

Temperature sensors on APAs

A. Cervera

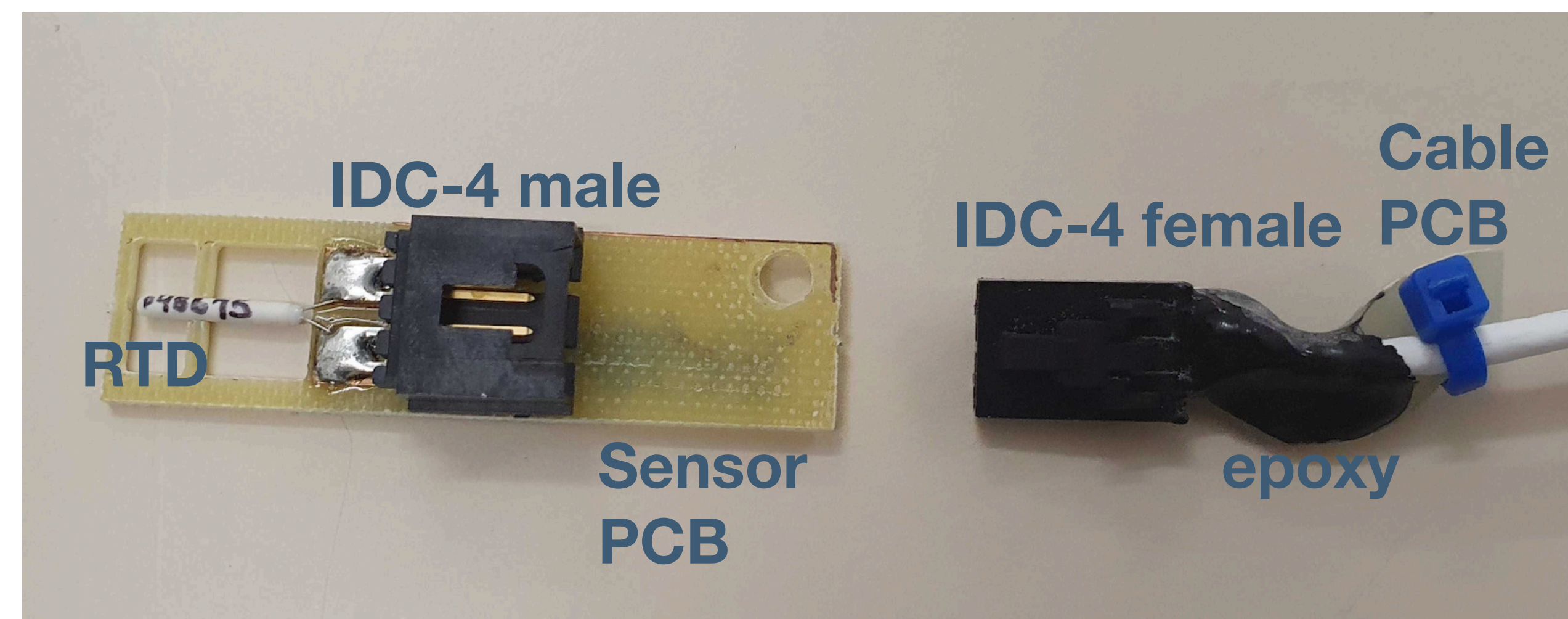
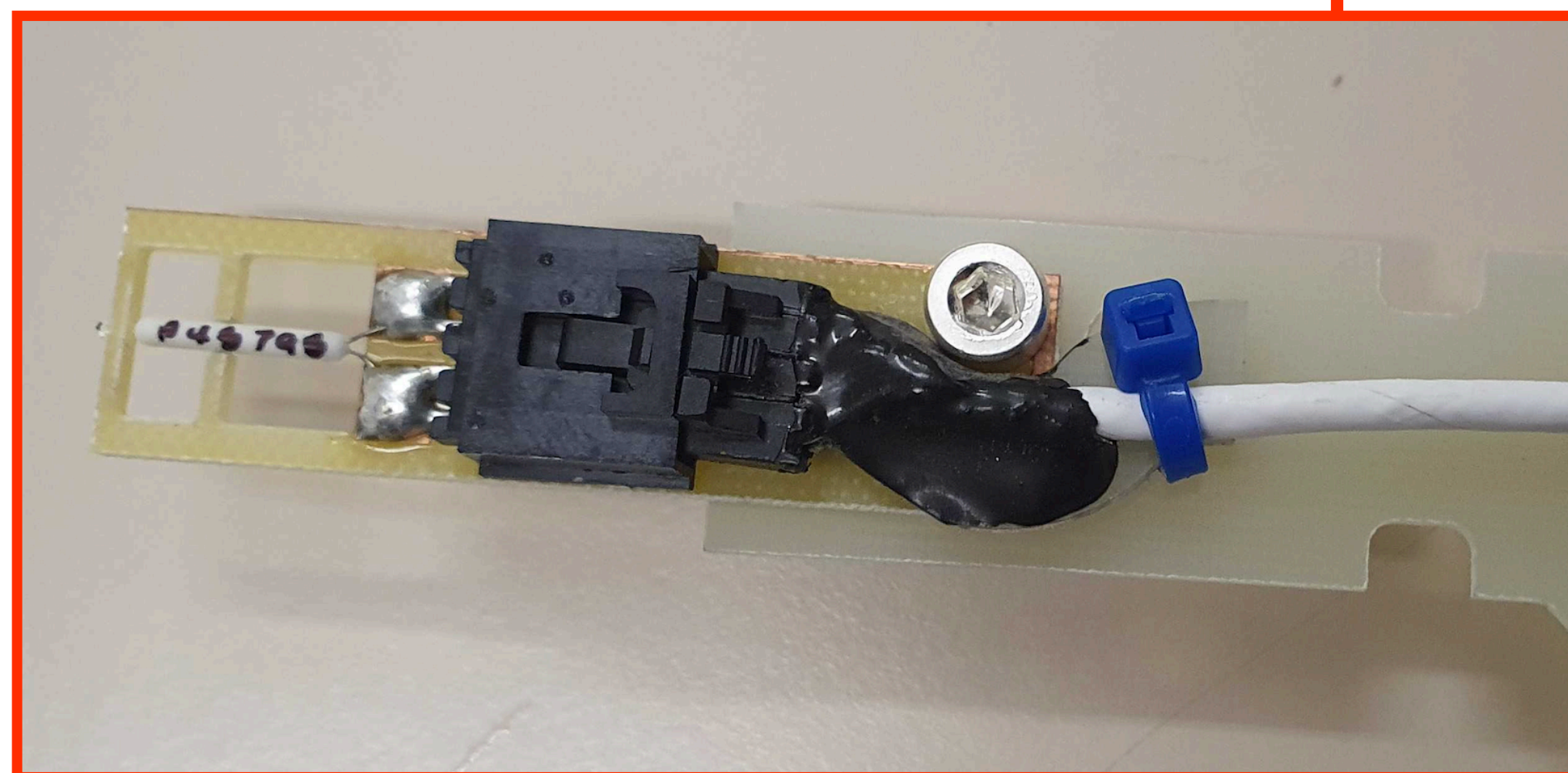
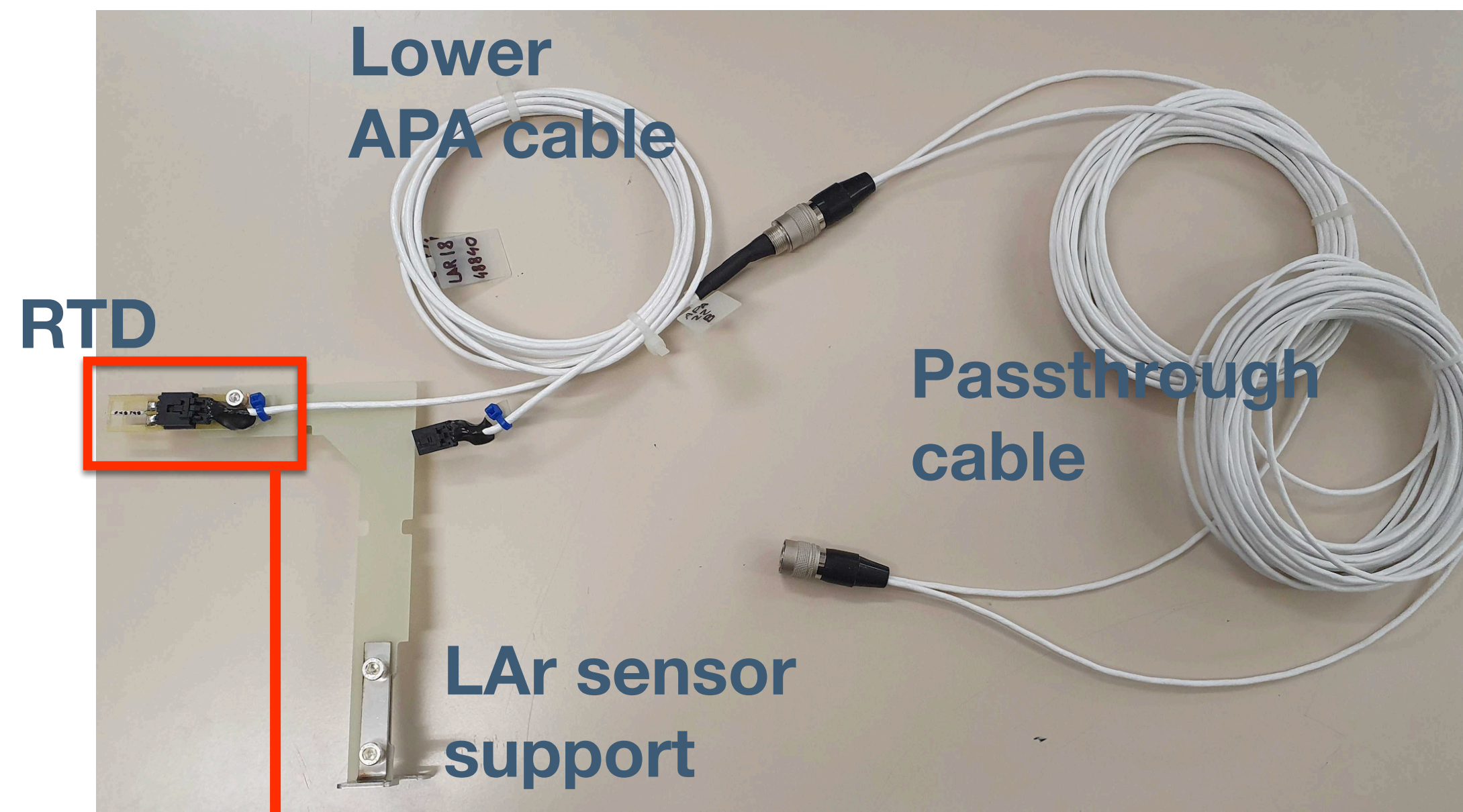
J. Capo

