



WILLIAM & MARY
CHARTERED 1693

Update on tooth strip attachment at W&M

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Status of production

- To maintain Chicago production, we were authorized to produce boards for layers 3U
 - Arrived at UC last Tuesday, Zubair accompanied and discussed QC with them
- Chicago already has layer 3G boards in hand
- Chicago requires APA layers 4X and 4V by the end of the month
 - This will be a mix of existing boards and new boards

Status of the action items for restart

- We have assembled ~25 boards with modern procedures and shipped them to the UK for QC checks
 - Results from UK are back; prompted both follow-on studies and discussion [slides]
- Lessons learned document
 - We completed a (thanks for Brian and Justin for comments with a keen eye) and timeline
 - Final pending addition of a few EDMS links and posting

Observations from the UK inspection of W&M test boards

- Some thin sheens of epoxy on surfaces of some boards
- One strip had a broken tooth
- Some boards of one type had strips misaligned with strips over sped
- All boards had board-to-strip steps over spec
- UK with return ship them to W&M for training purposes and to remeasure

Epoxy and broken tooth

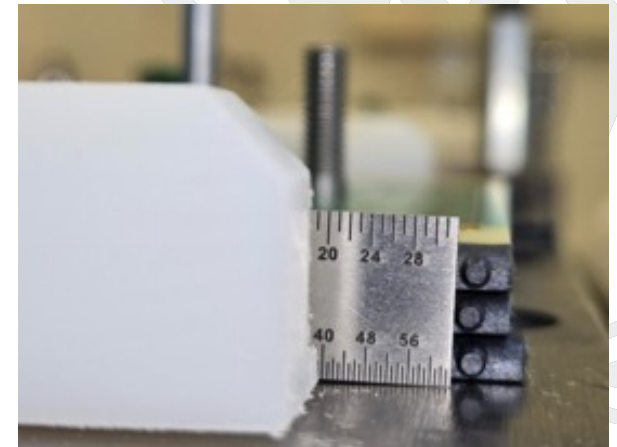
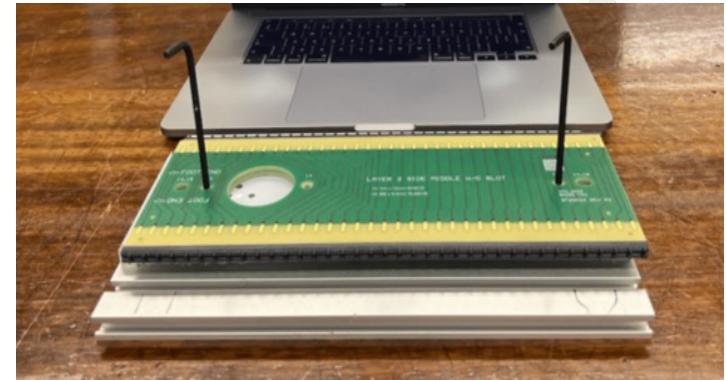
- Some thin sheens of epoxy on the surfaces of boards
 - Reemphasize final cleaning with new lint-free sheets each swipe
- One strip had a broken tooth
 - We have seen 4 of these in our entire production
 - We know 1 (X foot) was from tipping over onto a corner (noted before final QC)
 - 3 of them seem to have happened in shipping; assume they were weakened in someway; Neither exactly in the center or on an end
 - Added a final QC step to check the teeth

Boards shifted WRT strips (1)

- UK tested boards with the Keyence for strip-board alignment (<150um)
 - We shipped boards of 5 different types
 - Found that examples 4 of 5 types passed
 - Retested 8 boards from the type that failed (V long boards) and 50% passed and 50% did not
 - In each example, the strips on both sides were shifted in the same direction indicating the board fixturing pins were the most likely issue (not the strip clamps)
 - We have 2 fixtures of that type, and each fixture has 2 sides; hypothesis was that there were issues with the pins on one or two fixture sides
 - We did not have good notes on which board came from which fixture/side; Adding this into the database entries for each board (This had been Brian's intent)

Boards shifted WRT strips (2)

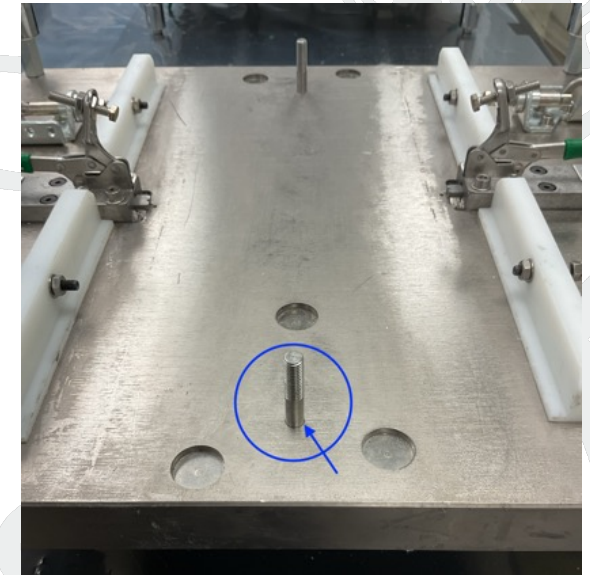
- At Manchester Justin and his team did a stack test to see if they could visually confirm the Keyence survey results
 - Align the boards on their bolt holes and check teeth alignment
 - This was able to see boards off at the >150um level
- At W&M...
 - We made boards with each side of each fixture (and kept track)
 - We did the stack test and could verify the alignment problems locally [top]
 - Since the test boards were tested in two different ways, we can conclude that neither method is sensitive enough to measure 200um-scale alignment [bott]
 - Wire over pins relative to solder pads
 - Checking that 'v' clamps fill seat on teeth (effect is there but very subtle at 300um)
- Will adopt an “stack” alignment test for future production
 - Requires a set of “golden” boards to use as the reference



