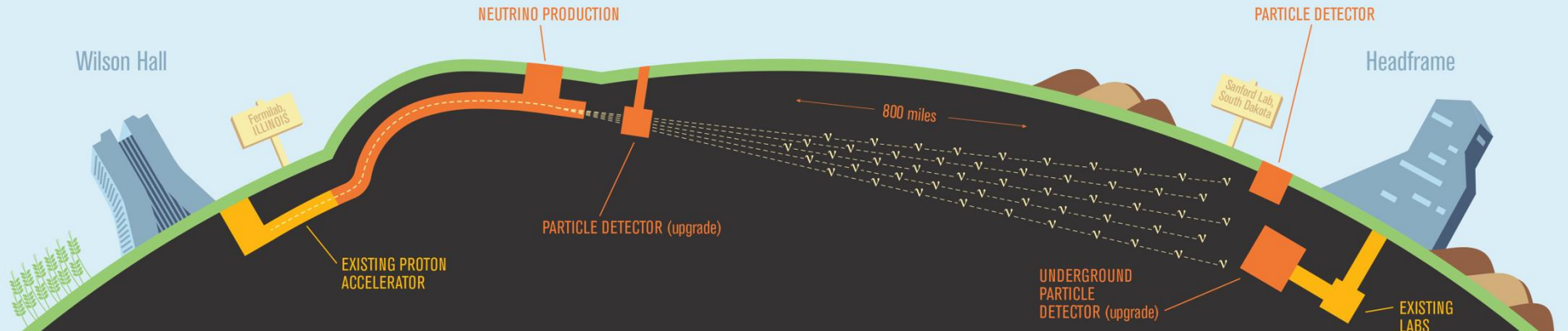


QC on W&M PCBs

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5th August 2024



Tooth strip lateral positions

Measurements with the Keyence imaging machine at Manchester suggested that some boards had tooth strips misplaced by more than the 200 μm tolerance

- The worst out by a little over 300 μm

This should be visible by eye when lined up with an in-tolerance board

8760026 Board From W&M (UK ID:20784) 22/07/2024				
S/N	Dimension in Model	Measured Dimension	Difference (mm)	Position
Top Board Part				
1	280.9	281.028	0.128	edge
2	277.165	277.062	0.103	core
3	133.165	133.115	0.05	core
4	14.7	14.721	0.021	edge
5	10.835	10.874	0.039	core
Middle Board Part				
6	60.3	60.431	0.131	core
7	60.3	60.391	0.091	core
8	60.3	60.39	0.09	core
9	60.3	60.382	0.082	core
10	60.3	60.386	0.086	core
11	60.3	60.396	0.096	core
Bottom Board Part				
12	13.265	12.907	0.358	core
13	130.735	131.048	0.313	core
14	274.735	275.037	0.302	core
15	278.6	278.741	0.141	edge
16	17	16.993	0.007	edge

Visual inspections

- We used the board with UK ID 24721 as the comparison board, as the Keyence measurements showed this tooth strip to be well aligned
- The comparison board is then aligned on top of this

