le, Sati Johal, Selva Paramasivan, and Dr. Evstatin Krastev of Dage.

Reference

1. Samtec Connector, "Processing Recommendations for Samtec's SEAEAY (SEM/SEAF Series) Connectors", Samtec, March, 2009.

2. Zhen (Jane) Feng, Juan Carlos Gonzalez, Evstatin Krastev, Sea Tang, and Murad Kurwa, "Non-Destructive Techniques for Identifying Crack Defect in BGA Joints: TDR, 2DX, and Cross-section/SEM Comparison", SMTA Proceeding, August, 2008.

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Flextronics International, Inc.
Milpitas, CA 95035, USA

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Agenda

- Background
- Case1: Samtec's SEARAY™ (AEAM/AEAF Series) connector
  - Previous SMT procedure
  - Current SMT procedure
  - Comparisons
  - Case 1 Summary
- Case 2: Two Press-fit SFP Cages
  - Background & Experimental design
  - Experimental data
    - Dage
    - Pull test
  - Case 2 Summary
- Conclusions

Background

- As Original Design Manufacturers (ODM) adopt the use of finer pitch connectors with increased pin counts on PCB assemblies. It becomes challenging for Electronic Contract Manufacturing Services (EMS) to build with a very low, or zero defects, with-in the PCBA operations.
- Our Milpitas CA team has been working on two case studies since last summer. We would like to share our experiments for improving the soldering process of these connectors, and the retention of 2 SFP cage types:

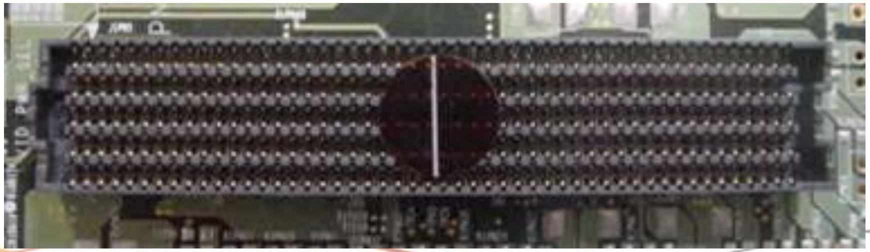
1. Samtec's SEARAYTM (AEAM/AEAF Series) connectors, with 500 leads which have a unique solder charge design. The leads themselves are on a 50 x 50 mils pitch from row to row. The fab thickness is 40 mils (1mm).
2. Two Press-fit SFP cages with different lead lenghts,1 with protrusion and 1 with no-lead protrusion on an 18 layer fab (2.5 mm thickness).

Case1. Samtec's SEARAY™ (AEAM/AEAF Series) Connector

The connector leads have a solder charge (pre-tin), and the minimum stencil thickness requirement is 6 mils. However the assembly supports a mixture of component technology for this product, and many components need the use of a 4 mils stencil thickness.

Two main SMT process improvement items which we did to eliminate defects:

- Use 6 mils stencil thickness with a Step-Down to a 4 mils thickness for other components, replacing the Mini-stencil use for these connectors: to solve operator handling issue that may cause damage to the solder charge.
- Based on experimental data to adjust profile for optimization solder joint with the connector. To verify the solder ability of the Samtec connector by reflowing the board and connector via the use of a SMT fixture.



50 mils x 50 mils pitch: its orientation alternates from row to row.

Previous SMT Procedure (May 2008 – September 2009)

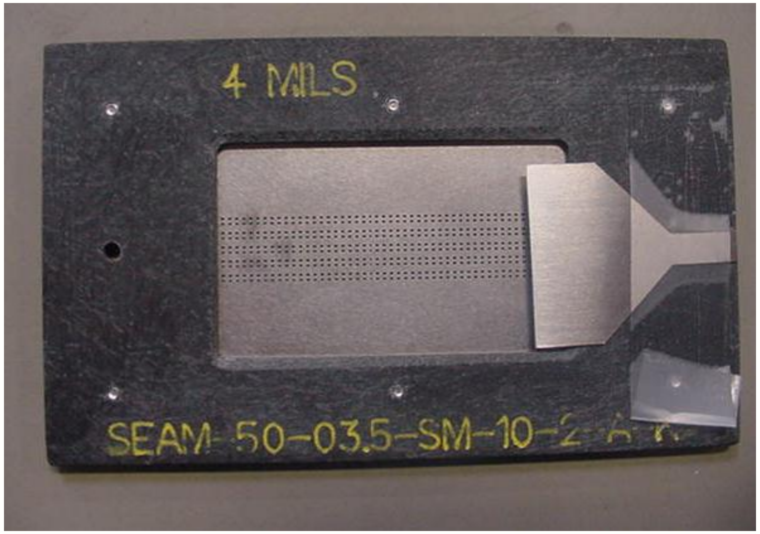
Used to place Samtec connector

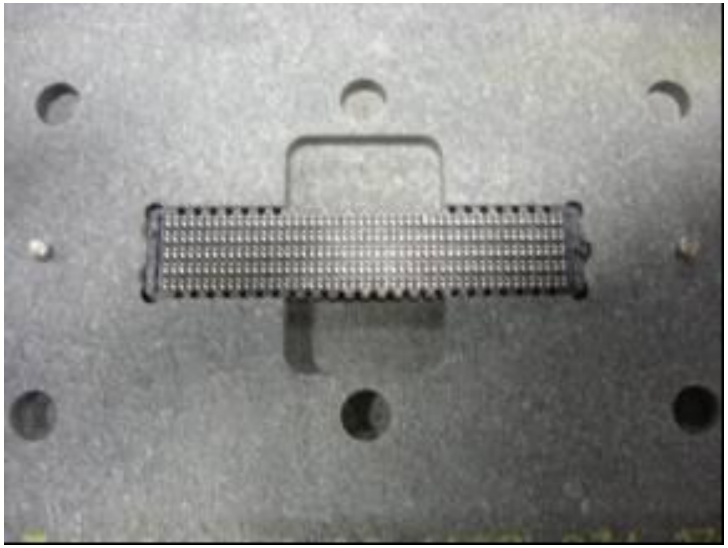
- Paste 4 mils solder to the board

  Note: from the time of paste printing to processing the board in the oven, it cannot take more than 30 min.

- Load board into SMT carrier
- Hand print additional paste to the device using mini stencil
- Hand load connector to board
- Process thru reflow with adjusted and approved profile
- Screen for defect visually and with 5DX/Dage
- Report out on any additional observations

Previous SMT Procedure (carrier for connector & board)



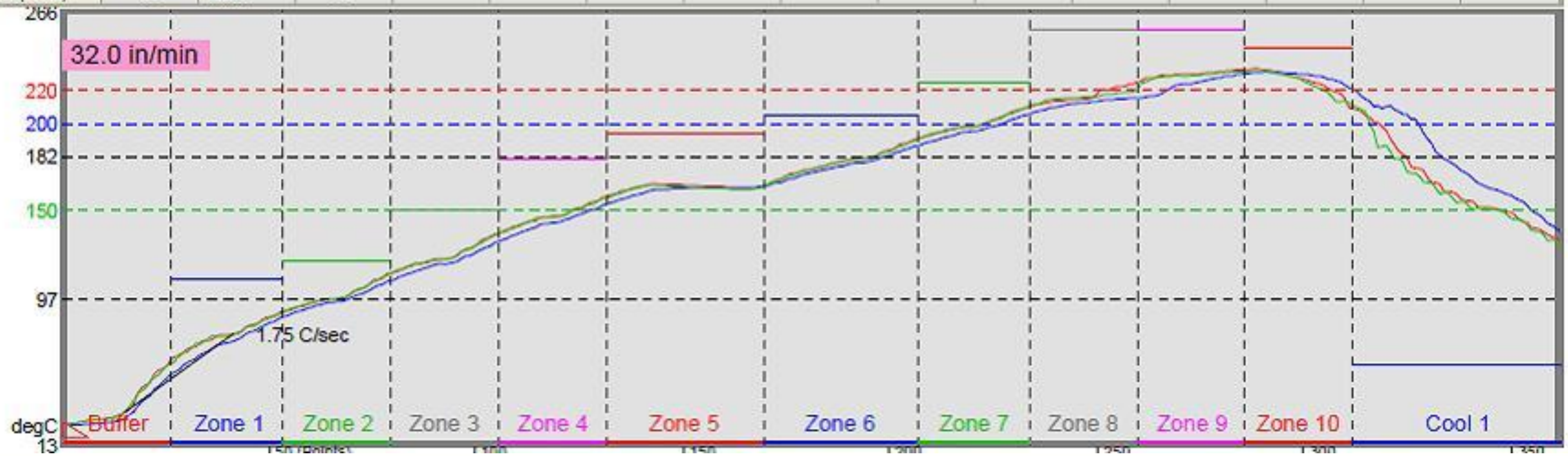


Carrier to hold connector

Mini stencil for additional solder for connector (additional 4 mils solder)