IFIC-Valencia

Introduction

- Few problems have been observed in RTD kits sent to Daresbury and Chicago. Many apologies to both for the inconveniences
- Kits not yet installed have been returned to IFIC and are being carefully inspected and repaired
- The path forward
 - 1.Characterise observed problems
 - 2.Repair existing kits
 - 3.Changes in production procedures for new kits
 - 4.Changes in QA/QC procedures for repaired/new kits
- These items will be covered in this talk

The elements



Diagnostic

- 15 kits with 4 cables each were sent back from Daresbury

- Inspected carefully →

<https://docs.google.com/spreadsheets/d/1YNHiGjV6-XVt4XpdNLR90WZ2ko7vvqBc/edit?usp=sharing&oid=112967415463163046769&rtpof=true&sd=true>

- 3 kits with 4 cables each were sent back from Chicago, not yet in Valencia

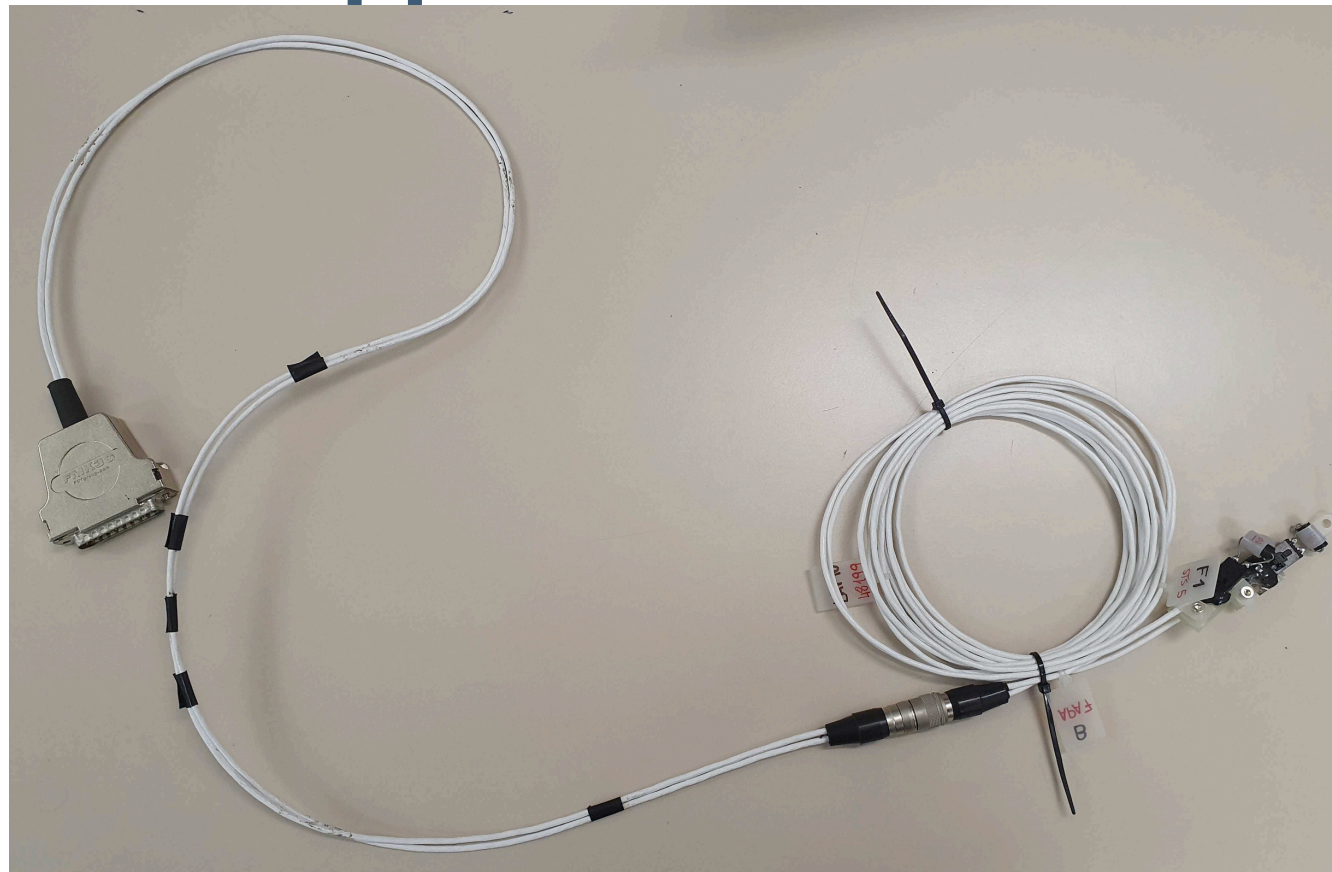
APA number	upper/lower	APA factory	Sensor ID	Electrical Connection	Has Cable tie/clamp	Epoxy Quality				Connector gluing on board		
						Aesthetics	Covering small cables	Allowing M4 screw hole	Allowing adding cable ties	Aligned M4 holes	Connecting sensor	
TOTAL	13/12	15	60	0	40	24	8	6	36	15	9	
3	U	D	LAr1	1	1	1	1	1	1	1	1	1
			LAr6	1	1	1	1	1	1	0	1	1
			LAr11	1	1	0	1	1	1	1	1	1
			LAr16	1	1	0	0	1	1	1	1	1
6	L	D	LAr4	1	1	1	1	1	1	1	1	1
			LAr9	1	1	1	1	1	1	1	1	1
			LAr14	1	1	1	1	1	1	1	1	1
			LAr18	1	1	1	1	1	1	1	1	1
7	U	D	F1	1	1	1	1	0	1	1	1	1
			LAr1	1	1	1	1	0	1	0	1	1
			LAr10	1	1	1	1	0	1	0	1	1
			F2	1	1	1	1	0	1	0	1	1
8	L	D	F1	1	1	0	1	1	1	1	1	1
			LAr9	1	1	0	1	1	1	1	1	0
			LAr18	1	1	0	1	1	1	1	1	1
			F2	1	1	0	1	1	1	1	1	1
11	U	D	F1	1	1	1	1	1	1	1	0	1
			LAr5	1	1	1	1	1	1	1	0	0
			LAr14	1	1	1	1	1	1	1	1	1
			F2	1	1	1	1	1	1	1	0	1
14	L	D	LAr1	1	0	1	0	1	0	1	1	1
			LAr6	1	0	1	1	1	0	1	1	1
			LAr11	1	0	0	1	1	1	0	1	1
			LAr16	1	0	1	1	1	0	1	1	1
15	U	D	F1	1	0	1	1	1	0	0	0	1
			LAr7	1	0	1	1	1	0	0	1	1
			LAr16	1	0	1	1	1	0	0	1	0
			F2	1	0	1	1	1	0	0	1	1
16	L	D	F1	1	0	0	1	0	0	0	1	1
			LAr3	1	0	0	1	0	0	0	1	1
			LAr12	1	0	0	1	1	0	0	1	1
			F2	1	0	0	1	1	0	0	1	1
17	U	D	LAr4	1	0	1	0	1	0	0	1	0
			LAr9	1	0	1	1	1	0	0	1	1
			LAr14	1	0	1	1	1	0	0	1	0
			LAr18	1	0	1	0	1	0	0	1	0
18	L	D	LAr1	1	0	1	0	1	1	1	1	1
			LAr5	1	0	1	1	1	1	1	1	1
			LAr10	1	0	1	1	1	1	1	1	1
			LAr15	1	0	1	1	1	1	1	1	1
19	U	D	F1	1	0	0	1	1	0	0	1	1
			LAr9	1	0	0	1	1	0	0	0	0
			LAr18	1	0	0	1	1	0	0	0	1
			F2	1	0	0	1	1	0	0	1	1
20	L	D	F1	1	0	0	1	1	0	0	1	1
			LAr9	1	0	0	1	1	0	0	0	0
			LAr18	1	0	0	1	1	0	0	0	1
			F2	1	0	0	1	1	0	0	1	1
21	U	D	F1	1	0	1	1	1	0	1	1	1
			LAr9	1	0	1	1	1	0	0	0	1
			LAr18	1	0	1	1	1	0	0	1	1
			F2	1	0	1	0	1	0	0	1	1
22	L	D	F1	1	0	0	1	1	0	0	1	1
			LAr9	1	0	0	1	1	0	0	0	0
			LAr18	1	0	0	0	1	0	0	1	1
			F2	1	0	0	1	1	0	0	1	1
23	U	D	F1	1	0	1	1	1	0	1	1	1
			LAr9	1	0	0	1	1	0	0	1	1
			LAr18	1	0	1	1	1	0	0	1	1
			F2	1	0	1	0	1	0	0	1	1