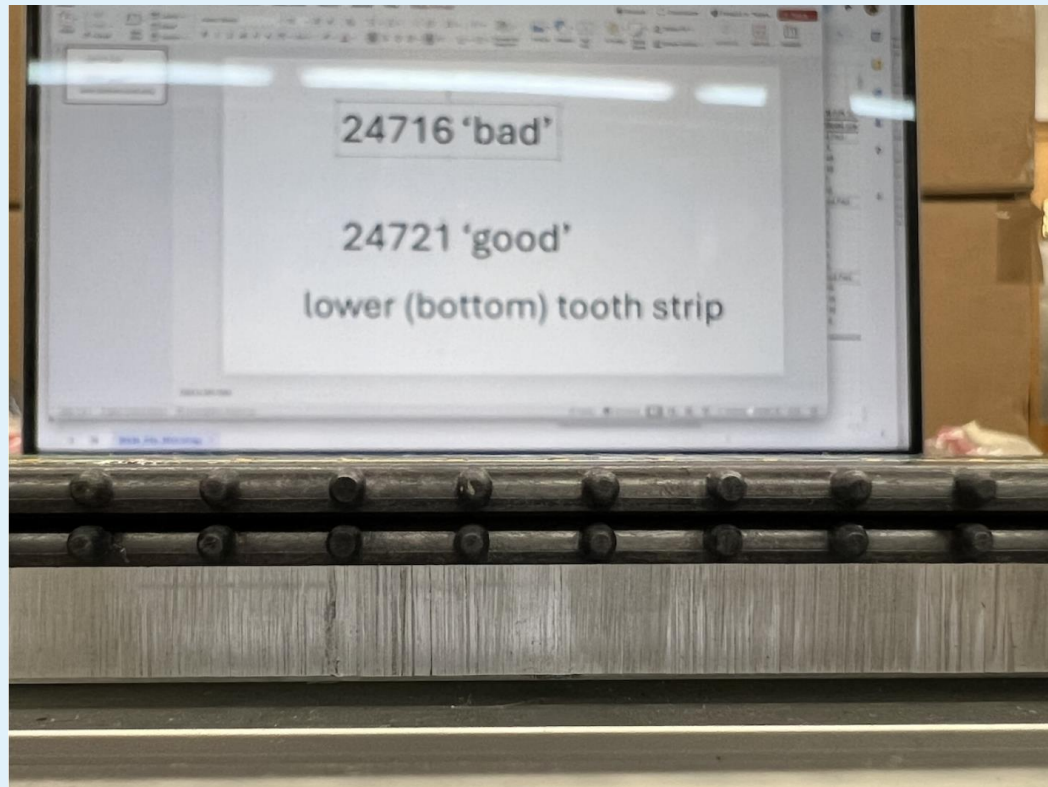


Visual inspections

This is an example of a 'bad' board

- UK ID 24716, showing the 'bottom' tooth strip
- Shifted slightly to the right

In all cases, Justin didn't tell Hamza what to expect, and in all cases Hamza was able to identify a shift consistent with that seen by the Keyence



8760026 Board From W&M (UK ID:24716) 22/07/2024				
S/N	Insion in Model	ured Dimension	Difference (mm)	Position
Top Board Part				
1	280.9	281.067	0.167	edge
2	277.165	276.887	0.278	core
3	133.165	132.908	0.257	core
4	14.7	14.71	0.01	edge
5	10.835	11.075	0.24	core
Middle Board Part				
6	60.3	60.423	0.123	core
7	60.3	60.433	0.133	core
8	60.3	60.408	0.108	core
9	60.3	60.307	0.007	core
10	60.3	60.367	0.067	core
11	60.3	60.43	0.13	core
Bottom Board Part				
12	13.265	13.044	0.221	core
13	130.735	130.971	0.236	core
14	274.735	274.953	0.218	core
15	278.6	278.755	0.155	edge
16	17	17.143	0.143	edge

