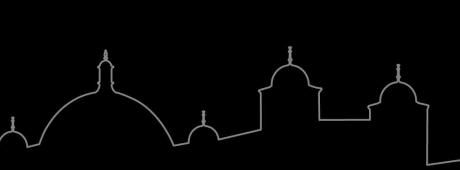


Wire bonding to LTU FPCs

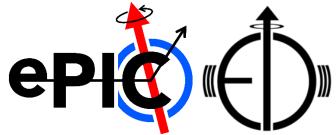
James Glover

EIC-UK WP1 (MAPS) meeting

Wed, 21st May 2025



Wire bond samples



FDI-A-24

We received samples from LTU to trial wire wire bonding (and perform pull tests on).

Cover layer (insulating)

Glue ~5um

Top Layer (signals)

Glue ~5um

FDI-A-24

Pi 10um

Fi 10

Samples also share with Liverpool for these trials. Spacer

Single Al foil layer: LTU-15-10

Dual Al foil layers: LTU-15-10 + 25µmKapton + LTU-15-10



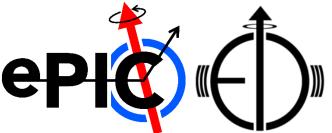
Initial findings from Liverpool were <u>reported</u> at the last <u>Electrical Interfaces Meeting</u>.

Bottom (GND)



Mounting options

No samples have been cleaned for these tests

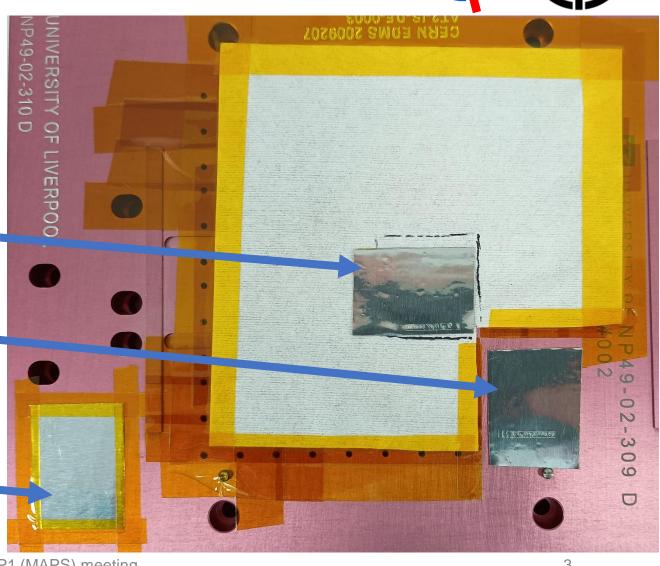


Focussed on Dual Al foil layers $(LTU-15-10 + 25\mu mKapton +$ LTU-15-10) for 1st trials.

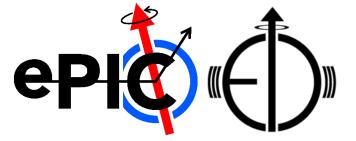
3 mounting options considered:

- Vacuumed with a diffuser.
- Vacuumed directly to jig (naked).
- Taped flat.





Material considerations



<u>Liverpool showed</u> that wire bonding onto this Al foils behaves very differently that to a standard PCB/silicon chip.

- Had to adjust bond parameters just to get wire to weld.
- Even then results were inconsistent.
- However, did show that good welds can occur.

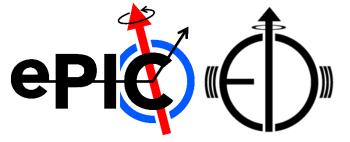
PCBs (typically) have thin metallisation on thick (FR4) substrate. ASICs (typically) have thin metallisation on silicon substrate.

- The metallisation can be similar to that on these foils (~15 µm AI).
- The substrate are very rigid* compared to these foils (<50 µm Kapton).



* For silicon >100 µm thick.

Soft substrates



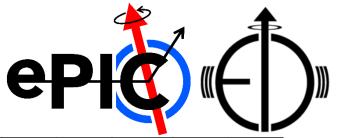
Had to rethink the bond parameters due to these more flexible substrates. Many parameters are optimised for rigid substrates(with soft wire):

- Touchdown force (cN) how much resistance the tool receives to known it has made contact.
- Overtravel (µm) how far the tool is pushed into the substrate after making contact.
- Bond force (cN) how much extra the tool pushes while welding.
- Deformation (%) how much the wire should change before welding is complete.