Previous SMT Procedure (oven profile)

	Buffer	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Cool 1	Cool 2		
Length (in)	14	14	14	14	14	20	20	14	14	14	14	28	28		
Top (degC)	0	110	120	150	180	195	205	225	255	255	245	60	40		
Bottom (degC)	0	110	120	150	180	195	205	225	255	255	245	60	40		
Predict (degC)	0	110	120	150	180	195	205	225	255	255	245	60	40		
Conveyor (in/min)	32	Predict	32												



Summary Stats	Peak	Minimum	Max (+)Slope	Max (-)Slope	Time Above 220C	Time 150-200C	220C / Peak
Sensor 1 J1PM1 corner	232.8	24.4	3.25	-3.33	57.0	99.0	0.35
Sensor 2 J1PM1 center	231.1	23.9	2.46	-3.33	46.0	99.0	0.46
Sensor 3 J1PM1 corner	231.7	23.9	2.78	-3.97	46.0	99.0	0.43
Range	1.7	0.6	0.79	0.63	11.0	0.0	0.00

Lead Free solder: Senju M705 GRN360-K1-MK-VS Sn3Ag0.5Cu

Peak Temperature is 231 – 233 degree Celsius

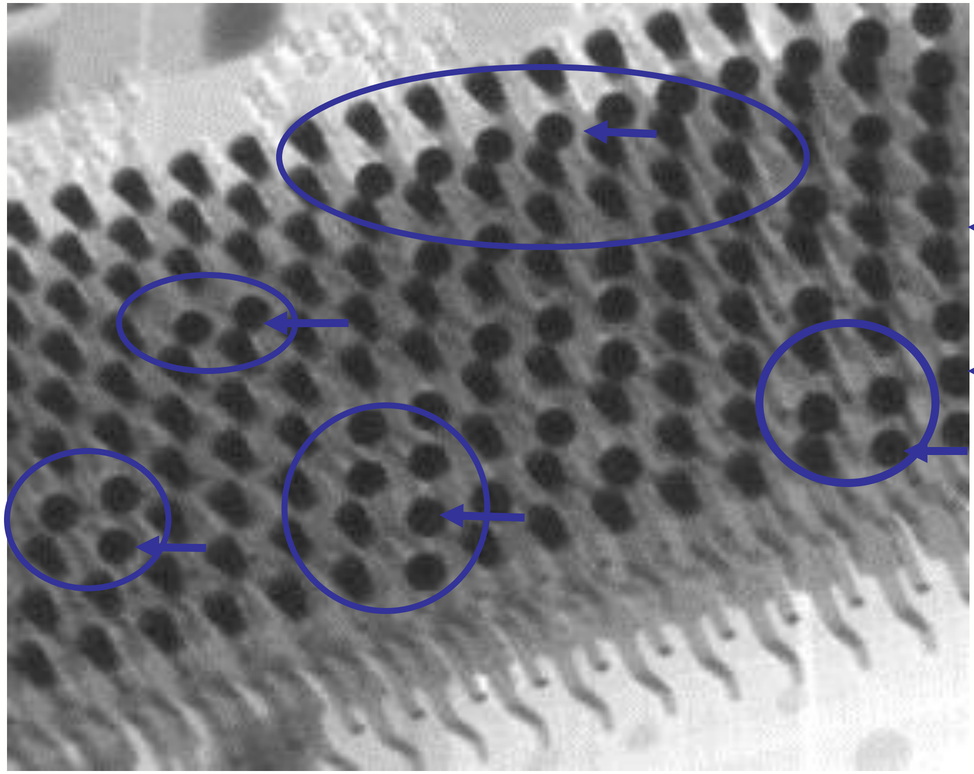
Reflowing time above melting point, 220 ℃, is between 46 – 57 seconds. Soak time is about 99.0 seconds. Ramp rate is 1.75 ℃/second

Previous SMT Procedure (testing results for connector)

Board #	SMT	5DX
1	Pass	Pass
2	Fail	Fail
3	Fail	Fail
4	Pass	Pass
5	Pass	Pass
6	Pass	Pass
7	Pass	Pass
8	Pass	Pass
9	Fail	Fail
10	Fail	Fail

40% boards failed at SMT and 5DX.

2DX Image of Fail Connector (previous process)



Board #2

Sample of open solder that are taken by Dage X-ray machine

2DX Images shown connector's pin have open solder.

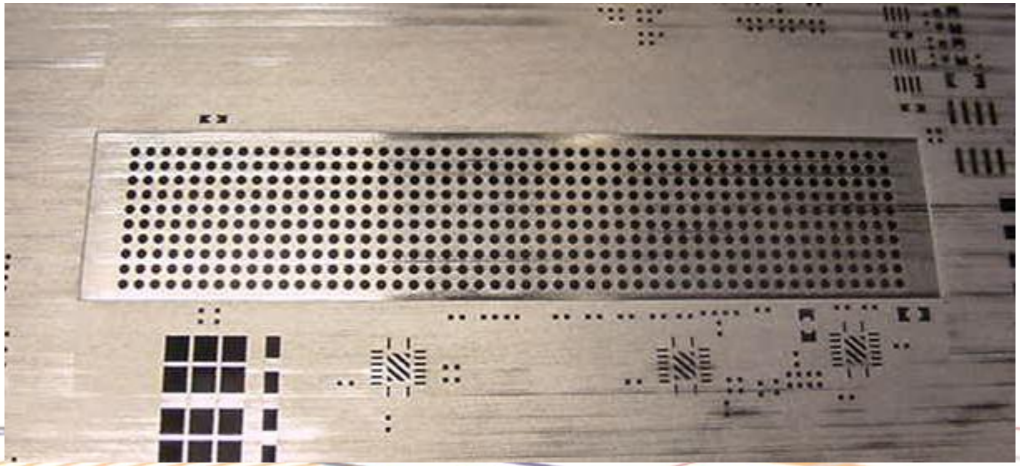
Current Stencil Design (October 2009 - Now)

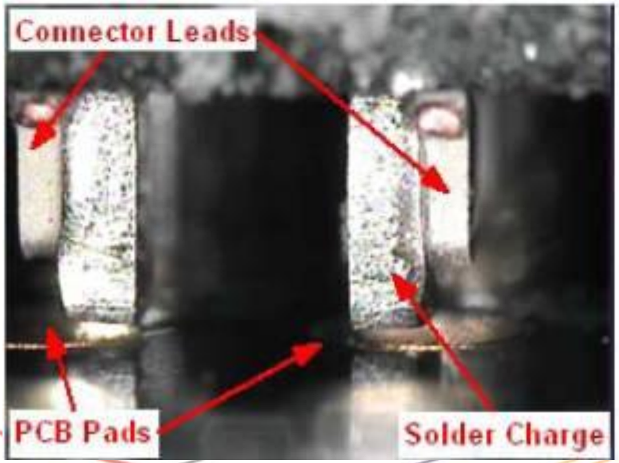
Use of a 6 mils thickness form for the connector location, and a 4 mils Step-Down thickness for the balance of the assembly.
Stencil type: Stainless steel and laser cut