Problems observed

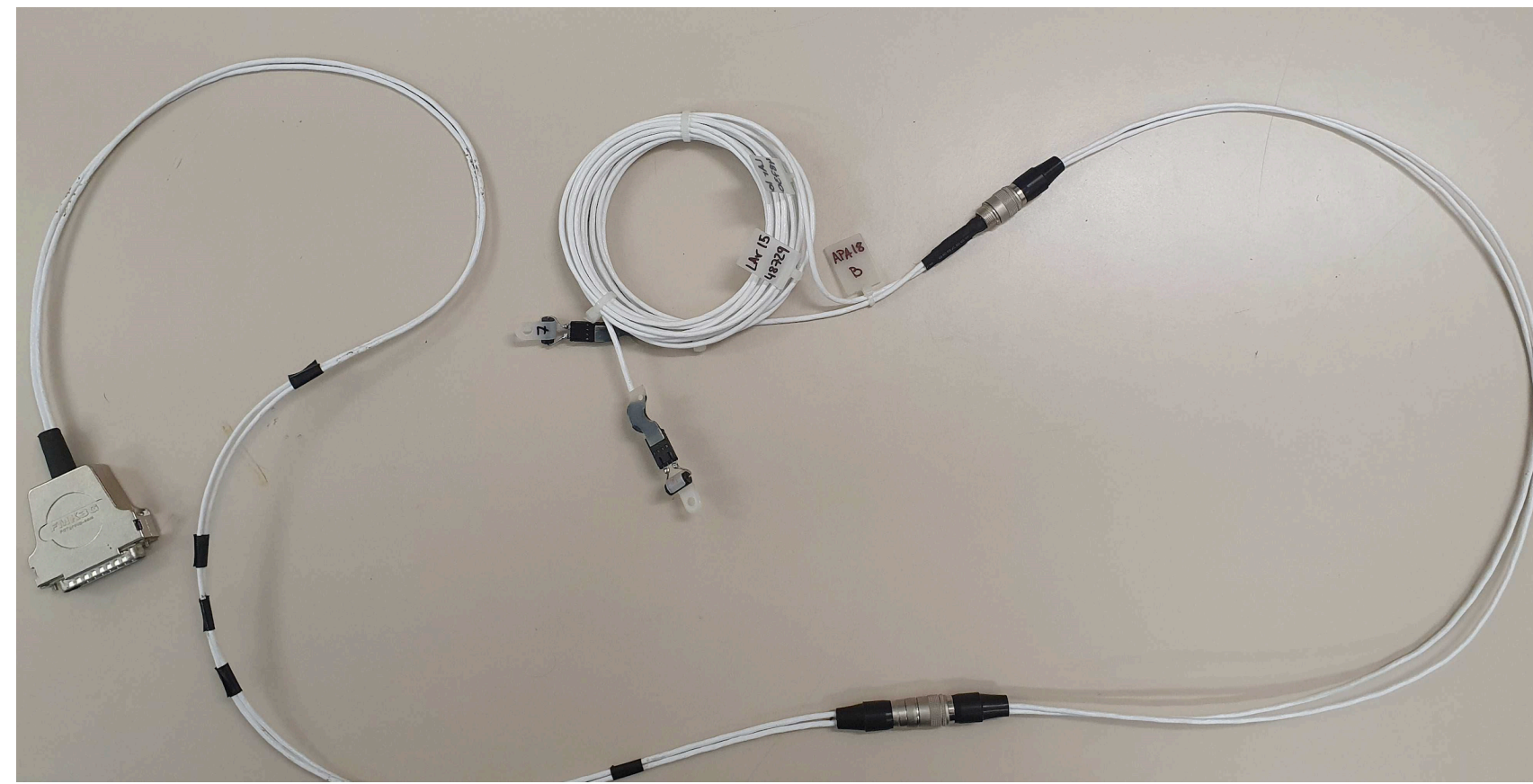
- Daresbury has reported electrical failures for many RTD cables
- We have retested all cables at IFIC and confirmed there is not a single failure
- Electrical tests were not foreseen at APA production factories and therefore there was not written procedure
 - All tests were done at IFIC before shipment, both in cold and in warm.
 - Probability of failure after shipment was estimated to be negligible
- We have now reconsidered this decision and will provide to APA production factories with the necessary hardware to quickly perform electrical tests in all cables

- **Repair:** none
- **Changes in production:** none
- **Changes in QA/QC:** electrical tests at APA production factories before and after installation