How much is one compacting the substrate, rather than the wire?



No samples have been cleaned for these tests



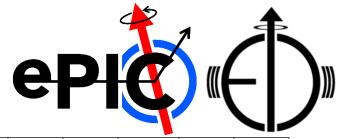
Initial settings (standard PCB) fail to get successful welds.

Lowering TF+BF, while increasing Def had little effect.



TF (cN)	Def (%)	BF (cN)	US (%)	S_OT (µm)	D_OT (µm)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Mean (g)	SD (g)	# of S_b(1)	# of D_b(2)	# of Span(3)	# of S_p(4)	# of D_p(5)
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	35	20	20	50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	50	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	9	6.99	1.80	0	0	0	5	4
16	50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
									Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
									Taped	8	4.74	1.18	0	0	0	8	0
14	50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
									Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
									Taped	9	13.30	1.38	0	0	0	6	3
14	50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
									Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
									Taped	8	11.21	1.75	1	2	3	0	2
14	50	16	24	25	25	45	Heraeus	w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
									Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
									Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
									Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
									Taped	10	9.65	1.37	9	0	0	0	1
14	50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
									Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
									Taped	10	10.73	2.18	2	1	1	0	6
14	50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)	10	11.57	1.74	9	1	0	0	0
									Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
									Taped	10							
14	50	16	24	13	13	45	CCC	w. grain	Vac'd (naked)	9	10.40	1.88	8	1	0	0	0
									Vac'd (diff)	10	9.95	2.27	6	0	0	4	0

No samples have been cleaned for these tests

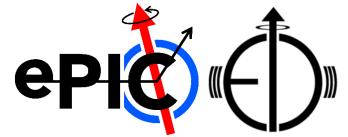


Additionally increasing US stated to get somewhere.

TF (cN)	Def (%)	BF (cN)	US (%)	S_OT (µm)	D_OT (µm)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Mean (g)	SD (g)	# of S_b(1)	# of D_b(2)	# of Span(3)	# of S_p(4)	# of D_p(5)
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	35	20	20	50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	50	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	9	6.99	1.80	0	0	0	5	4
16	50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
									Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
									Taped	8	4.74	1.18	0	0	0	8	0
14	50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
									Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
									Taped	9	13.30	1.38	0	0	0	6	3
14	50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
									Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
									Taped	8	11.21	1.75	1	2	3	0	2
14	50	16	24	25	25	45	Heraeus	w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
									Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
									Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
									Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
									Taped	10	9.65	1.37	9	0	0	0	1
14	50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
									Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
		40		45	45	45	000		Taped	10	10.73	2.18	2	1	1	0	6
14	50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)	10	11.57	1.74	9	1	0	0	0
									Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
		40		40	40	45	000		Taped	10							
14	50	16	24	13	13	45	CCC	w. grain	Vac'd (naked)		10.40	1.88	8	1	0	0	0
									Vac'd (diff)	10	9.95	2.27	6	0	0	4	0



No samples have been cleaned for these tests



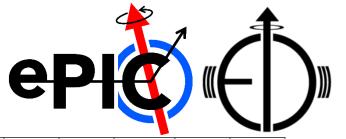
Bonds were done in small groups (of 10 wires).

of successful wires bonded was a good initial indicator.



TF (cl	I) Def (%)	BF (cN)	US (%)	S_OT (µm)	D_OT (µm)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Mean (g)	SD (g)	# of S_b(1)	# of D_b(2)	# of Span(3)	# of S_p(4)	# of D_p(5)
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	35	20	20	50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	50	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	9	6.99	1.80	0	0	0	5	4
16	50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
									Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
									Taped	8	4.74	1.18	0	0	0	8	0
14	50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
									Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
									Taped	9	13.30	1.38	0	0	0	6	3
14	50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
									Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
						45	Heraeus		Taped	8	11.21	1.75	1	2	3	0	2
14	50	16	24	25	25			w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
									Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
									Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
									Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
									Taped	10	9.65	1.37	9	0	0	0	1
14	50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
									Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
									Taped	10	10.73	2.18	2	1	1	0	6
14	50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)	10	11.57	1.74	9	1	0	0	0
									Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
									Taped	10							
14	50	16	24	13	13	45	CCC	w. grain	Vac'd (naked)	9	10.40	1.88	8	1	0	0	0
									Vac'd (diff)	10	9.95	2.27	6	0	0	4	0

No samples have been cleaned for these tests

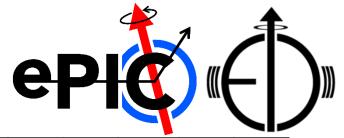


Reducing the (source) overtravel had a large effect!