Stencil thickness (6-to-4) (mil)	**6**
Stencil aperture (mil)	**35**

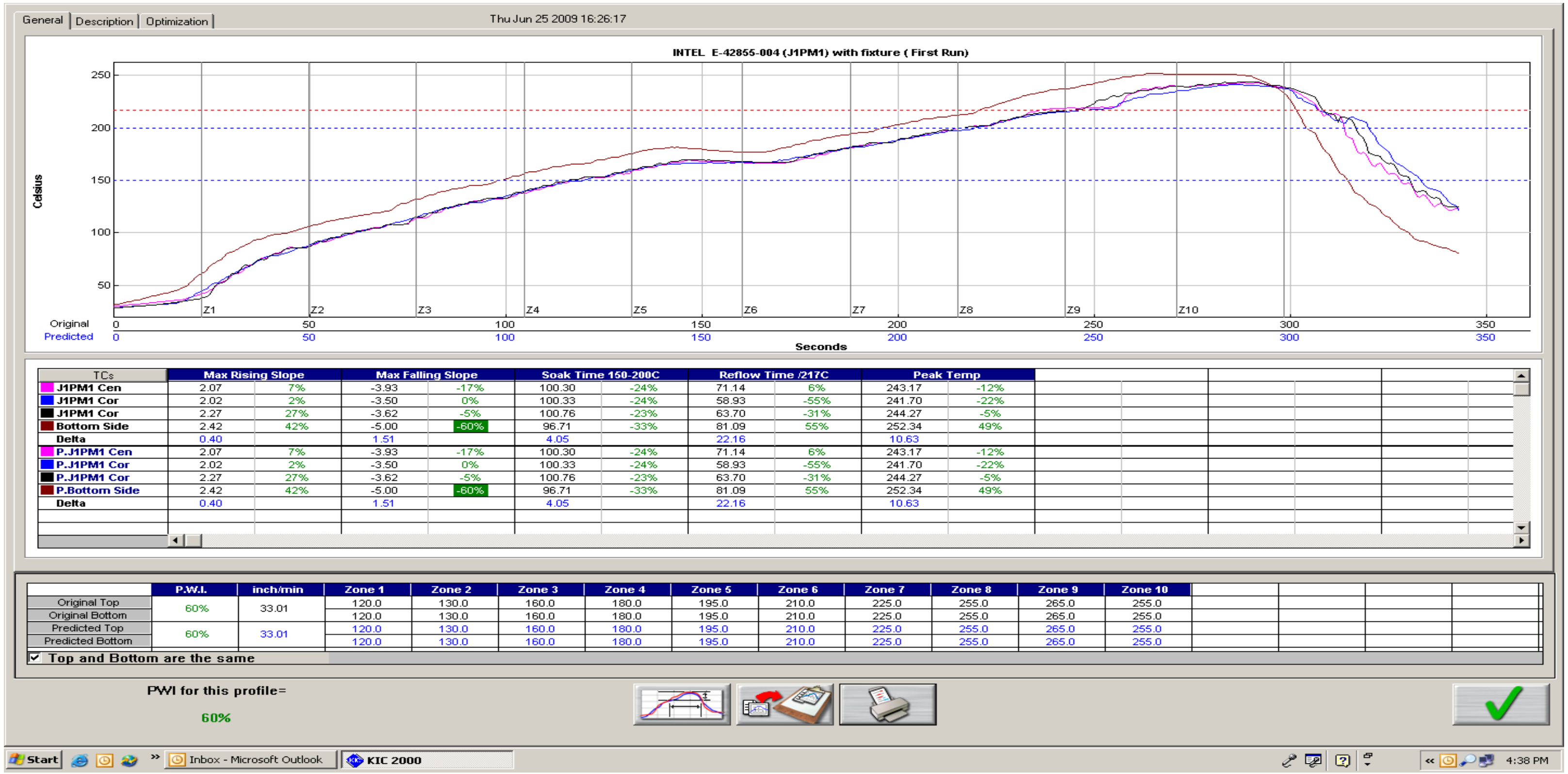
Circ. Pad dia.	Radius	Area ratio	Stencil T	Aspect Ratio	Volume(mil3)
35	17.5	1.458	6	5.833	5772.51

Unit: mil





Current SMT Procedure (oven profile)



TCs	Max Rising Slope		Max Falling Slope		Soak Time 150-200C		Reflow Time /217C		Peak Temp	
J1PM1 Cen	2.07	7%	-3.93	-17%	100.30	-24%	71.14	6%	243.17	-12%
J1PM1 Cor	2.02	2%	-3.50	0%	100.33	-24%	58.93	-55%	241.70	-22%
J1PM1 Cor	2.27	27%	-3.62	-5%	100.76	-23%	63.70	-31%	244.27	-5%
Bottom Side	2.42	42%	-5.00	-60%	96.71	-33%	81.09	55%	252.34	49%
Delta	0.40		1.51		4.05		22.16		10.63	
P.J1PM1 Cen	2.07	7%	-3.93	-17%	100.30	-24%	71.14	6%	243.17	-12%
P.J1PM1 Cor	2.02	2%	-3.50	0%	100.33	-24%	58.93	-55%	241.70	-22%
P.J1PM1 Cor	2.27	27%	-3.62	-5%	100.76	-23%	63.70	-31%	244.27	-5%
P.Bottom Side	2.42	42%	-5.00	-60%	96.71	-33%	81.09	55%	252.34	49%
Delta	0.40		1.51		4.05		22.16		10.63	

	P.W.I.	inch/min	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10
Original Top	60%	33.01	120.0	130.0	160.0	180.0	195.0	210.0	225.0	255.0	265.0	255.0
Original Bottom			120.0	130.0	160.0	180.0	195.0	210.0	225.0	255.0	265.0	255.0
Predicted Top	60%	33.01	120.0	130.0	160.0	180.0	195.0	210.0	225.0	255.0	265.0	255.0
Predicted Bottom			120.0	130.0	160.0	180.0	195.0	210.0	225.0	255.0	265.0	255.0

☑ Top and Bottom are the same

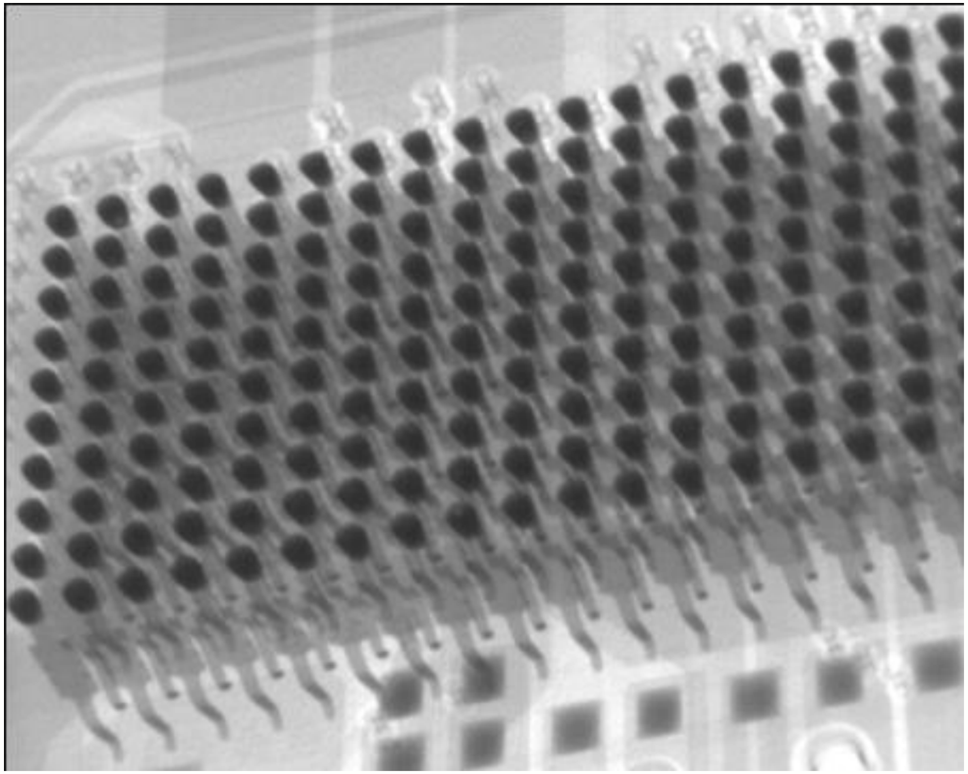
Lead Free solder: Senju M705 GRN360-K1-MK-VS Sn3Ag0.5Cu

Peak Temperature is between 241 – 244 degree Celsius.

Reflowing time above melting point, 217 ℃, is about 65 seconds.

And soak time is about 100 seconds. Ramp rate is 2.12 ℃/second

2DX Image for Current Connector Joints



Solder Joint images are taken by Dage X-ray inspection equipment

2DX Images showing connector pin's having good solder joints.

Comparisons

Time Costs for previous process

Step	Process	Time needed (s)
1	remove connector from tape reel	10
2	inspect solder charge	10
3	place connector on fixture holder	15
4	align mini stencil of connector	20
5	print solder stencil	60
6	remove mini stencil	15
7	remove connector with solder pase	10
8	inspect solder paste and solder charge	30
9	install connector on board	10
	Total time needed	180

Reduce SMT process time 0.05 hour for each board.

	May 2008 – Sep. 2009	Oct. 2009 – April 2010
Stencil Type	Previous: 4 mils + mini stencil 4 mils	New: Step - down 6 to 4 mils
Total Connectors loaded	5648	1870
Defects	15%	0.50%
Total defective connectors	848	10
Total process time (second)	1,016,640	336,600
Total time added (hour)	282.4	93.5

With new stencil (step-down 6 to 4 mils), the defects were reduced to < 0.5% from 15%. This is a Big savings!

We also have a SMT process time savings ($70/hour x 0.05 hour for each board) reducing the overall cost of about $6500.