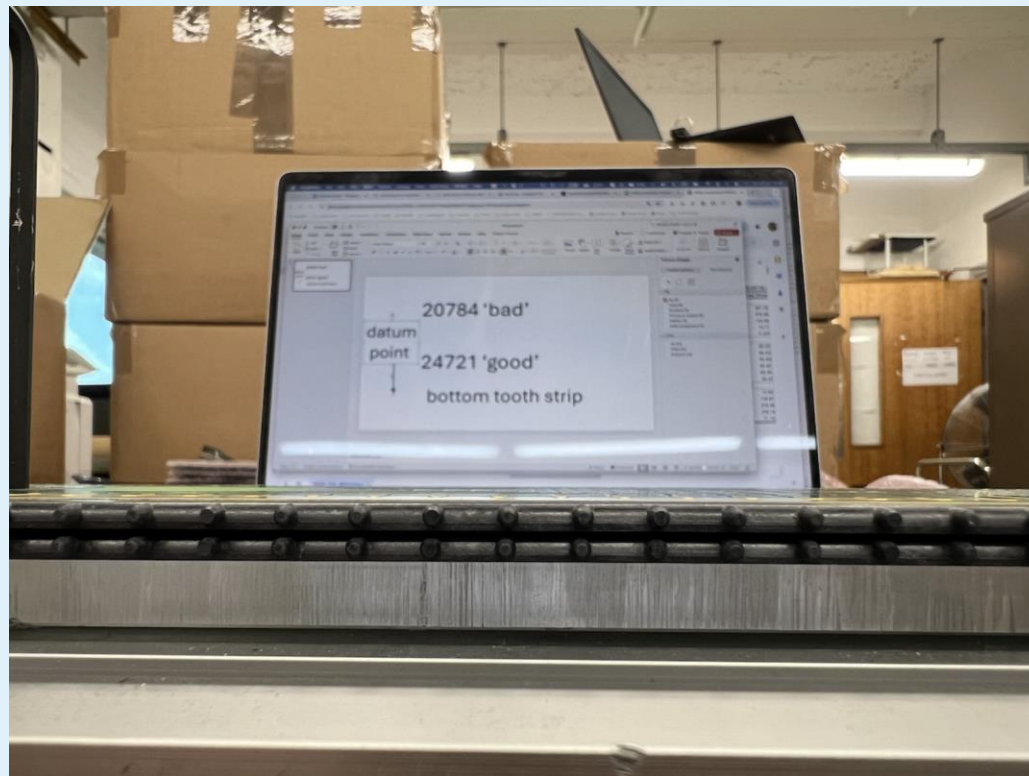
Visual inspections

Another example of a 'bad' board

- UK ID 20786, showing the 'bottom' tooth strip
- Shifted slightly to the right

8760026 Board From W&M (UK ID:20784) 22/07/2024

S/N	Dimension in Model	Measured Dimension	Difference (mm)	Position
Top Board Part				
1	280.9	281.028	0.128	edge
2	277.165	277.062	0.103	core
3	133.165	133.115	0.05	core
4	14.7	14.721	0.021	edge
5	10.835	10.874	0.039	core
Middle Board Part				
6	60.3	60.431	0.131	core
7	60.3	60.391	0.091	core
8	60.3	60.39	0.09	core
9	60.3	60.382	0.082	core
10	60.3	60.386	0.086	core
11	60.3	60.396	0.096	core
Bottom Board Part				
12	13.265	12.907	0.358	core
13	130.735	131.048	0.313	core
14	274.735	275.037	0.302	core
15	278.6	278.741	0.141	edge
16	17	16.993	0.007	edge



Visual inspections

An example of a good board

- UK ID 24723, showing the 'bottom' tooth strip
- No visible offset

8760026 Board From W&M (UK ID:24723) 22/07/2024				
S/N	Dimension in Model	Measured Dimension	Difference (mm)	Position
Top Board Part				
1	280.9	280.926	0.026	edge
2	277.165	277.253	0.088	core
3	133.165	133.271	0.106	core
4	14.7	14.825	0.125	edge
5	10.835	10.706	0.129	core
Middle Board Part				
6	60.3	60.373	0.073	core
7	60.3	60.372	0.072	core
8	60.3	60.349	0.049	core
9	60.3	60.353	0.053	core
10	60.3	60.336	0.036	core
11	60.3	60.378	0.078	core
Bottom Board Part				
12	13.265	13.305	0.04	core
13	130.735	130.825	0.09	core
14	274.735	274.794	0.059	core
15	278.6	278.644	0.044	edge
16	17	17.091	0.091	edge