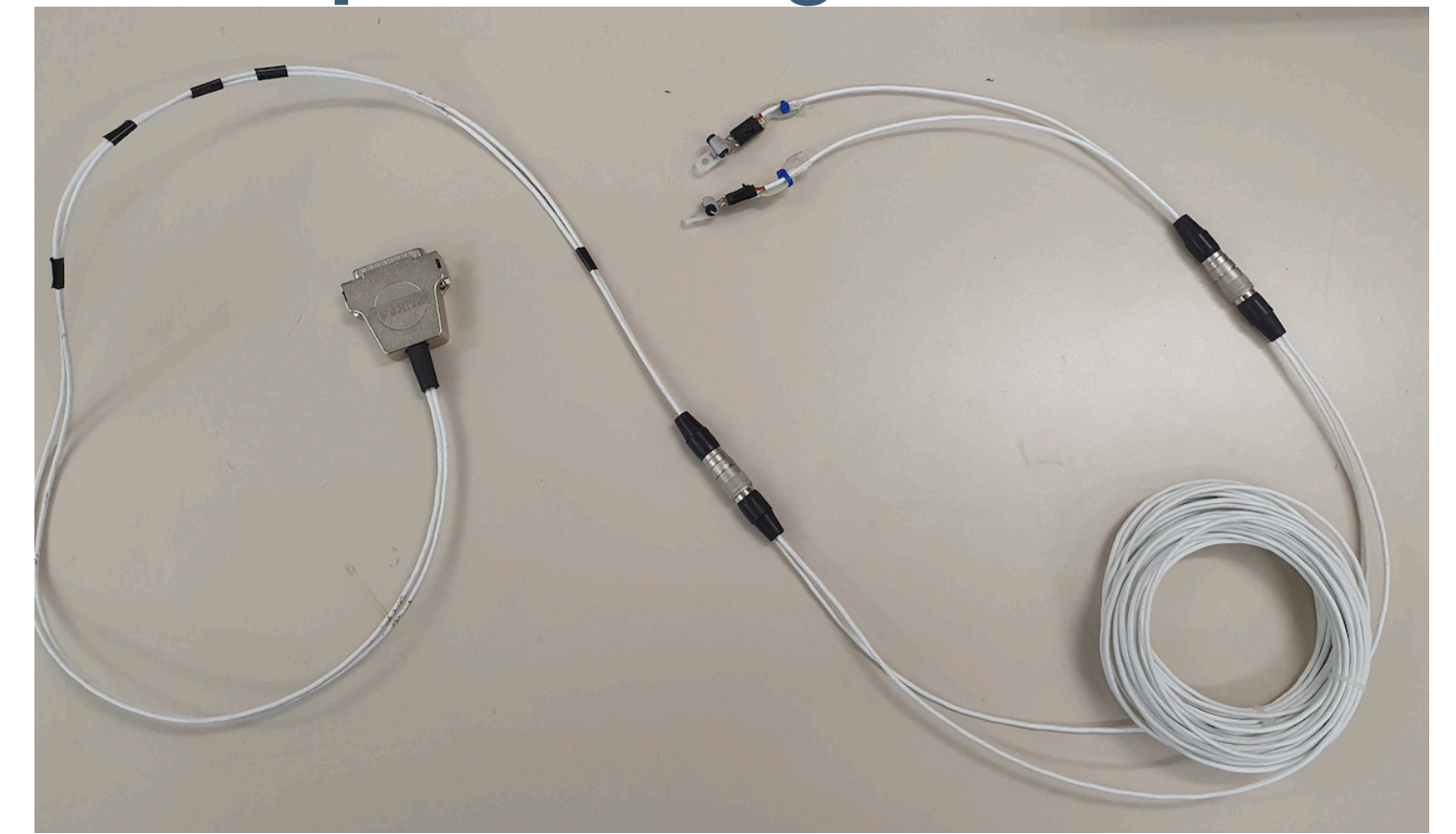
Test upper APA cables



Test lower APA cables



Test passthrough cables



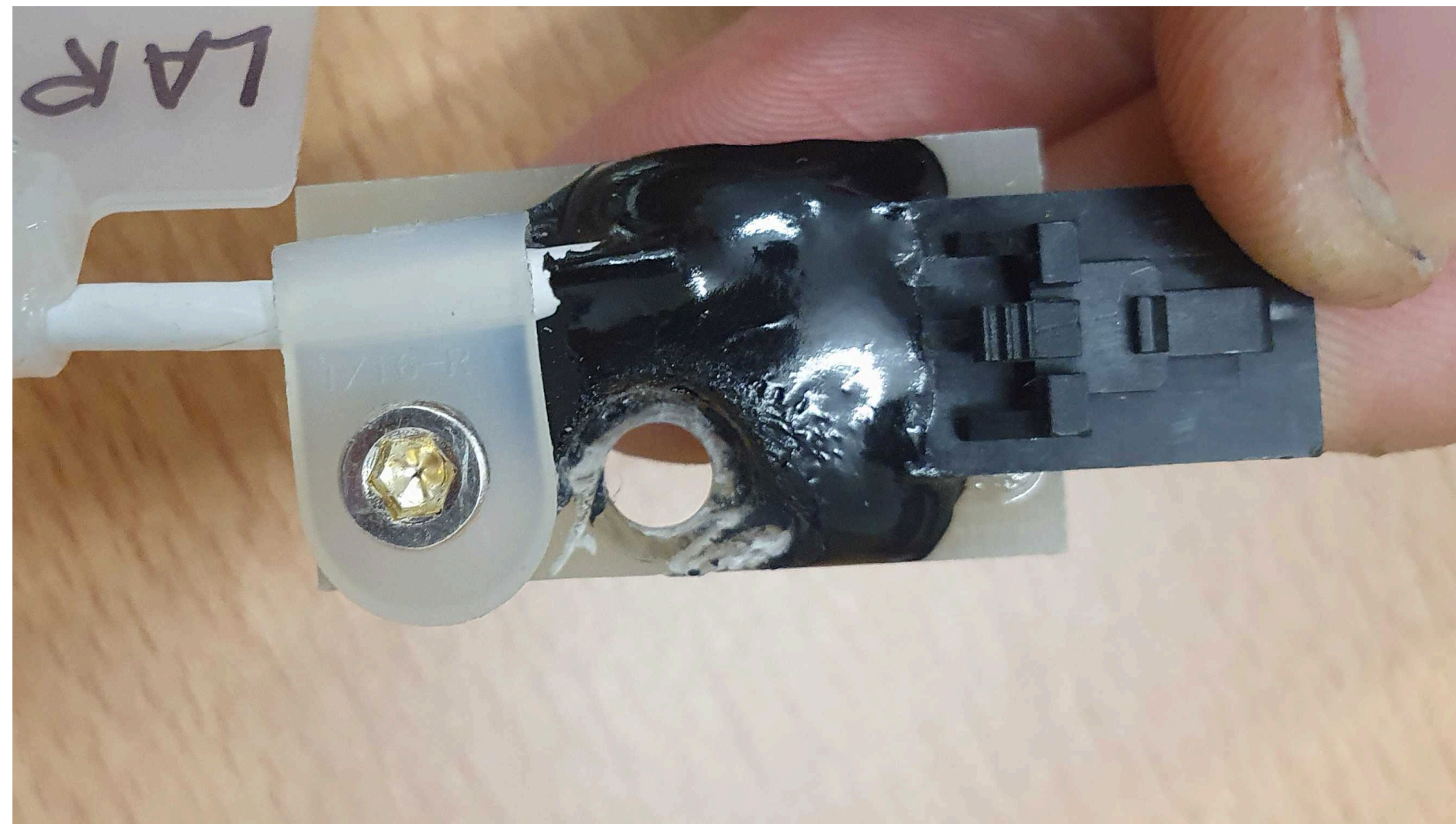
Substitute SUBD-25 connector by a PCB with 4 copper pads, two for each RTD

Problem 2: cable tie/clamp not present

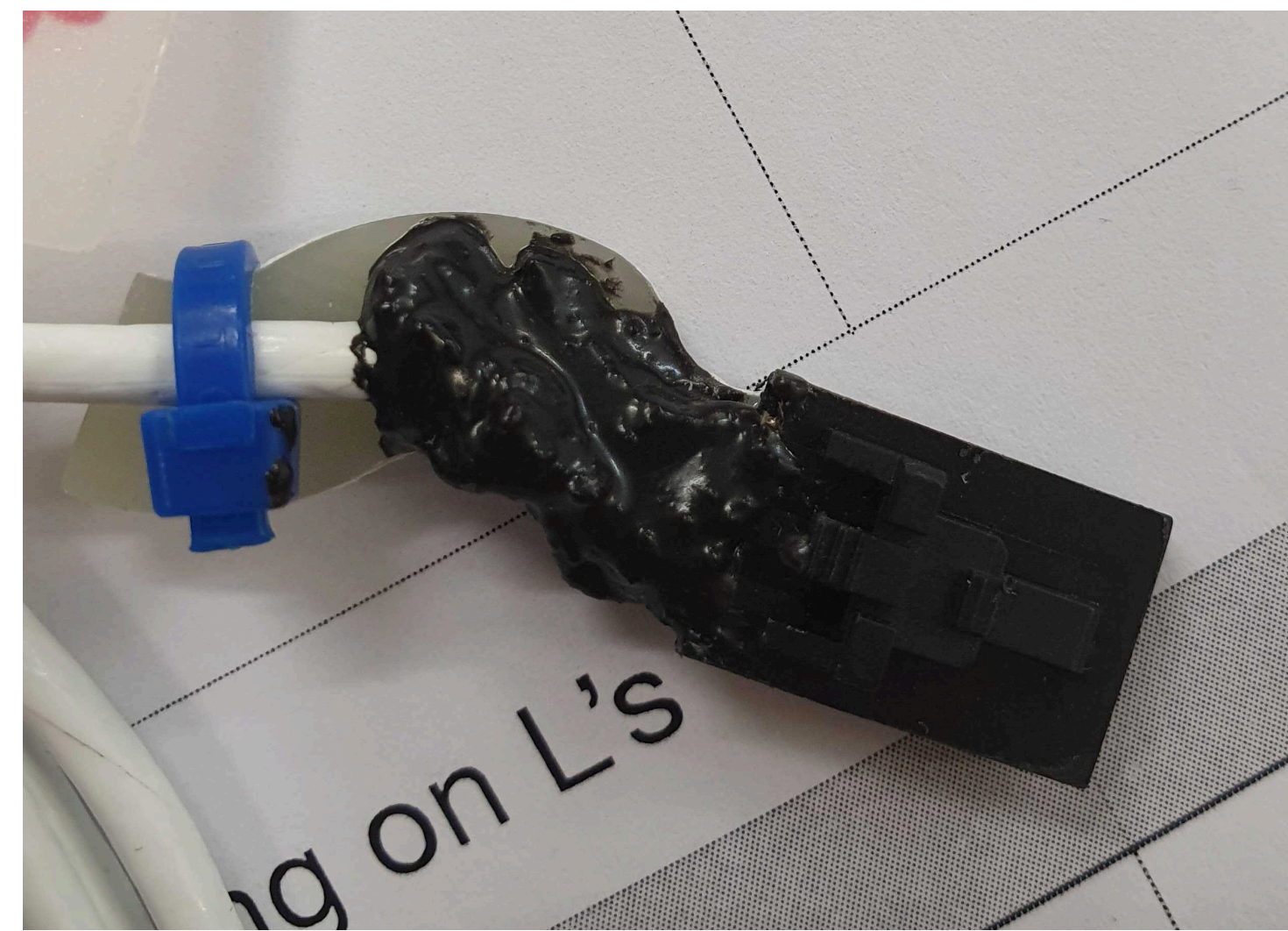
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- After APA 13 we decided to remove the cable tie/clamp in order to simplify the manufacturing process
- However we have noticed that the assembly is more robust with it
- In consequence, these elements will be restored