TF (cN)	Def (%)	BF (cN)	US (%)	S_OT (µm)	D_OT (µm)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Mean (g)	SD (g)	# of S_b(1)	# of D_b(2)	# of Span(3)	# of S_p(4)	# of D_p(5)
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	35	20	20	50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	50	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	9	6.99	1.80	0	0	0	5	4
16	50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
									Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
									Taped	8	4.74	1.18	0	0	0	8	0
14	50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
									Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
									Taped	9	13.30	1.38	0	0	0	6	3
14	50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
									Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
									Taped	8	11.21	1.75	1	2	3	0	2
14	50	16	24	25	25	45	Heraeus	w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
									Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
									Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
									Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
									Taped	10	9.65	1.37	9	0	0	0	1
14	50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
									Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
	50	40		45	45	45	000		Taped	10	10.73	2.18	2	1	1	0	6
14	50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)	10	11.57	1.74	9	1 -	0	0	0
									Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
1	50	40	0.4	40	40	45	000		Taped	10	40.46	4.00					
14	50	16	24	13	13	45	CCC	w. grain	Vac'd (naked)	9	10.40	1.88	8	1	0	0	0
									Vac'd (diff)	10	9.95	2.27	6	0	0	4	0



No samples have been cleaned for these tests

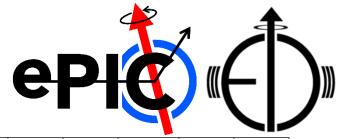


Turning overtravel down as far as the bon machine would allow (without bond errors), seemed to the way to go.



35 50	20	20	S_OT (µm)	υ_Ο1 (μm)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Mean (g)	SD (g)	# OT 5 D(1)	# OT 13 D(2)	# of Span(3)	# of S_p(4)	# of D_p(5)
	20	20														
	20	20		0.5	00	000		Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50			50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50								Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50								Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
								Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
								Taped	9	6.99	1.80	0	0	0	5	4
50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
								Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
								Taped	8	4.74	1.18	0	0	0	8	0
50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
								Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
								Taped	9	13.30	1.38	0	0	0	6	3
50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
								Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
								Taped	8	11.21	1.75	1	2	3	0	2
50	16	24	25	25	45	Heraeus	w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
								Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
								Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
								Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
								Taped	10	9.65	1.37	9	0	0	0	1
50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
								Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
								Taped	10	10.73	2.18	2	1	1	0	6
50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)	10	11.57	1.74	9	1	0	0	0
								Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
								Taped	10							
50	16	24	13	13	45	CCC	w. grain	Vac'd (naked)	9	10.40	1.88	8	1	0	0	0
								` ′					0	0	4	0
	50 50 50 50	50 16 50 16 50 16 50 16 50 16 50 16	50 16 24 50 16 24 50 16 24 50 16 24 50 16 24 50 16 24 50 16 24	50 16 24 50 50 16 24 25 50 16 24 25 50 16 24 25 50 16 24 25 50 16 24 25 50 16 24 15	50 16 24 50 25 50 16 24 25 25 50 16 24 25 25 50 16 24 25 25 50 16 24 25 25 50 16 24 25 25 50 16 24 15 15	50 16 24 50 25 90 50 16 24 25 25 90 50 16 24 25 25 45 50 16 24 25 25 90 50 16 24 25 25 90 50 16 24 25 25 45 50 16 24 25 25 45	50 16 24 50 25 90 CCC 50 16 24 25 25 90 CCC 50 16 24 25 25 45 Heraeus 50 16 24 25 25 90 Heraeus 50 16 24 25 25 45 CCC 50 16 24 25 25 45 CCC 50 16 24 15 15 45 CCC	50 16 24 50 25 90 CCC w. grain 50 16 24 25 25 90 CCC w. grain 50 16 24 25 25 45 Heraeus w. grain 50 16 24 25 25 90 Heraeus w. grain 50 16 24 25 25 45 CCC w. grain 50 16 24 25 25 45 CCC w. grain	Taped Vac'd (naked) Vac'd (ldiff) Taped Vac'd (laked) Vac	Taped 9 So 18 24 50 25 90 CCC w. grain Vac'd (naked) 3 Vac'd (diff) 4 Taped 8 Vac'd (naked) 3 Vac'd (diff) 4 Taped 8 Vac'd (naked) 3 Vac'd (naked) 3 Vac'd (diff) 9 Taped 9 Vac'd (naked) 7 Vac'd (naked) 7 Vac'd (naked) 7 Vac'd (naked) 10 Vac'd (naked) 10	Taped 9 6.99 6.99 50 18 24 50 25 90 CCC w. grain Vac'd (naked) 3 4.94 4 5.48 7 50 16 24 50 25 90 CCC w. grain Vac'd (naked) 3 6.44 6.44 7 6.00 6.00 7 7 7 7 7 7 7 7 7	Taped 9 6.99 1.80 1.	Taped 9 6.99 1.80 0 0 0 0 0 0 0 0 0	Taped Part Taped Part Taped Part Part	Taped Part Part	Taped Second Taped Second Second Taped Second Seco