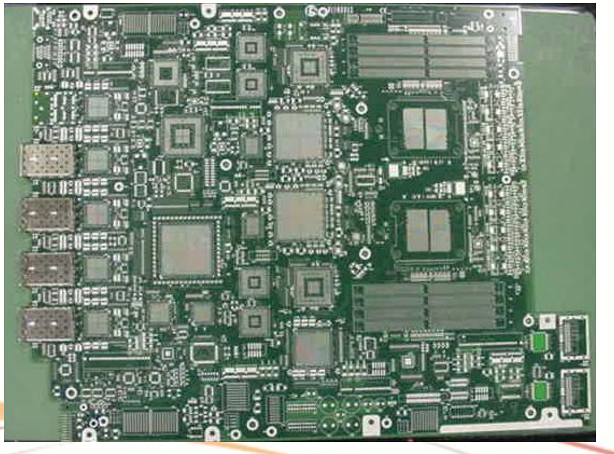
Case 1 Summary

- Solder paste: Senju M705 GRN360-K1-MK-VS Sn3Ag0.5Cu, print on PCB and connector.
- After reflow with previous procedure, there were 4 boards with open solder. (Picture on page 9 as sample: the board is warping up in middle of connector.)
- New stencil (step-down 6 to 4 mils) reduced defects to 0.5% from 15%.
- SMT process time saving ($70/hour x 0.05 hour for each board); and the defective pins reduced to 0.5% from 15%. This is a Big savings!

Item	Original Profile	Modify Profile
Temperature Peak @ 220^{o}C	231.1	243.17
T above @ 220^{o}C	46	65
Soak Time @ 150 - 220^{o}C	99	100.3

Case2. Press-fit Connector

- Because there were issues with these Press-fit SFP cages failing mechanical drop test. The customer requested us to add solder to the peripheral row of pins of the SFP cages, for a stronger retention to the fab.
- We couldn’t make all pins have a good solder joint with a Non-modified wave fixture, and wave as a normal process. Therefore, we have three new process designs for our experiments.



Background & Experimental Design

With concern of solder ability due to different pin lengths, our experiment was to ensure enough solder could be applied to meet part retention, and pass customer mechanical drop tests. To verify this we used three different process methods for this experiment.

HW2: Modified wave fixture, add flux on the top side of PCB & wave as normal process

HW3: Modified wave fixture, add flux on the top side of PCB & wave as normal process

HW4: Not modified wave fixture, add flux on the top side of PCB & wave as normal process

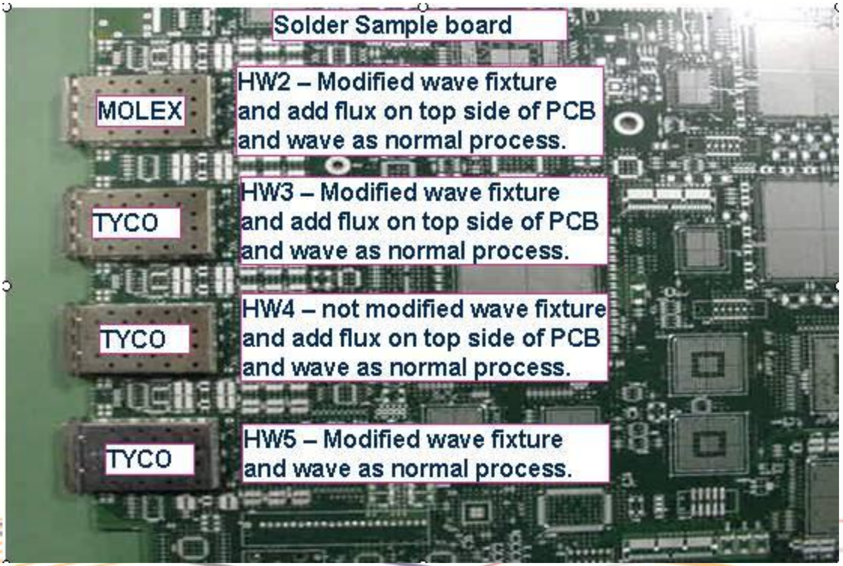
HW5: Modified wave fixture and wave as normal process

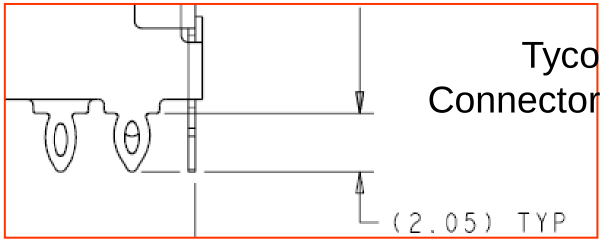
HW2

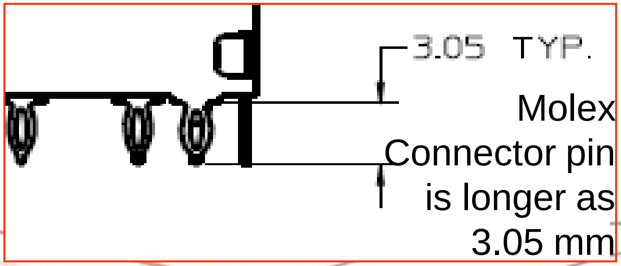
HW3

HW4

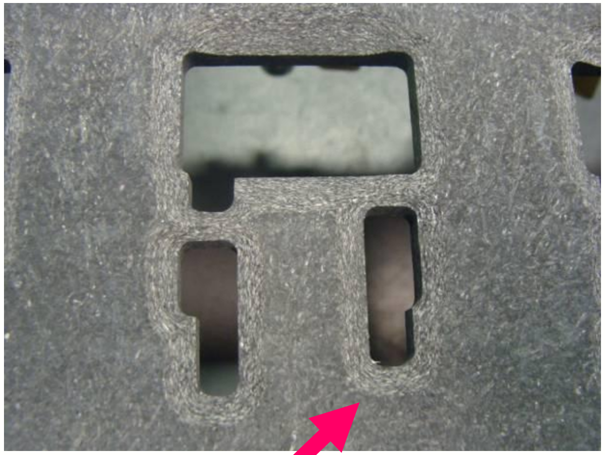
HW5



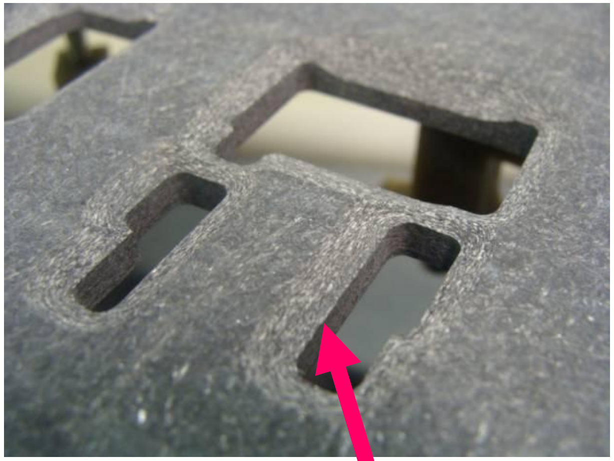




Original Wave Fixture

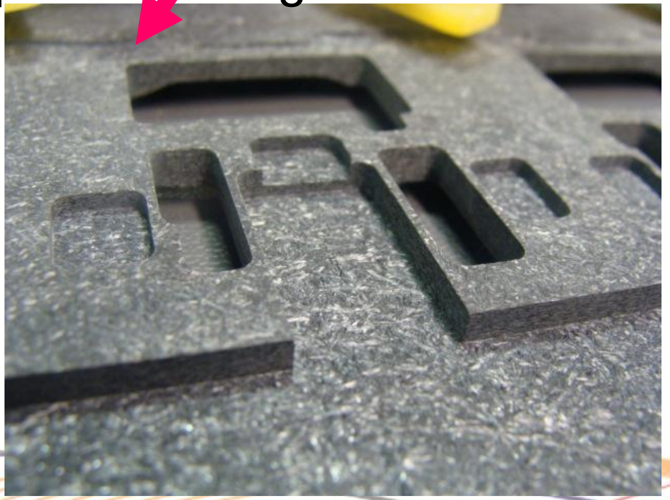


Bottom view of original wave fixture

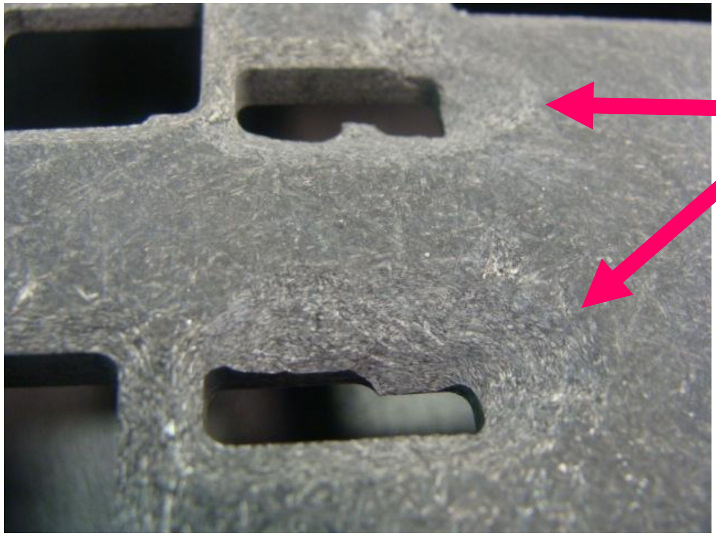


Bottom view of original wave fixture in angle to see the thickness of the wall.