Cable clamp for upper APAs

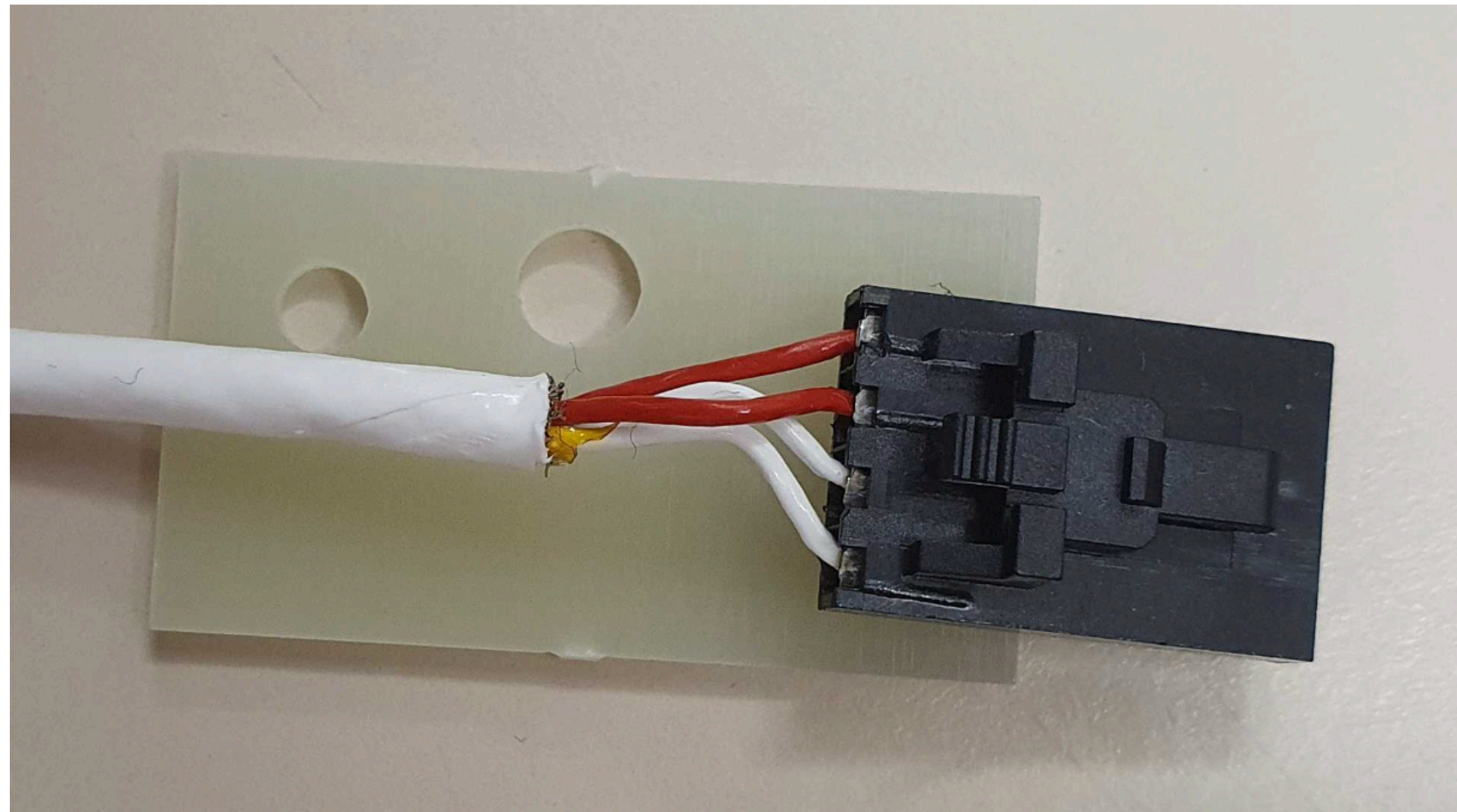


Cable tie for lower APAs



Problem 3: Epoxy quality

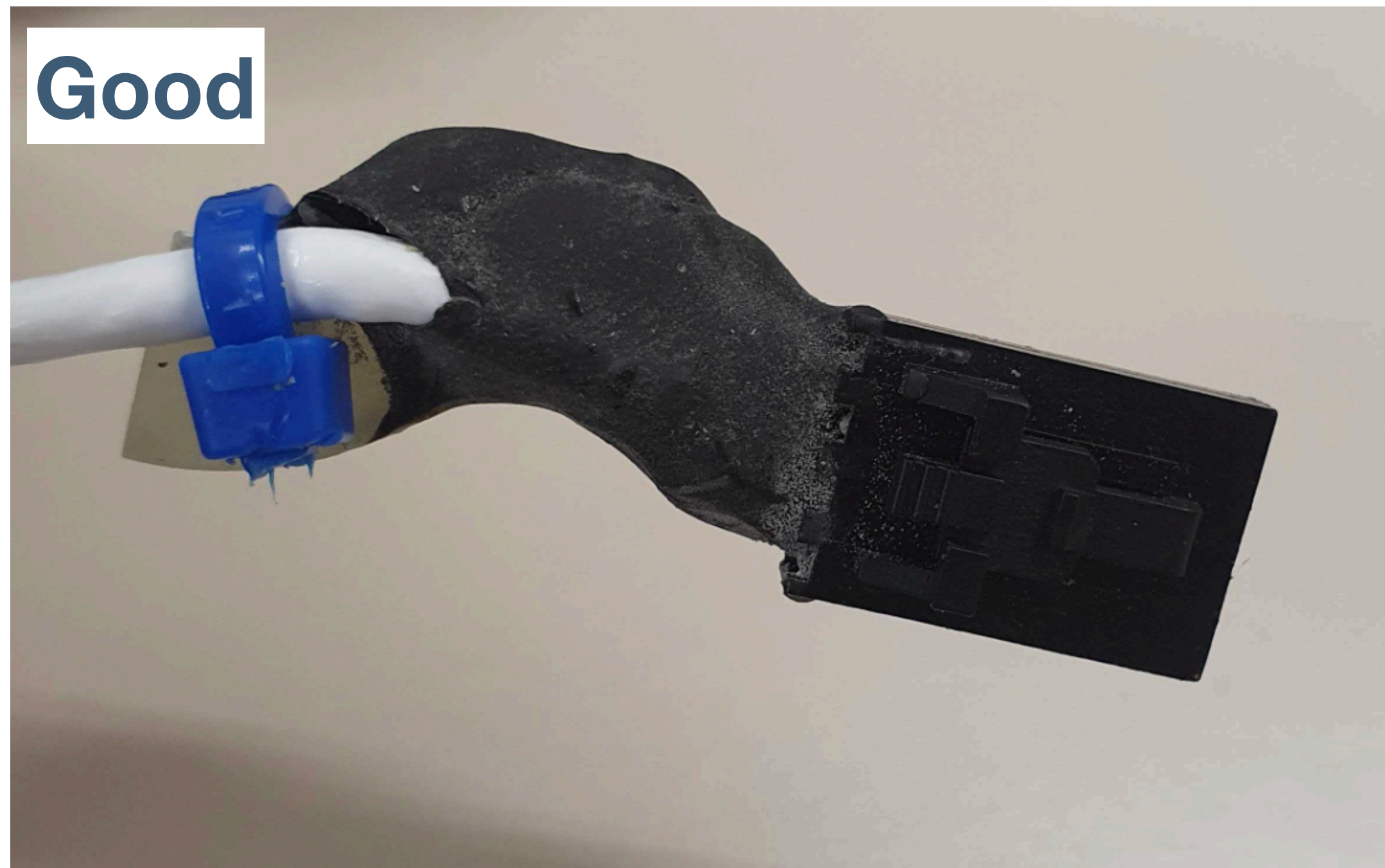
- Loctite Stycast 2850 FT epoxy is used to protect the four little cables in each sensor cable
- Several problems have been identified



Problem 3.a: Epoxy quality

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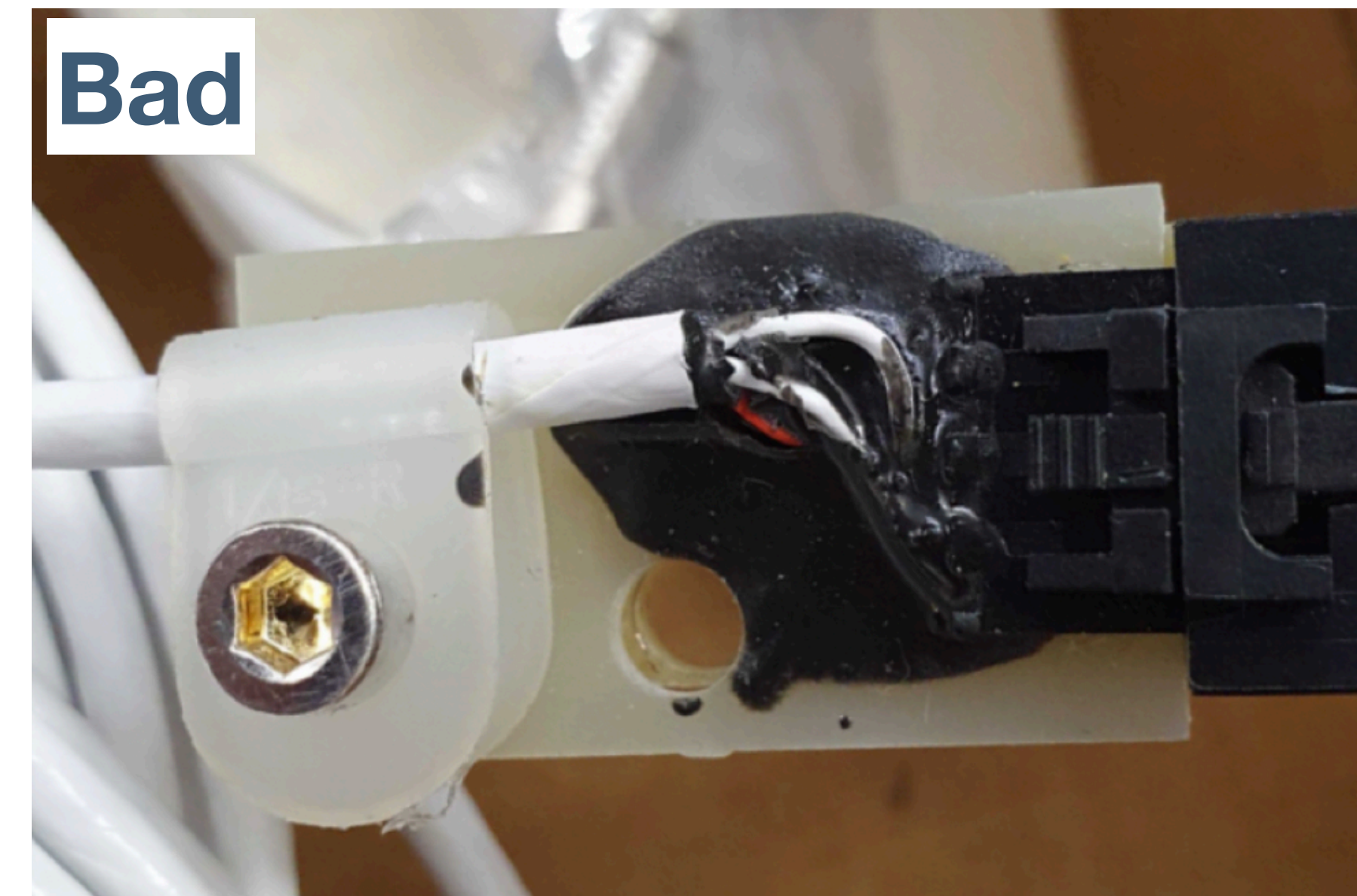
- Sometime it is only aesthetics
- **Repair:** add more epoxy with proper distribution
- **Changes in production:** remove bubbles before applying epoxy
- **Changes in QA/QC:** look at aesthetics



Problem 3.b: Epoxy quality

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- The four little cables not completely covered by epoxy
- **Repair:** add more epoxy
- **Changes in production:** when applying epoxy make sure it covers cables
- **Changes in QA/QC:** make sure epoxy covers cables



Problem 3.c: Epoxy quality

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- Epoxy prevents housing the M4 screw head
- **Repair:** remove extra epoxy with a drilling machine
- **Changes in production:** none, a temporary bolt is used when adding epoxy
- **Changes in QA/QC:** mount entire kit