No samples have been cleaned for these tests



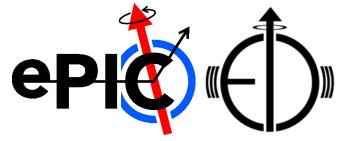
In general, minimal difference between the mounting variations.

"Taped", noticeably lifted during pull tests.

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TF (cN)	Dof (9/)	BF (cN)	116 (0/)	S OT (µm)	D. OT (1177)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Moon (=)	SD (g)	# of C b/4\	# of D b/2\	# of Span(3)	# of C p/4\	# of D n/5
IF (CN)	Def (%)	BF (CN)	05 (%)	5_U1 (µm)	υ_Ο1 (μm)	LeaveAng (*)	wire	Direction			Mean (g)						
4.0	0.5	00	00		0.5	0.0	000		Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	35	20	20	50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	50	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
									Taped	9	6.99	1.80	0	0	0	5	4
16	50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
									Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
									Taped	8	4.74	1.18	0	0	0	8	0
14	50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
									Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
									Taped	9	13.30	1.38	0	0	0	6	3
14	50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
									Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
									Taped	8	11.21	1.75	1	2	3	0	2
14	50	16	24	25	25	45	Heraeus	w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
									Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
									Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
									Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
									Taped	10	9.65	1.37	9	0	0	0	1
14	50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
								· ·	Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
									Taped	10	10.73	2.18	2	1	1	0	6
14	50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)		11.57	1.74	9	1	0	0	0
								3 -	Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
									Taped	10	10.02		10				
14	50	16	24	13	13	45	CCC	w. grain	Vac'd (naked)	9	10.40	1.88	8	1	0	0	0
		"				"	000	W. grant	Vac'd (flaked) Vac'd (diff)	10	9.95	2.27	6	0	0	4	0
				<u> </u>					vacu (uili)	10	3.30	2.21					

Reasons for the changes



If the tool pushes too hard, it risks piercing the foil or damaging the Kapton insulating the aluminium layers, therefore:

- Minimise touchdown force (TF).
- Minimise bond force (BF).
- Minimise overtravel (OT).

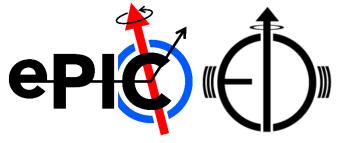
The foil (\sim 15 µm) is thinner than the wire diameter (25 µm), it could melt at a similar point to (or before) the wire, so:

 Increase deformation (Def), to account for deformation of the foil (and not just the wire).



Summary

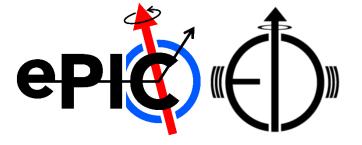
No samples have been cleaned for these tests



- Further studies on wire bonding to the aluminium foils from LTU have occurred.
- We are seeing some good indications and are determining parameters to focus on for optimising the welds.
- Parameters are not there yet but should be a good starting point.
 - Expecting that the support structure will also play a big part (bonding on a thick aluminium vacuum jig).
 - Noticed some difference with the bonds on the diffused vacuum sample.
 The clean room paper gave some cushioning and needed more
 overtravel (14 µm) than the others (13 µm) when very low.



Added bonus – spTAB update



- We have an additional jig from Oxford (thanks)!
 - This version is designed to be James-proof (FPC only fits in the correct orientation).
- We also have the updated PCBs from Andy (thanks)!