Top view of original wave fixture.

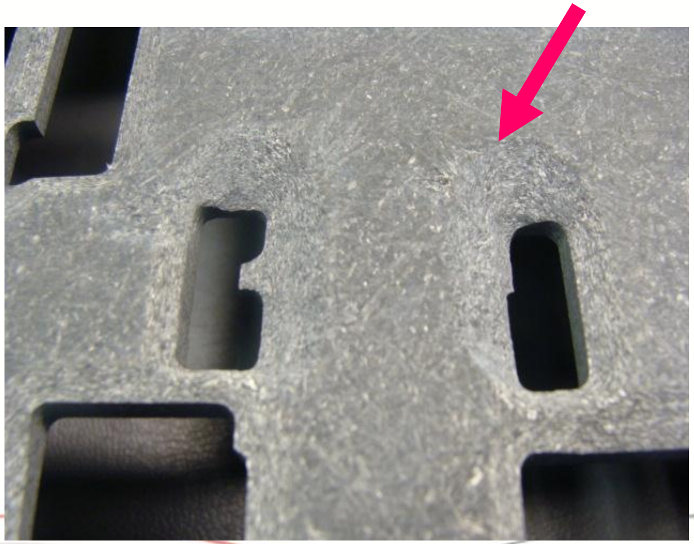


Modified Wave Fixture



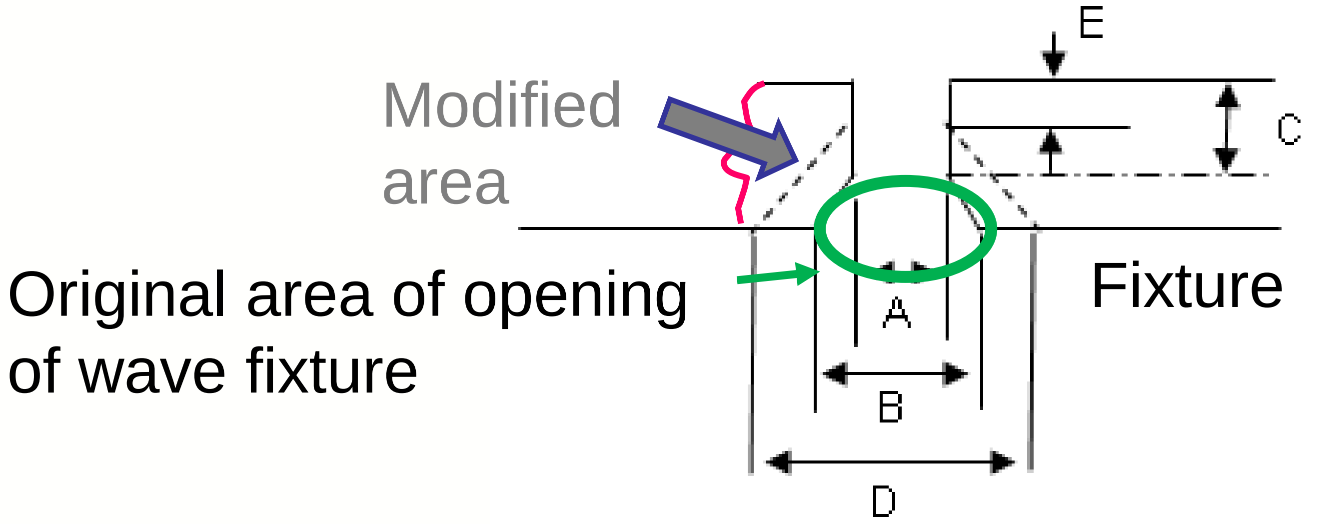
Bottom view of modified wave fixture to remove material

Bottom view of modified wave fixture to remove material.

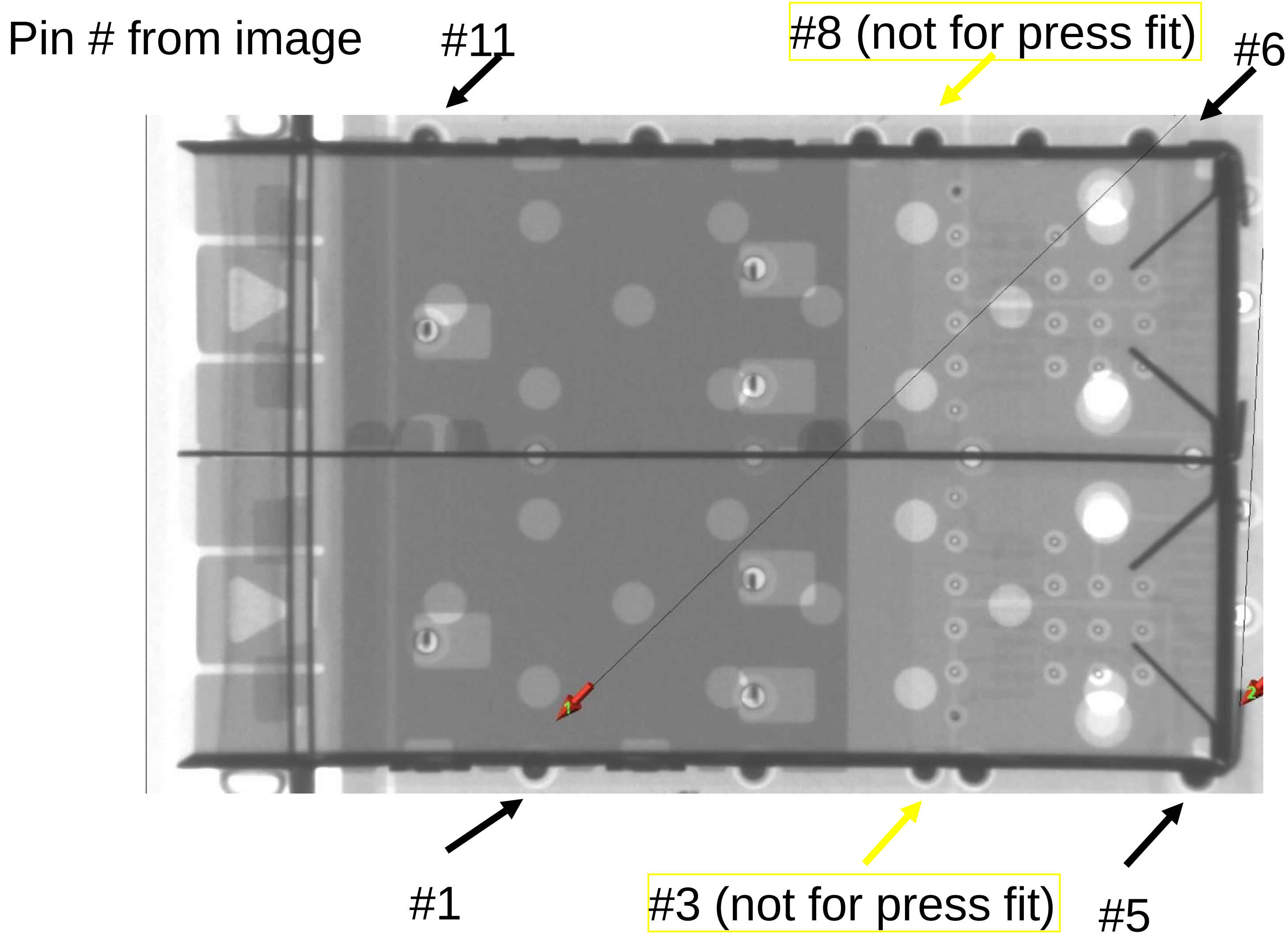


Modified Wave Fixture

Original Fixture Dimension (mil)			Modified Fixture Dimension (mil)	
A	B	C	D	E
172.5	412.5	155	696.5	90