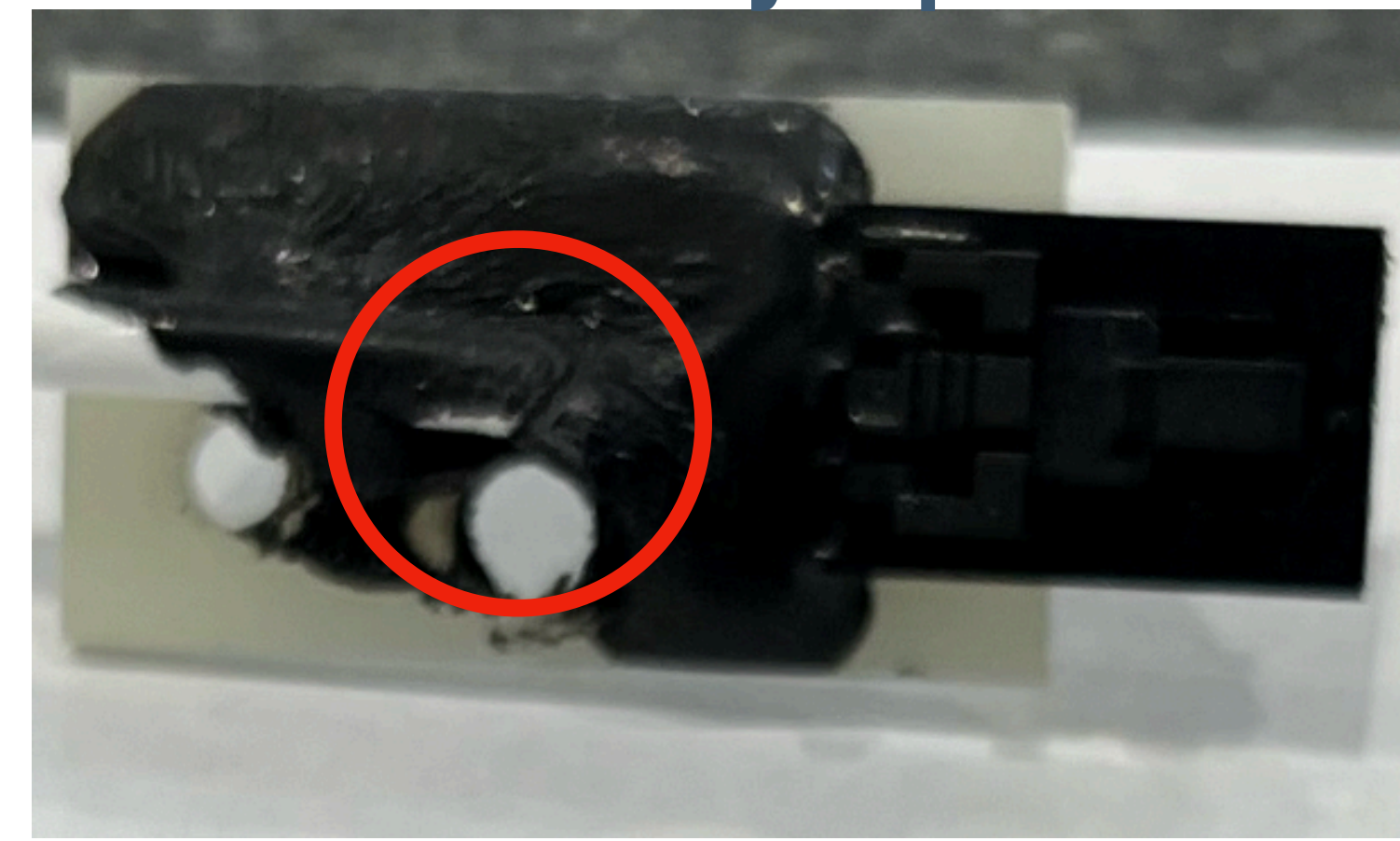
Good



Bad



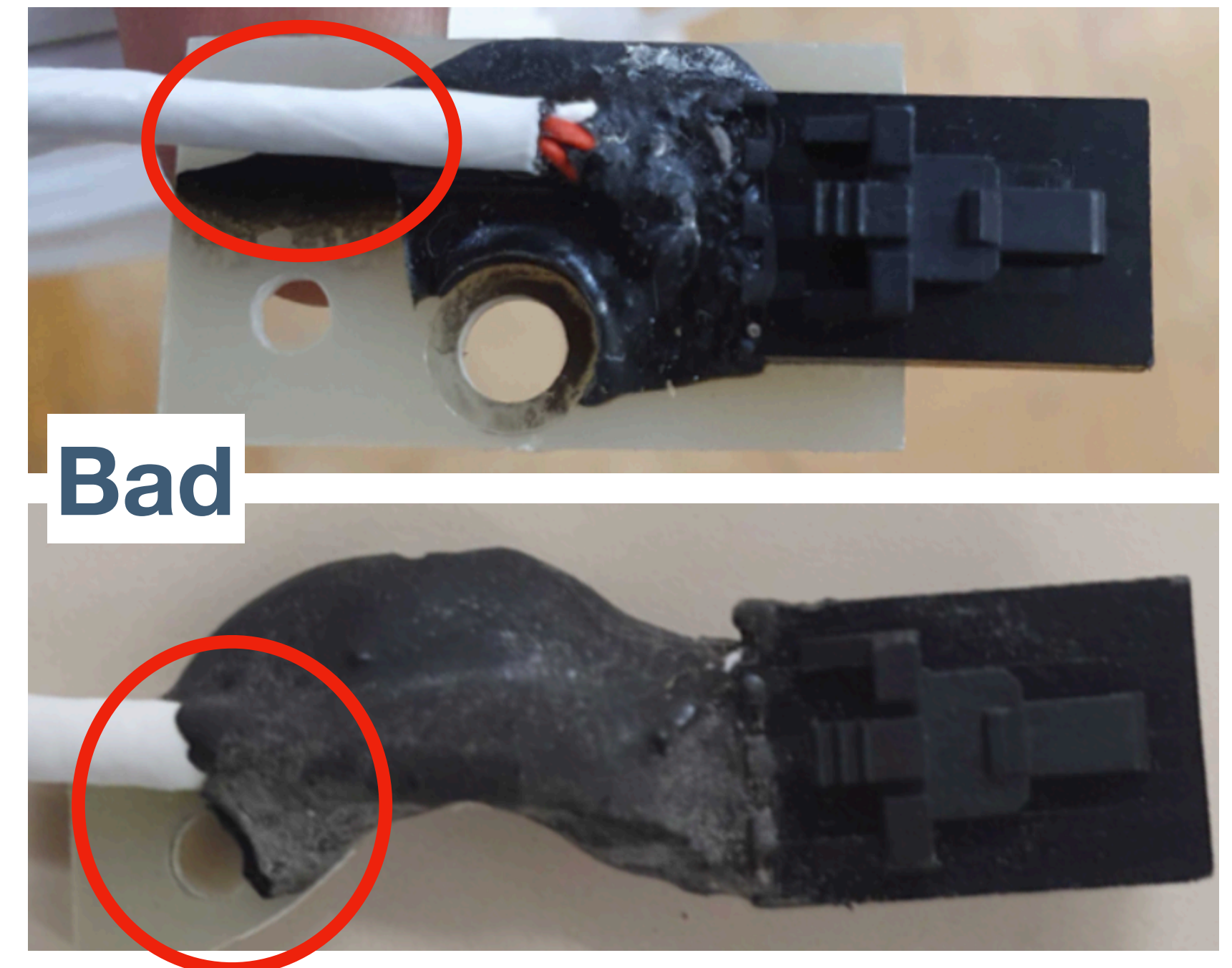
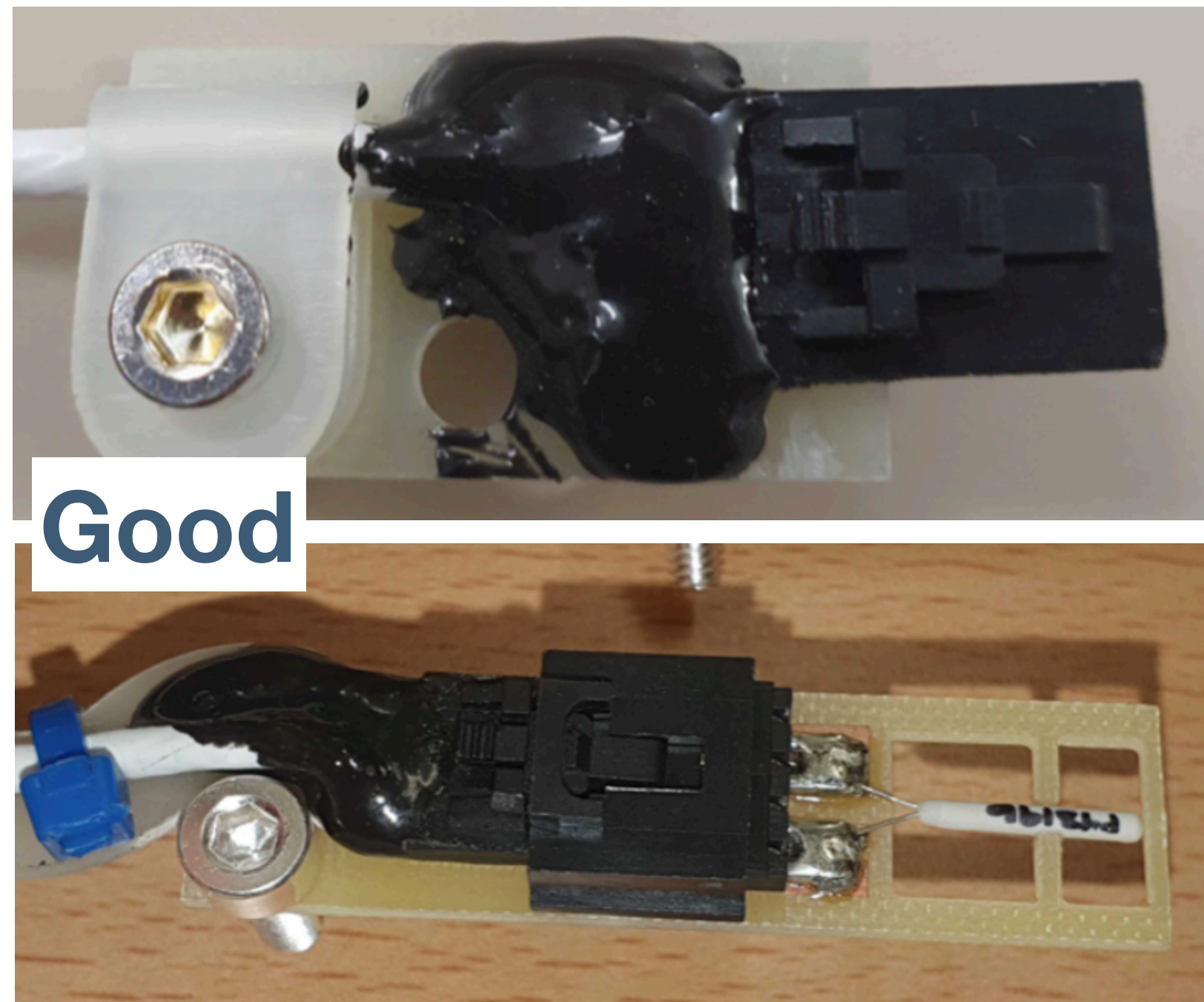
Cable is too close, cannot be easily repaired