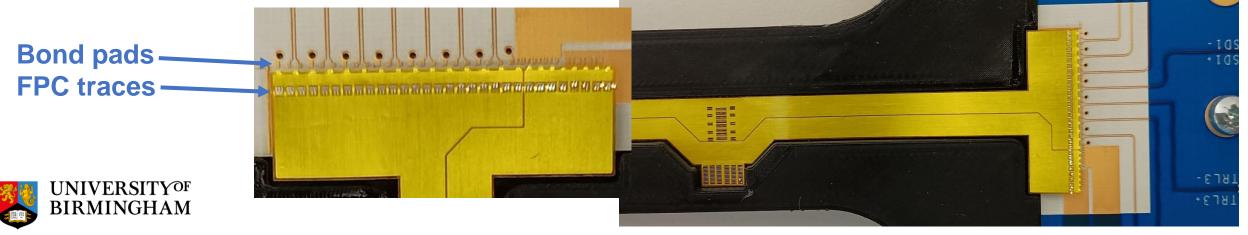
 Now with the the solder resist removed under the FPC to minimise the height different between the aluminium layers of the FPC and the pads

of the PCB.

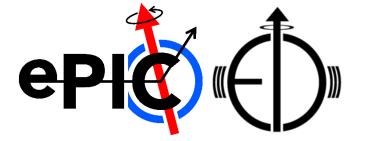


Oxford jig

- Upon inspection, this jig does not have the cut-outs for the B-FPC alignment tabs.
 - Can be solved by cutting off tabs (can only used for FPC for the M-FPC data transmission tests).
- PCB (for the wider, Power/Data IN side) sits too far out and bond pads do not align with the FPC's traces.



Summary - 2



The Oxford jig (in its current form) is not suitable.

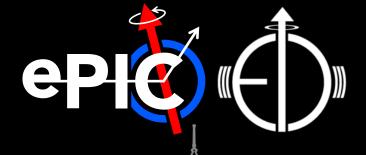
- We are looking to modify the designs.
- Fallback would be to return to the previous Birmingham jig.

Considerations for mounting and bond the 2nd version of the M-FPC is ongoing. Considerations between:

- Bonding while FPC is held by a weight only (and holding with a bead of glue, around edges, after bonding).
- Holding FPC with glue dots for bonding (and adding more glue afterwards).

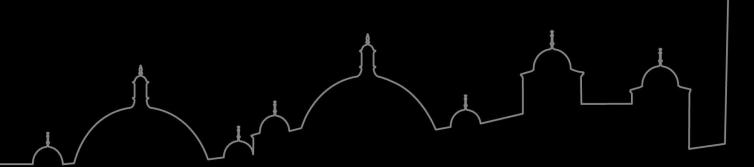




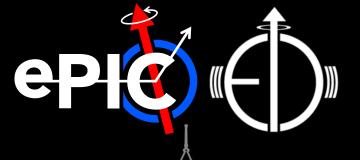


Thank you very much!

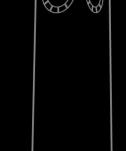
Any questions?