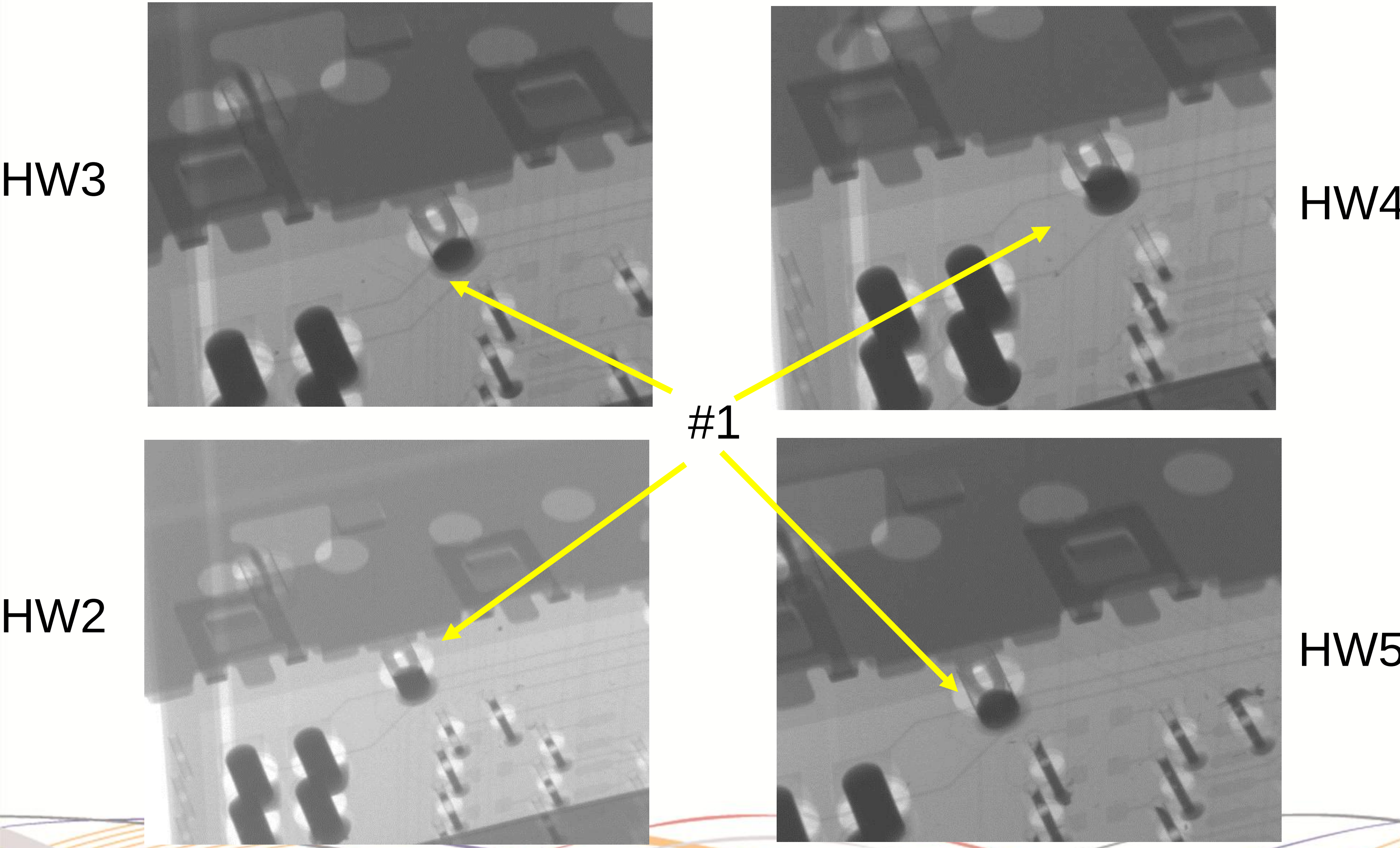
Experimental Data



2DX: 100kv

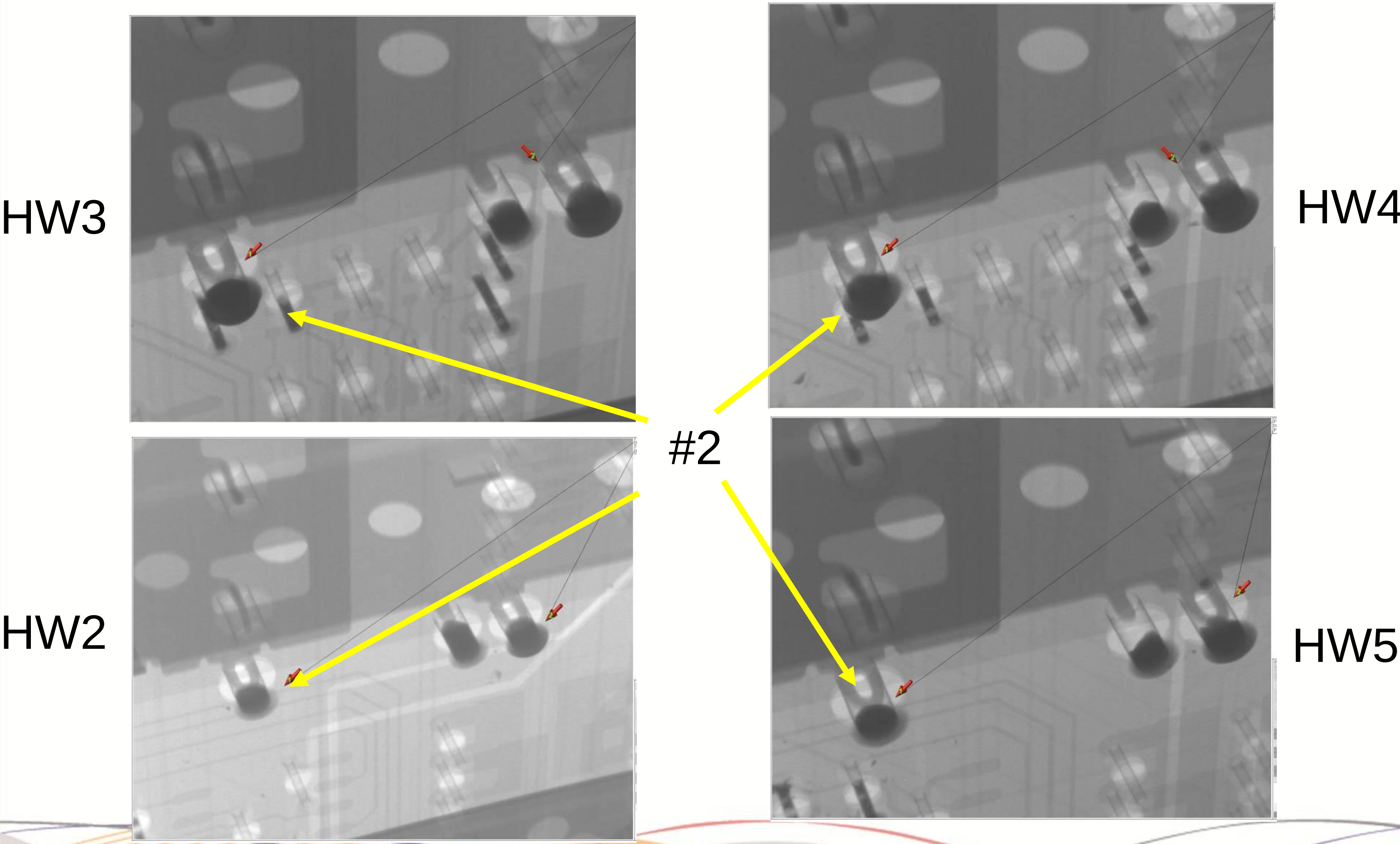
Experiment – Dage Images (pin 1)