Problem 3.d: Epoxy quality

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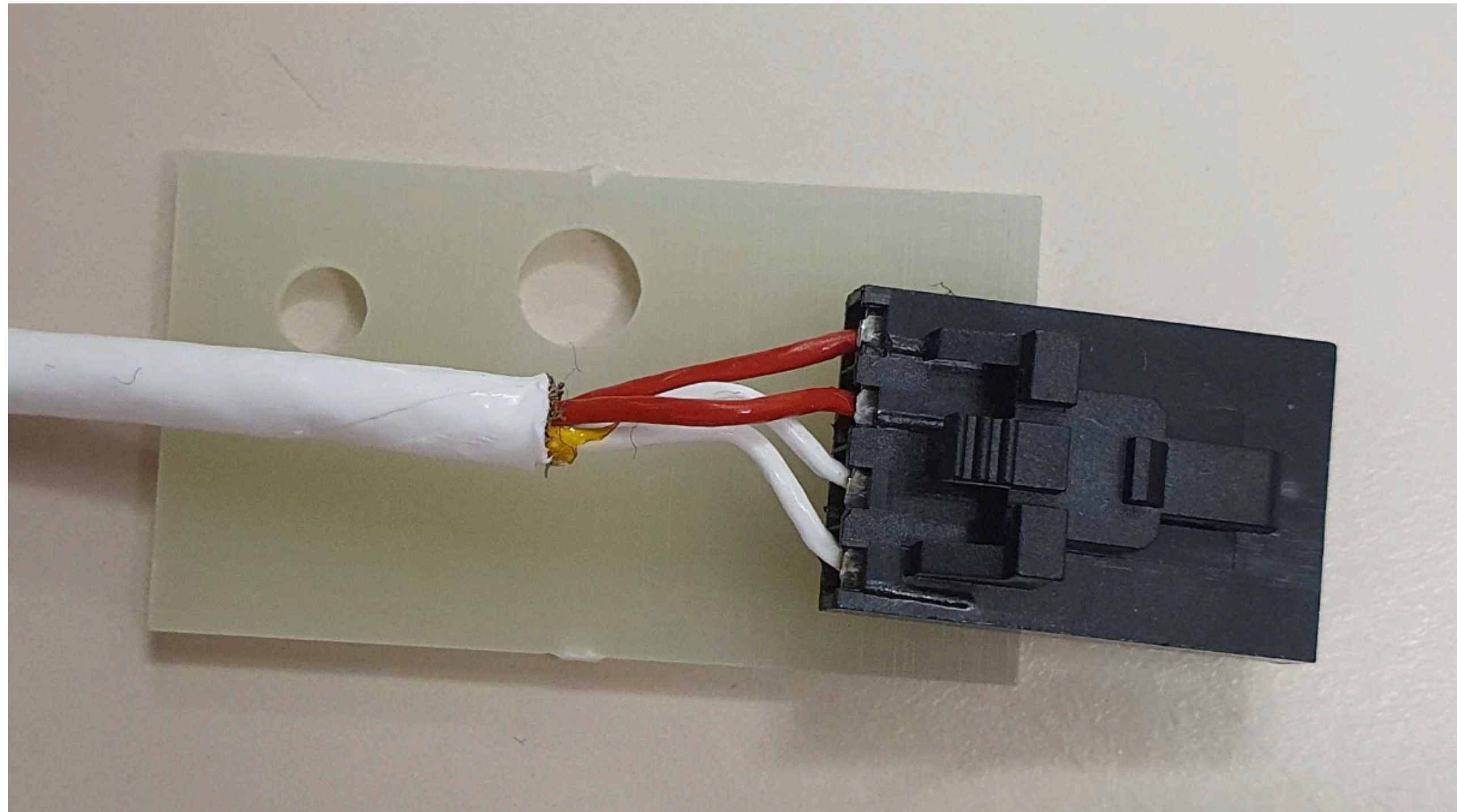
- Epoxy prevents adding the cable clamp/tie
- **Repair:** remove extra epoxy when possible
- **Changes in production:** add cable tie/clamp before epoxying
- **Changes in QA/QC:** make sure cable tie/clamp is present before



Problem 4: Misaligned holes in PCBs

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- The IDC-4 female connector is glued with loctite super glue-3 on the cable PCB. This is done manually, and alignment is done by eye



Problem 4: Misaligned holes in PCBs

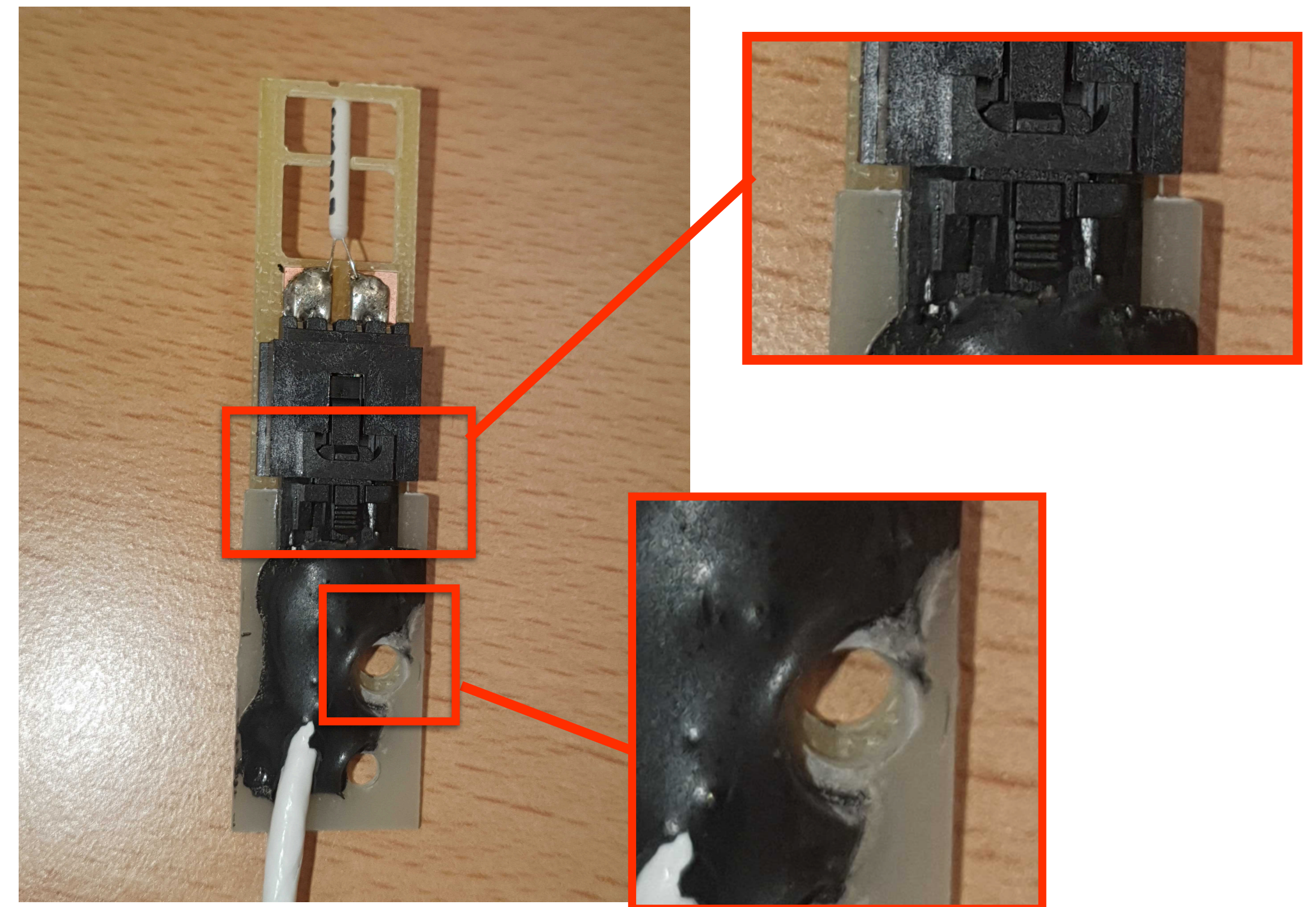
15/60

- In some cases the alignment is not correct and once the sensor is plugged in the holes of the two PCBs doesn't match each other