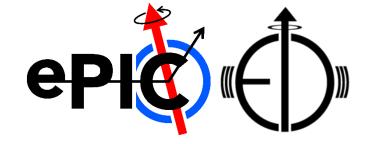




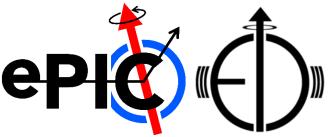
Additional (support) slides



Spreadsheet definitions



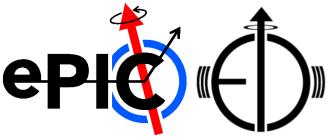
```
TF= Touchdown Force (cN)
           Def= Deformation (%)
           BF= Bond Force (cN)
           US= Ultrasonic Power (%)
        S_OT= Source Overtravel (µm)
        D_OT= Destination Overtravel (µm)
   LeaveAng= Leave Angle (°), 90° = perpendicular to surface
     Heraeus = Hersaeus AlSi-M, Aluminiun+1%Silicon wire (medium strength), 25 µm, >1% elongation, 15-17cN Breaking Load (installed to
              the Right-hand wire bonder in BILPA)
         CCC= Custom Chip Connections CC-250, Aluminiun+1%Silicon wire (medium strength), 25 µm, 1-4% elongation, 15-18g Tear
              Strength (installed to the Left-hand wire bonder in BILPA)
      w. grain = With the grain of the Al foil
      a. grain = Against the grain of the Al foil
        Taped= Foil taped down (all 4 sides) to chuck.
Vac'd (naked) = Foil vacuumed to chuck, nothing in between chuck and foil.
   Vac'd (diff)= Foil vacuumed to chuck, with clean room paper as a diffuser between chuck and foil.
          #/10= # of pullable wires, out of a maximum of 10 wire attempts
   # of S_b(1)= # of Source heel breaks (failure mode: "1")
  # of D_b(2)= # of Destination heel breaks (failure mode: "2")
 # of Span(3) = # of Span breaks, centre of wire snaps (failure mode: "3")
   # of S_p(4)= # of Source peels (failure mode: "4")
  # of D p(5)= # of Destination peels (failure mode: "5")
```



The standard deviation is still higher than preferred.

Γ	TF (cN)	Def (%)	BF (cN)	US (%)	S_OT (µm)	D_OT (µm)	LeaveAng (°)	Wire	Direction	Mounting	#/10	Mean (g)	SD (g)	# of S_b(1)	# of D_b(2)	# of Span(3)	# of S_p(4)	# of D_p(5)
Ī										Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18	35	20	20	50	25	90	CCC	w. grain	Vac'd (naked)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
										Vac'd (diff)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
										Taped	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	16	50	18	20	50	25	90	CCC	w. grain	Vac'd (naked)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
										Vac'd (diff)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
										Taped	9	6.99	1.80	0	0	0	5	4
	16	50	18	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	4.94	0.80	0	0	0	3	0
										Vac'd (diff)	4	5.48	0.98	0	0	0	4	0
										Taped	8	4.74	1.18	0	0	0	8	0
	14	50	16	24	50	25	90	CCC	w. grain	Vac'd (naked)	3	6.44	0.86	0	0	0	3	0
L										Vac'd (diff)	9	6.00	1.91	0	0	0	9	0
										Taped	9	13.30	1.38	0	0	0	6	3
	14	50	16	24	25	25	90	CCC	w. grain	Vac'd (naked)	9	14.37	1.68	0	0	0	6	3
										Vac'd (diff)	10	13.12	1.76	0	0	0	3	7
										Taped	8	11.21	1.75	1	2	3	0	2
	14	50	16	24	25	25	45	Heraeus	w. grain	Vac'd (naked)	9	13.22	1.37	2	2	3	0	2
L										Vac'd (diff)	4	9.61	0.32	0	0	0	4	0
										Taped	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	14	50	16	24	25	25	90	Heraeus	w. grain	Vac'd (naked)	7	13.45	0.87	3	0	2	2	0
-										Vac'd (diff)	8	11.44	2.18	4	1	1	2	0
		50	40	0.4	0.5	0.5	45	000		Taped	10	9.65	1.37	9	0	0	0	1
	14	50	16	24	25	25	45	CCC	w. grain	Vac'd (naked)	10	11.93	0.72	8	0	0	1	1
-										Vac'd (diff)	9	10.70	1.82	8	0	1	0	0
	14	50	16	24	15	15	45	CCC		Taped	10	10.73	2.18	2	1	1	0	6
	14	50	16	24	15	15	45	CCC	w. grain	Vac'd (naked)		11.57	1.74	9	1	0	0	0
-										Vac'd (diff)	10	10.02	2.41	10	0	0	0	0
	14	50	16	24	13	13	45	ccc	w groin	Taped	10	10.40	1.88					
	14	50	10		13	13	45	CCC	w. grain	Vac'd (naked)	9	10.40 9.95	1.88 2.27	8	1	0	0 4	0
										Vac'd (diff)	10	9.95	2.27	6	0	1 0	4	0

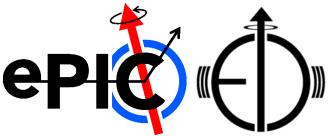




Some trials performed on a different bond machine, with different wire for comparison.