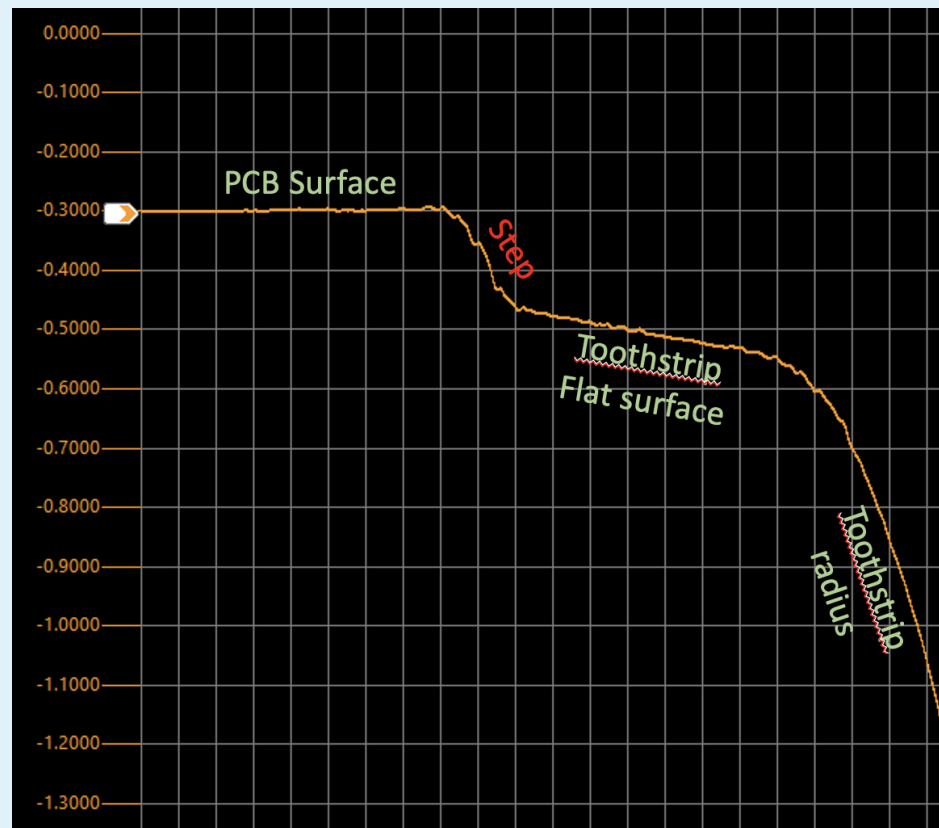


Tooth strip lateral positions

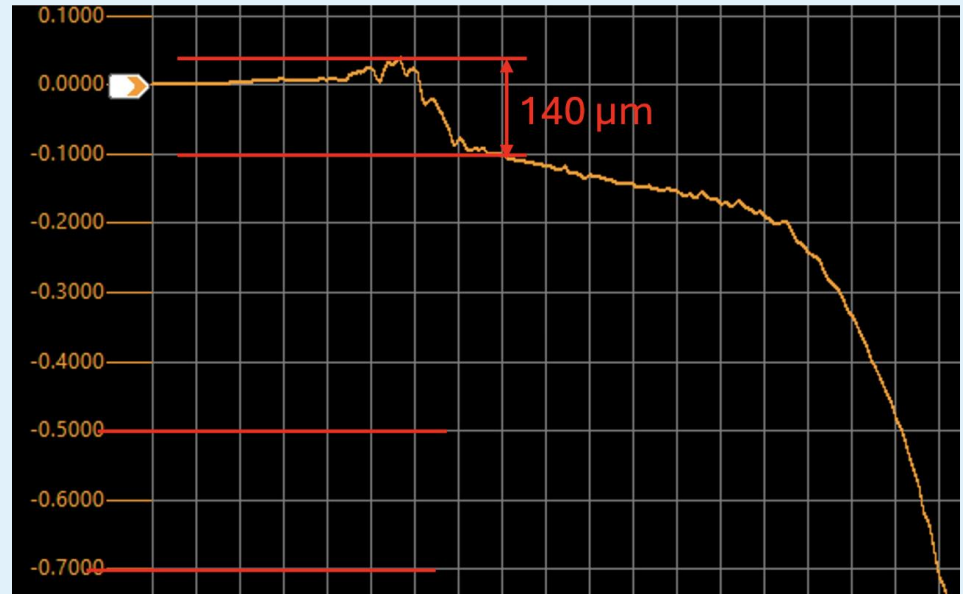
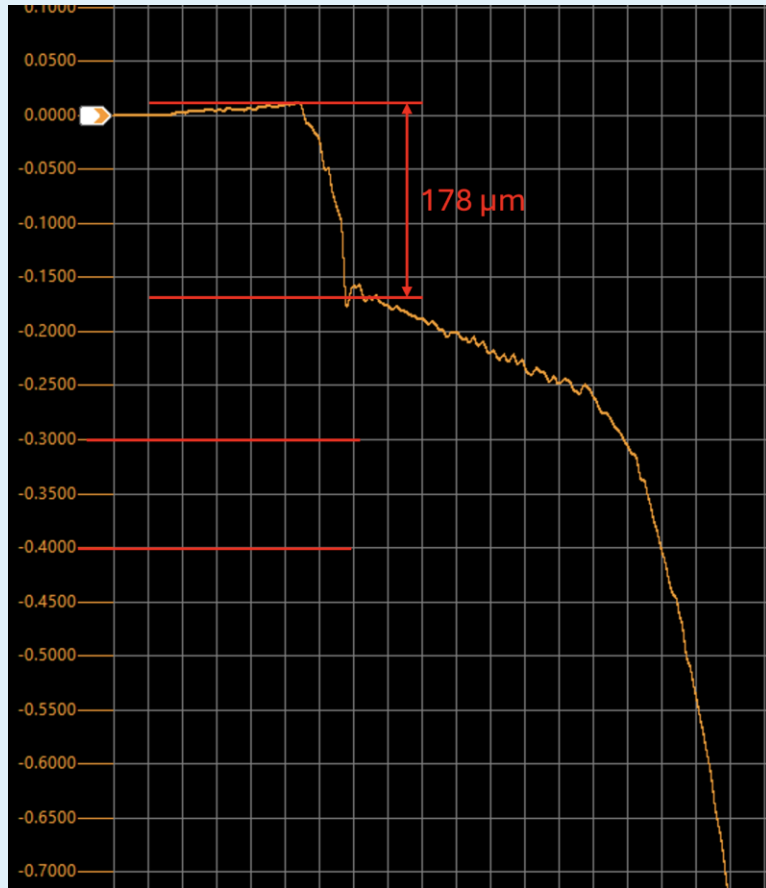
- We looked at five W&M boards
- In all cases we could visually confirm the Keyence measurements, seeing any out-of-tolerance offsets of tooth strips
- The W&M team have narrowed this down to a misalignment of the positioning lugs on one side of one jig
- PSL have a Keyence device on which they can reproduce these QC measurements

Steps between PCBs and tooth strips

- W&M measurements showed all steps between tooth strips and PCBs to be less than 200 μm
- Sheffield rejected the majority of the boards for having steps greater than 200 μm
- We have used the confocal displacement sensor (1 μm precision) to scan this step on three boards



Examples of scans (board 18282)



Summary of results

Typically the dial indicator overestimates the size of the step with respect to the laser scan by some tens of μs

- The laser scan would have passed board 18282, failed board 20715, and would 'just' have failed 23392

All measurements in μm						
UK ID 18282						
Bottom (FHSCS) side						
Sheffield	215	220	230	220	155	85
Manchester	170		133		110	
Δ	48		92		10	
Top (KCL) side						
Sheffield	210	190	210	145	230	200
Manchester	178		140		155	
Δ	22		38		60	
UK ID 20715						
Bottom (Sleeve) side						
Sheffield	270	250	105	240	280	160
Manchester	229		122		265	
Δ	31		51		-45	
Top (BHSCS) side						
Sheffield	150	175	95	60	200	260
Manchester	150		31		225	
Δ	13		47		5	
UK ID 23392						
Bottom (Sleeve) side						
Sheffield	275	310	200	195	265	160
Manchester	226		122		184	
Δ	67		76		29	
Top (BHSCS) side						
Sheffield	225	195	150	145	180	220
Manchester	189		100		189	
Δ	21		48		11	