Rotation angle: 290 degrees, Oblique angle: 54 degrees



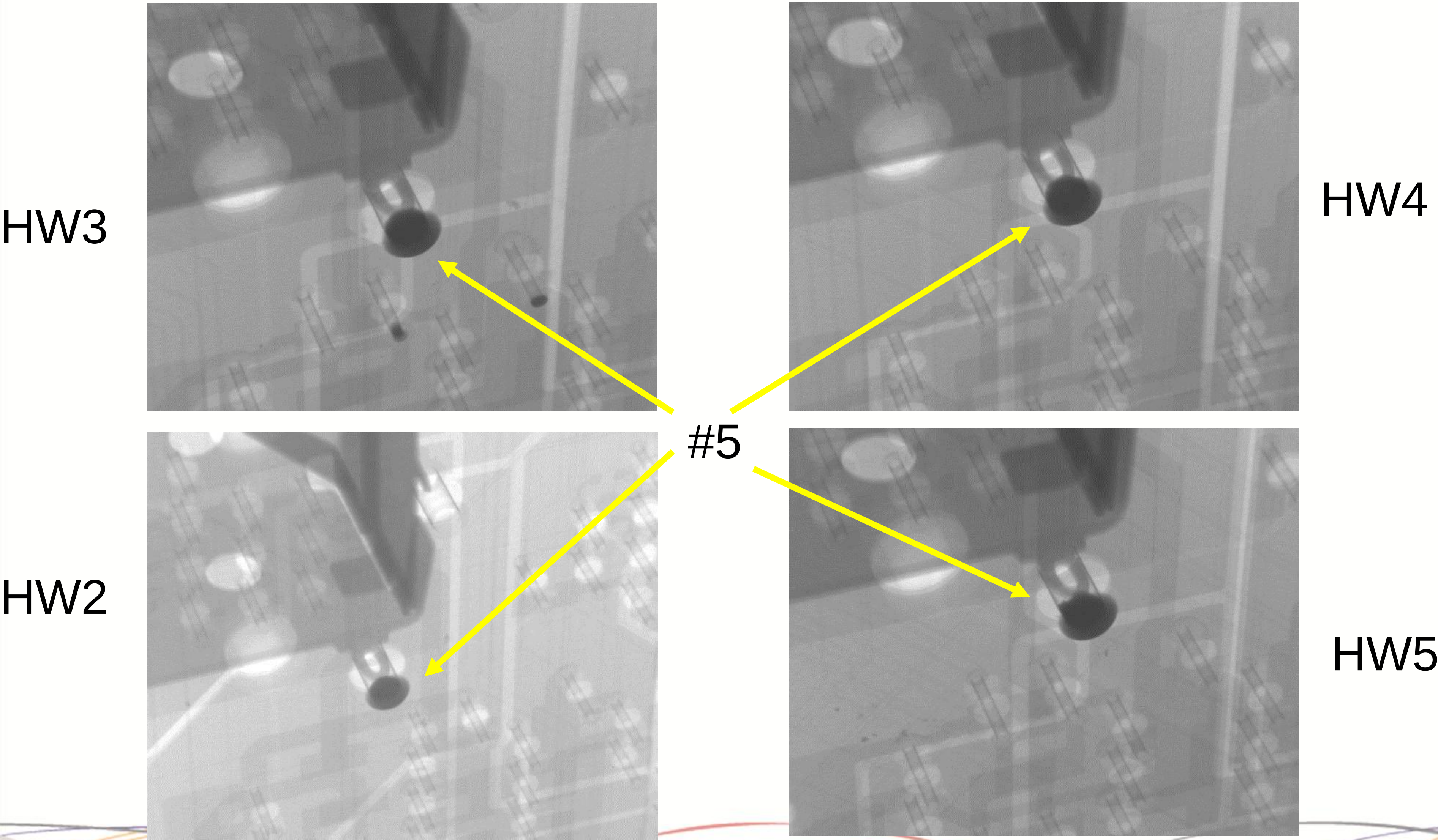
Experiment – Dage Images (pins 2-4)

Rotation angle: 290 degrees, Oblique angle: 54 degrees



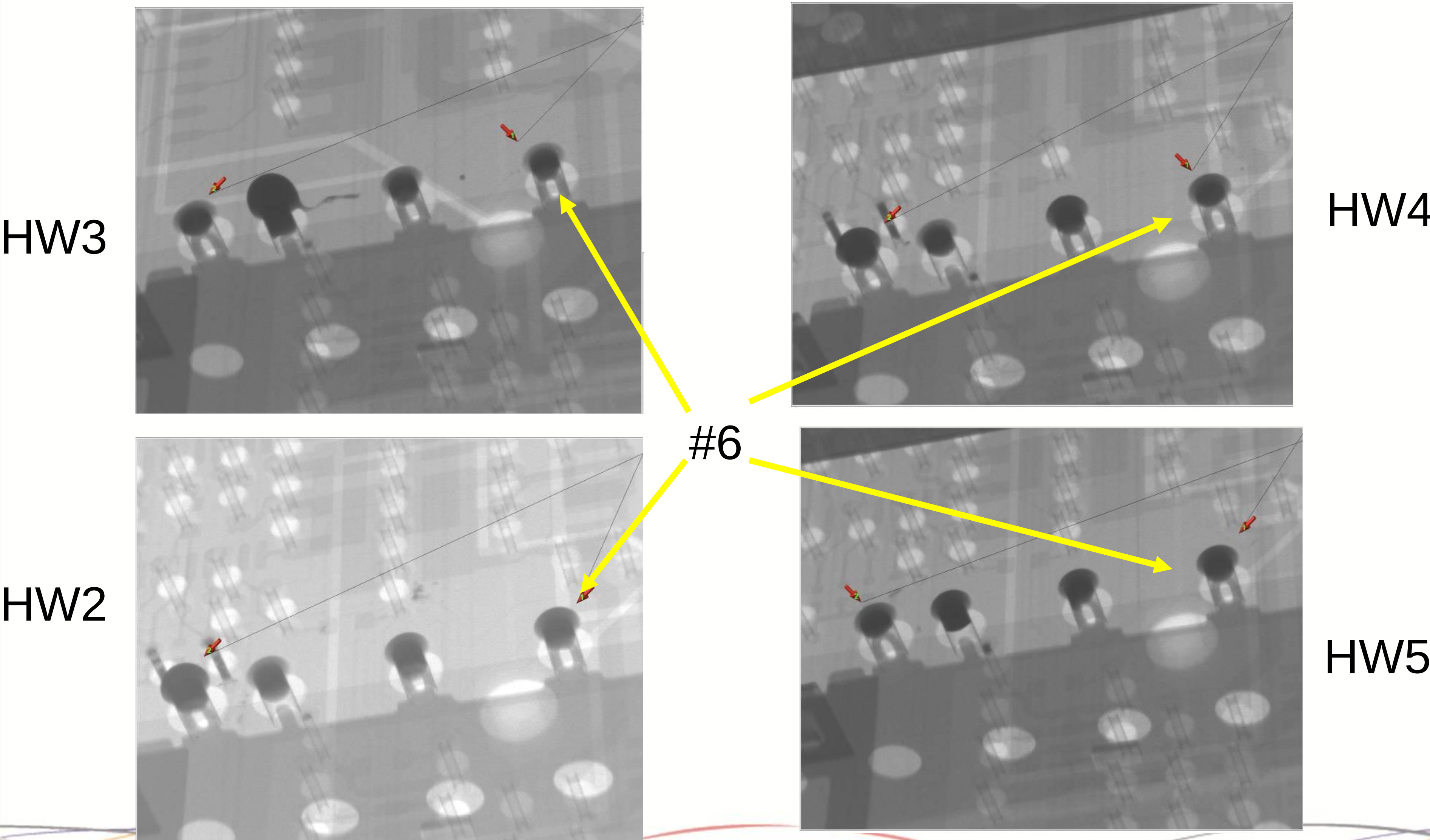
Experiment – Dage Images (pin 5)