Def (%) BF (cN) US (%) S_OT (μm) D_OT (μm) LeaveAng (°) Mean (g) | SD (g) | # of S_b(1) | # of D_b(2) | # of Span(3) | # of S_p(4) | # of D_p(5) Wire Direction Mounting Taped 35 25 90 CCC 20 20 50 w. grain Vac'd (naked) N/A N/A N/A N/A N/A N/A 0 N/A N/A N/A N/A Vac'd (diff) N/A N/A N/A N/A N/A N/A N/A N/A N/A Taped N/A 50 18 20 25 90 CCC N/A w. grain Vac'd (naked N/A Vac'd (diff) 1.80 Taped 6.99 0 0 18 24 25 90 CCC 4.94 0.80 0 0 3 0 w. grain Vac'd (naked) Vac'd (diff) 5.48 0.98 0 0 0 4.74 1.18 0 Taped 90 14 50 16 24 25 CCC 3 0.86 0 0 3 0 w. grain Vac'd (naked) 6.44 6.00 0 0 Vac'd (diff) 1.38 0 0 Taped 13.30 14 50 16 24 25 25 90 CCC w. grain Vac'd (naked) 14.37 1.68 0 0 6 3 10 13.12 1.76 0 Vac'd (diff) 1.75 11.21 Taped 50 24 25 25 45 1.37 Heraeus w. grain 13.22 Vac'd (naked 0 0 9.61 0.32 0 Vac'd (diff) N/A Taped N/A N/A N/A N/A N/A N/A N/A 50 24 25 90 0.87 Heraeus w. grain Vac'd (naked 13.45 8 11.44 2.18 0 Vac'd (diff) 10 9.65 1.37 9 0 0 Taped 45 CCC 50 16 24 25 Vac'd (naked) 10 11.93 0.72 8 0 1 9 10.70 1.82 0 0 Vac'd (diff) 10 10.73 2.18 1 0 Taped 14 50 16 24 15 15 45 CCC Vac'd (naked) 11.57 1.74 0 Vac'd (diff) 10 10.02 2.41 10 0 0 0 10 Taped 50 45 CCC 14 16 24 13 13 Vac'd (naked) 10.40 1.88 8 0 0 0 Vac'd (diff) 10 9.95 2.27 0 0





Seeing any wire span breaks is impressive.

Def (%) BF (cN) US (%) S_OT (μm) D_OT (μm) LeaveAng (°) Mean (g) SD (g) # of S_b(1) # of D_b(2) # of Span(3 # of S_p(4) # of D_p(5) Wire Direction Mounting Taped 35 25 90 CCC N/A N/A 20 20 50 w. grain Vac'd (naked) 0 N/A N/A N/A N/A 0 N/A N/A N/A N/A N/A Vac'd (diff) N/A N/A N/A N/A N/A N/A N/A Taped N/A 16 50 18 20 50 25 90 CCC N/A N/A w. grain Vac'd (naked) N/A Vac'd (diff) 0 1.80 Taped 6.99 0 50 18 24 50 25 90 CCC 3 4.94 0.80 0 0 0 3 0 w. grain Vac'd (naked) 0 Vac'd (diff) 5.48 0.98 0 0 4.74 1.18 0 Taped 90 50 16 24 25 CCC 3 0.86 0 0 0 3 0 w. grain Vac'd (naked) 6.44 9 0 6.00 1.91 0 0 Vac'd (diff) 0 1.38 0 Taped 13.30 90 50 16 24 25 25 CCC w. grain Vac'd (naked) 14.37 1.68 0 0 0 6 3 10 13.12 1.76 0 0 Vac'd (diff) 3 11.21 1.75 0 Taped 50 24 45 14 16 25 25 Heraeus w. grain 13.22 1.37 2 2 3 0 2 Vac'd (naked) 4 9.61 0.32 0 0 0 0 Vac'd (diff) N/A N/A N/A N/A N/A N/A Taped N/A 14 50 16 24 25 25 90 Heraeus w. grain Vac'd (naked) 13.45 0.87 3 2 8 11.44 2.18 0 Vac'd (diff) 10 1.37 0 0 Taped 9.65 45 CCC 0 14 50 16 24 25 Vac'd (naked) 10 11.93 0.72 8 9 10.70 1.82 8 1 0 Vac'd (diff) 10 10.73 2.18 1 0 Taped 14 50 16 24 15 15 45 CCC 0 Vac'd (naked) 11.57 1.74 10 10.02 2.41 10 0 0 0 Vac'd (diff) 10 Taped 50 45 CCC 14 16 24 13 13 0 Vac'd (naked) 10.40 1.88 8 0 0 Vac'd (diff) 10 9.95 2.27 0 0



Prior to cutting B-FPC tabs