Least count is $1/64'' = 400\mu\text{m}$ ⁷

Boards shifted WRT strips (3)

- We examined the fixtures and found that for the long board fixtures the alignment pins for 2 of the fixture sides were “wiggly”
 - These steel pins are press fit into the fixtures’ aluminum bases
 - We reset them with a rubber mallet
 - Unique to this fixture style – the rest are secured with set screws
- Action items
 - Need to add a “fixture pin wiggle” test before mounting the boards for curing
 - We are making new test boards to verify this solved the alignment issue
 - PSL gearing up to test boards with their Keyence
 - To certify our “golden boards”
 - To recertify all our fixtures

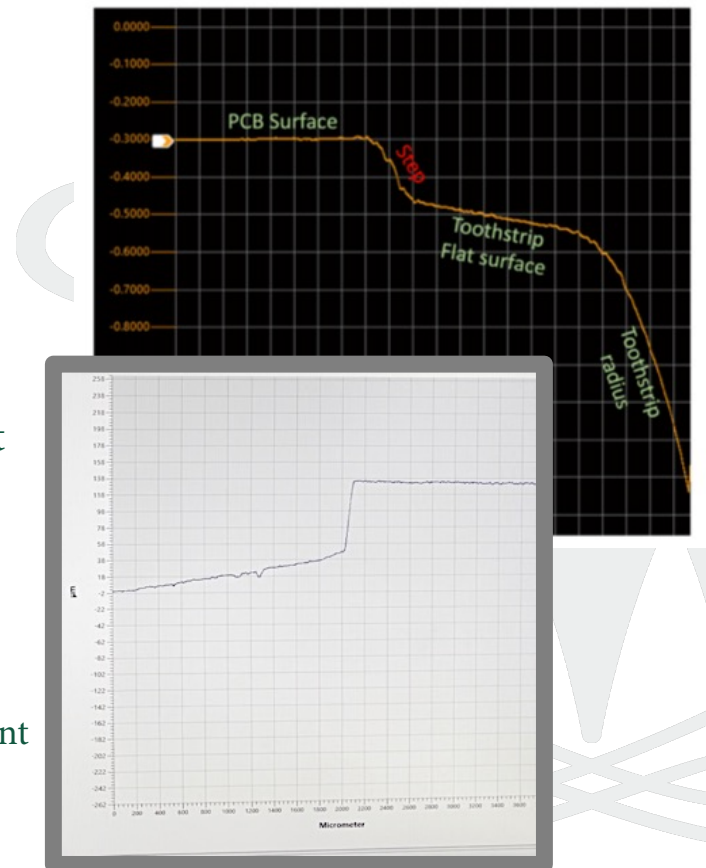


Board to tooth strip steps (1)

- We measured the steps on each test boards and found them all below 200um steps
- The UK measured all boards to have failed the step specification
- What's up with that?
- Background:
 - At the meeting 2 weeks ago, I presented how we calibrated our step measurements using a profilometer (10s of nm precision)
 - We found we measured ~25um higher steps (conservative) with the W&M dial indicator measurements with 40um RMS
 - Remember these boards were made on fixture without the extra clamps and the board/strip height correction; they were expected to be close to the limit
- Follow on video meeting (24-Jul-2024) with the UK teams where we went over the step measurement techniques at each site
 - My feeling was that we were all using the compatible techniques
 - W&M were using a 1mm radius stylus while 1mm diameter at UK – will move to the same diameter

Board to tooth strip steps (2)

- Manchester made optical step measurement on the 3 worst boards according to UK dial indicator measurements
 - In the optical tests: 1 board would pass, 1 on the limit, and 1 still failed
 - Observed that the strips were tilted WRT the board
- We observed the same thing with the profilometer
 - The slope indicates that our 25um bias is consistent with making the measurements ~1mm from the strip
- When we make the dial indicator measurements, we try to take them as close to the step as it becomes a stable measurement
- Unfortunately, we did not find the W&M step measurements for the test boards; We'll have to remeasure them at W&M
- Observations
 - Note: both optical and profilometer measurements are very time intensive
 - Could the difference between the UK and US measurements be primarily distance from the step?
 - We expect that when we complete the fixture upgrades the strips should no longer be tilted and the location if the measurement are should be less important



W&M Fixture retrofit status

- Side addons completed for all but 2 fixtures
- Adding on the clamps
- Have Kapton tape on hand to shim up the strips relative to the board (70um thick)
 - Our average step before this is 110um (including measured 25um bias)
 - We see ~50um variance in steps (with 40um precision) over 209 strips
 - These shims should add a good bit of head room