Rotation angle: 290 degrees, Oblique angle: 54 degrees



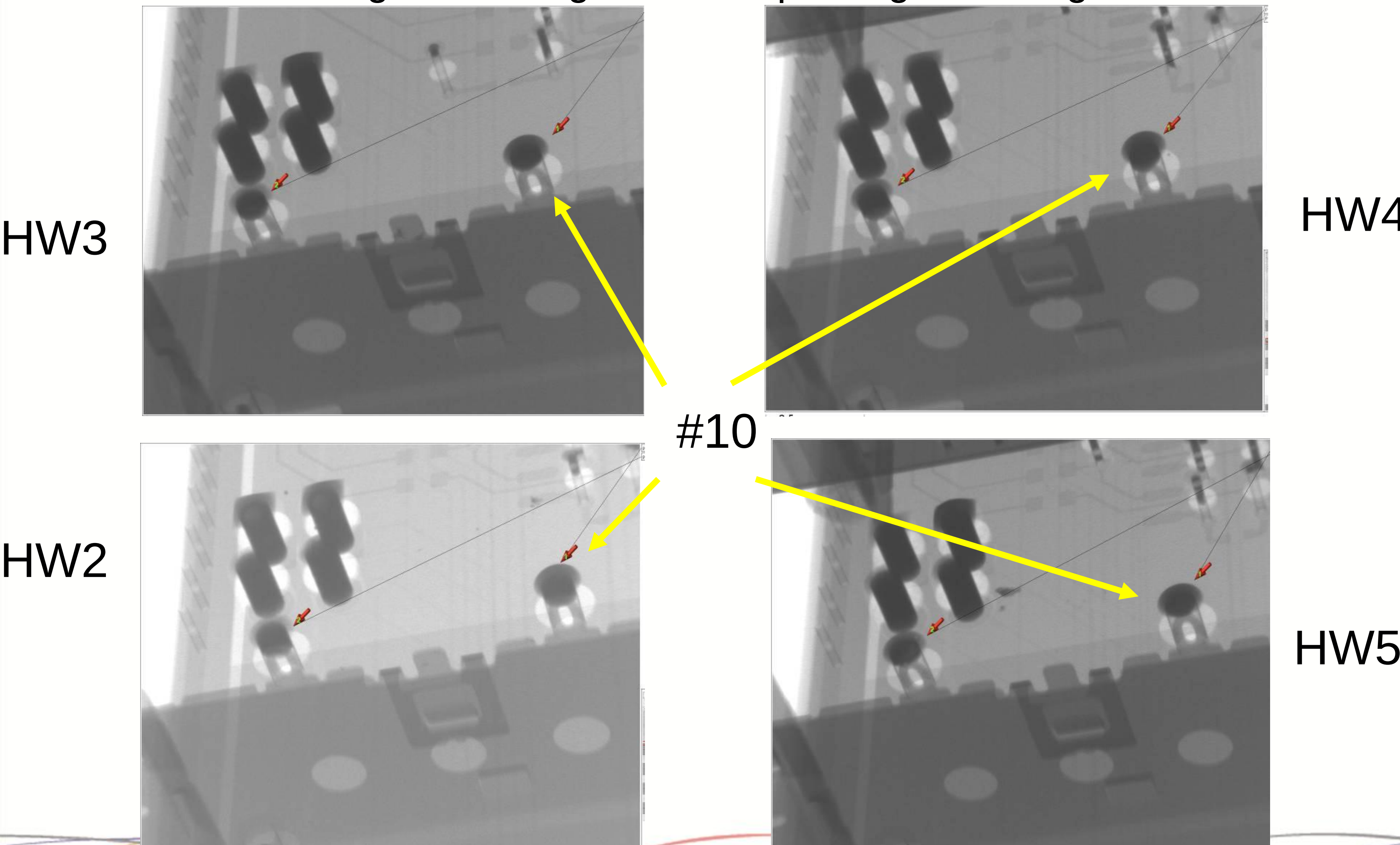
Experiment – Dage Images (pins 6-9)

Rotation angle: 105 degrees, Oblique angle: 52 degrees



Experiment – Dage Images (pins 10-11)

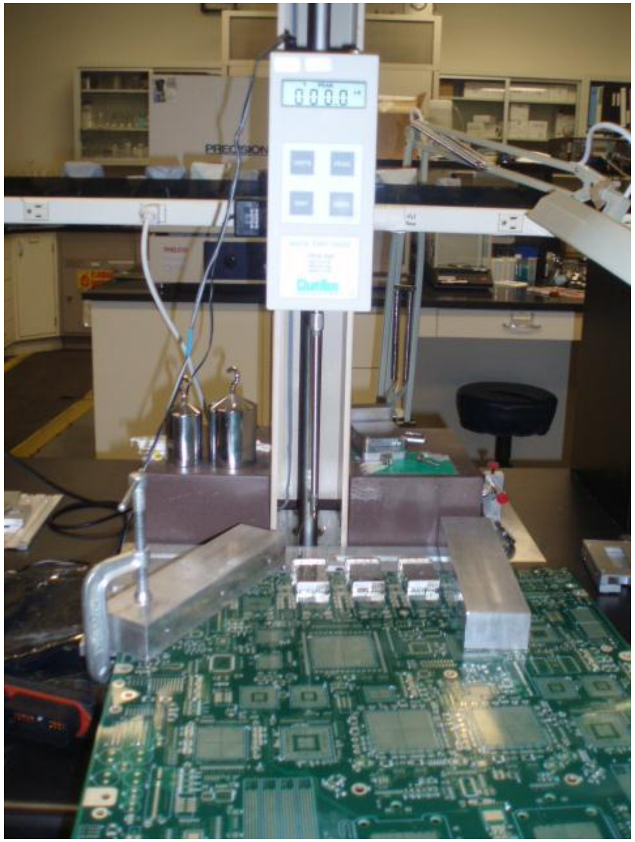
Rotation angle: 105 degrees, Oblique angle: 52 degrees



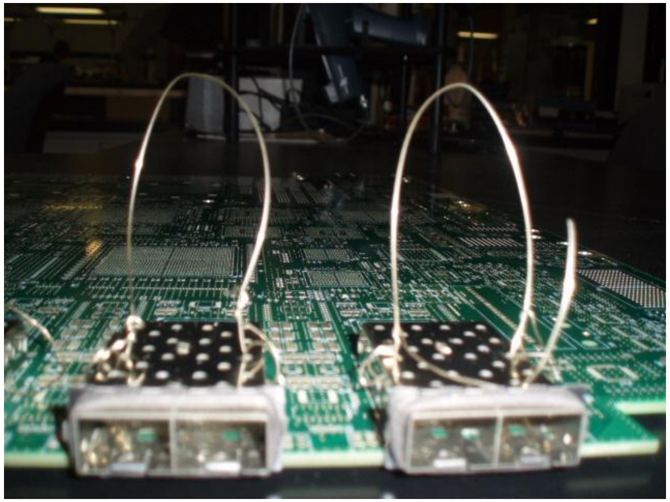
More than 250 boards built and shipped – No issue with method of HW2, HW3, HW4, and HW5.

It is working with the new soldering process methods: these SFP Cages have good retention to the fab, and no defective pins for boards we are building. We used 2DX with tilting angle detector to check the solder joints of the SFP Cages.

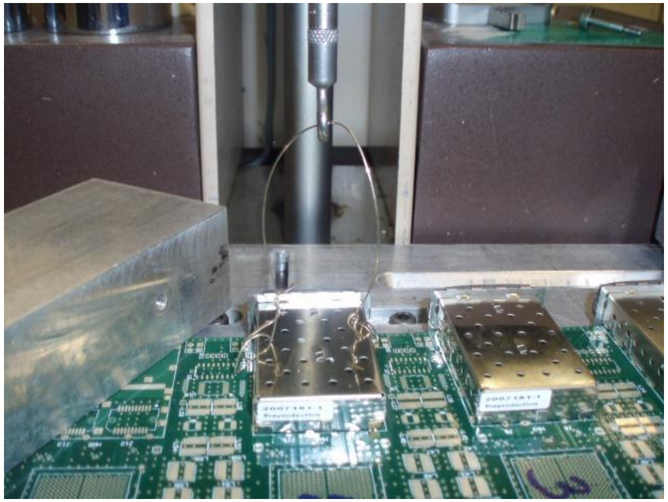
Experiment – Pull Test



Pull Test set-up using Chatillon Digital Force Gauge - Model DFIS 200



Attached a 2.5” wire at the center of the press fit connector.



Pulled the press fit connector as shown.

Experiment – Pull Test Results

Connector Name	Process ID	Pull Force (lb)
Molex	HW2	45.6
Tyco	HW3	15.8
Tyco	HW4	19
Tyco	HW5	16.8

Pull test data also indicate that these three methods work well. HW2 and HW3 is the same method with different SFP Cage pin length's from different vendors.

It shows reliable solder joint barrel fill to ensure part retention of these press - fit SFP Cages, though pin protrusion is not compliant to our preferred condition.

Case 2 Summary

Pull test indicates that though the part with no lead protrusion and less solder barrel fill, required approx 30-40% less force to remove, that it retains the SFP cage to meet our customer's testing parameters, and be a process option to resolve the SFP cages from coming loose in the field.

Customer test engineering have verified it, and it meets their internal structural test requirements.

Conclusions

- There is signification yield improvement for Samtec's SEARAYTM (AEAM/AEAF Series) connector with new stencil design, oven profile.

- There is solder joint improvement with one of these three methods: modified wave fixture and add flux on the top side of PCB and wave as normal process; or Not modified wave fixture and add flux on the top side of PCB and wave as normal process; or Modified wave fixture and wave as normal process.

Reference

1. Samtec Connector, “Processing Recommendations for Samtec’s SEAEAY (SEM/SEAF Series) Connectors”, Samtec, March, 2009.

2. Zhen (Jane) Feng, Juan Carlos Gonzalez, Evstatin Krastev, Sea Tang, and Murad Kurwa, “Non-Destructive Techniques for Identifying Crack Defect in BGA Joints: TDR, 2DX, and Cross-section/SEM Comparison”, SMTA Proceeding, August, 2008.

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