Good

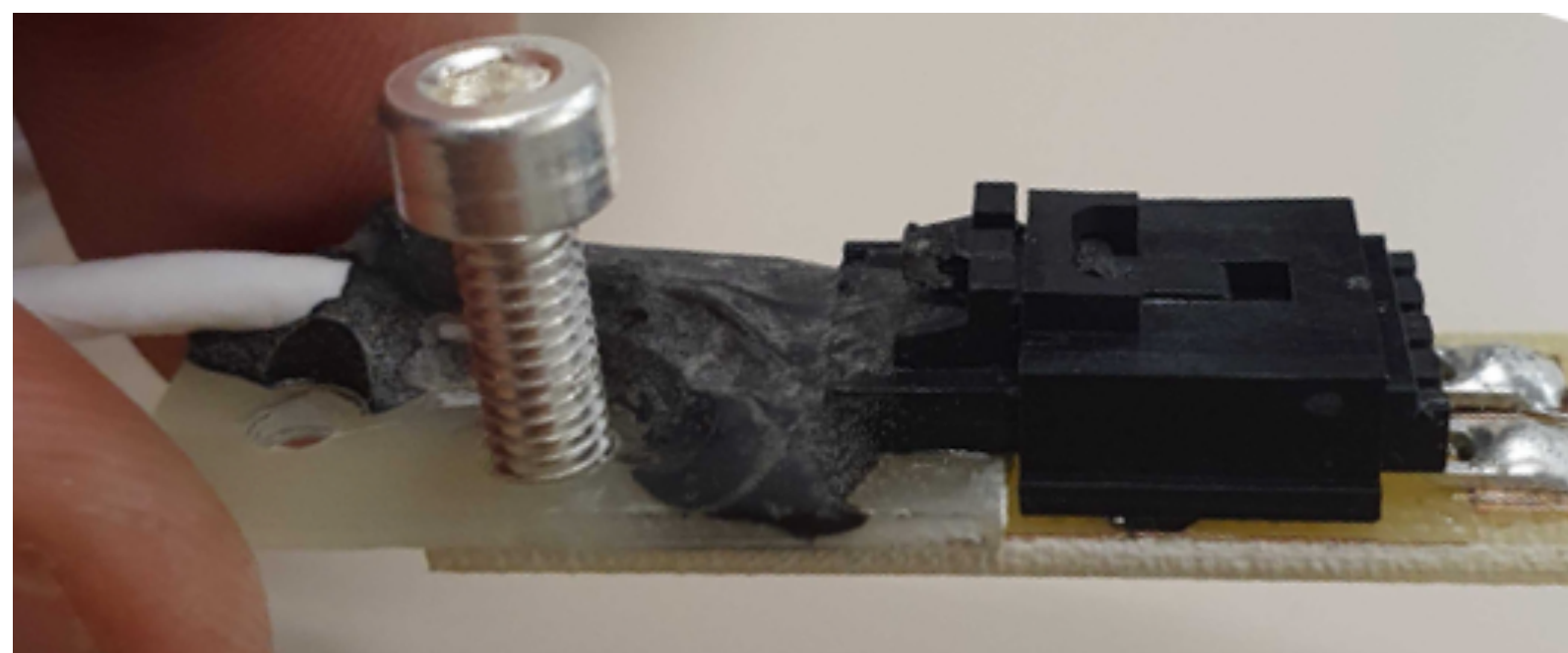


Bad

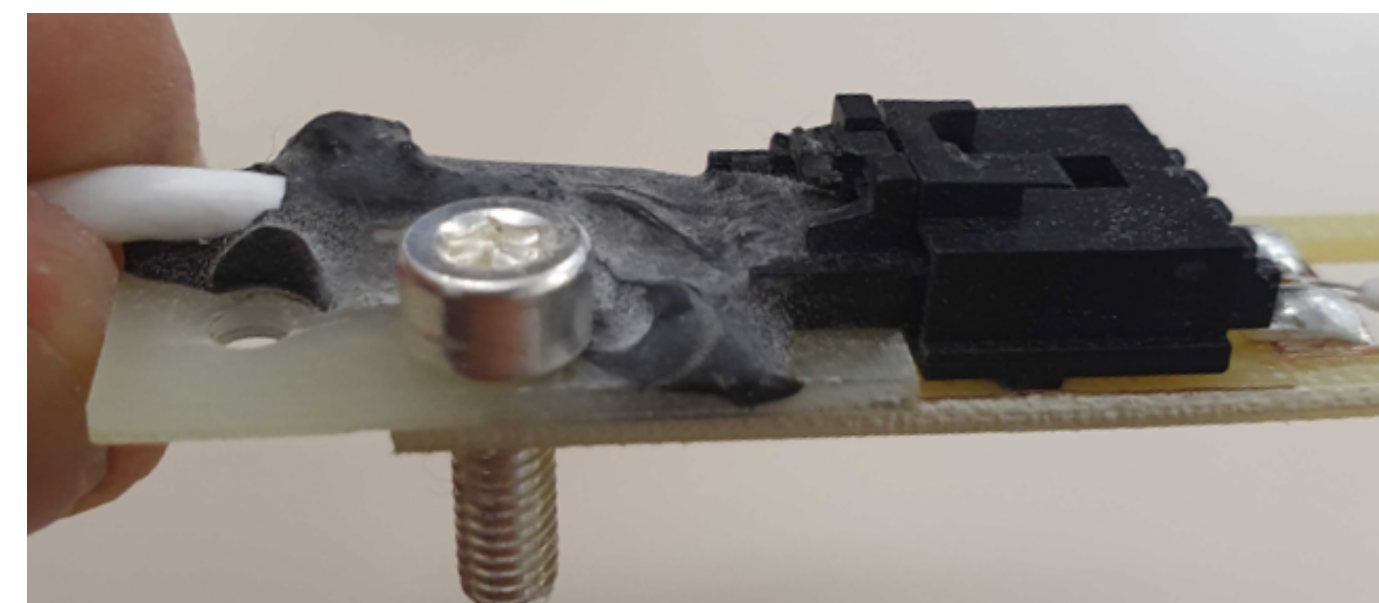
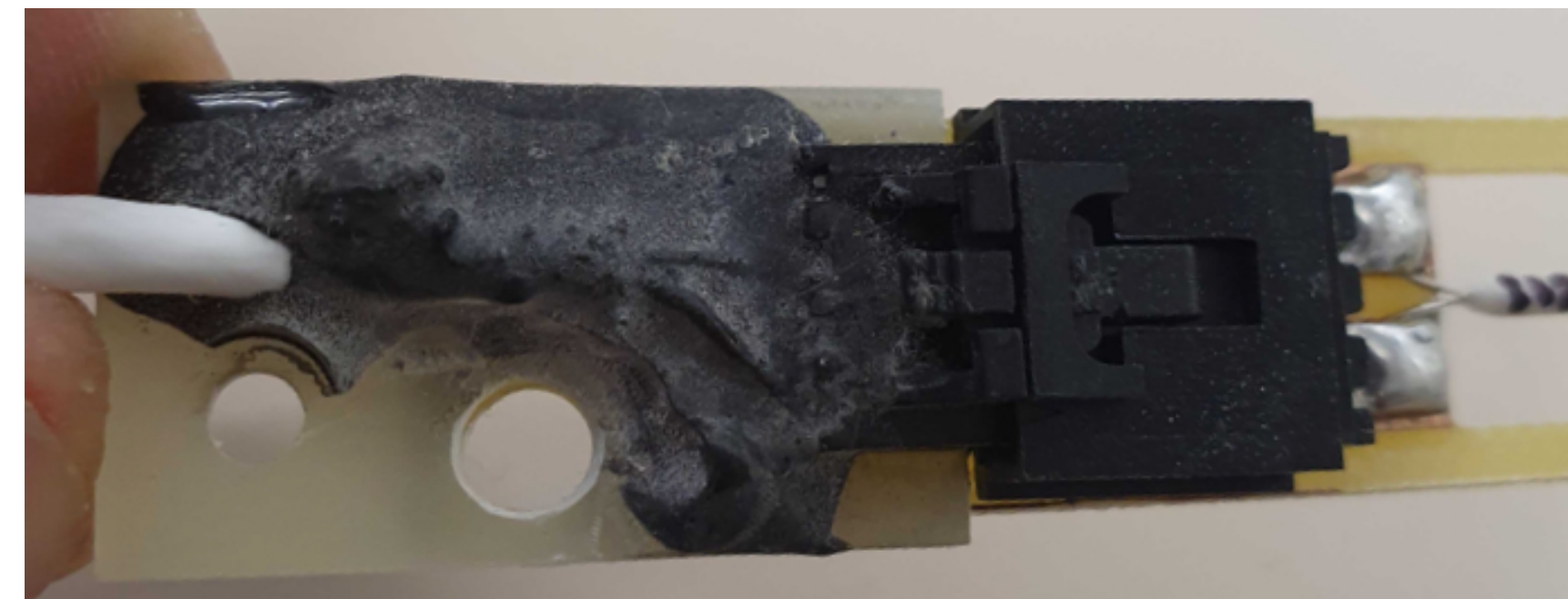


- **Repair:** Use a cylindrical lime to increase the size of hole in lower PCB
- **Changes in production:** A special tool where the cable PCB and the IDC-4 female connector are placed before gluing is been fabricated
- **Changes in QA/QC:** Mount the entire kit

Before

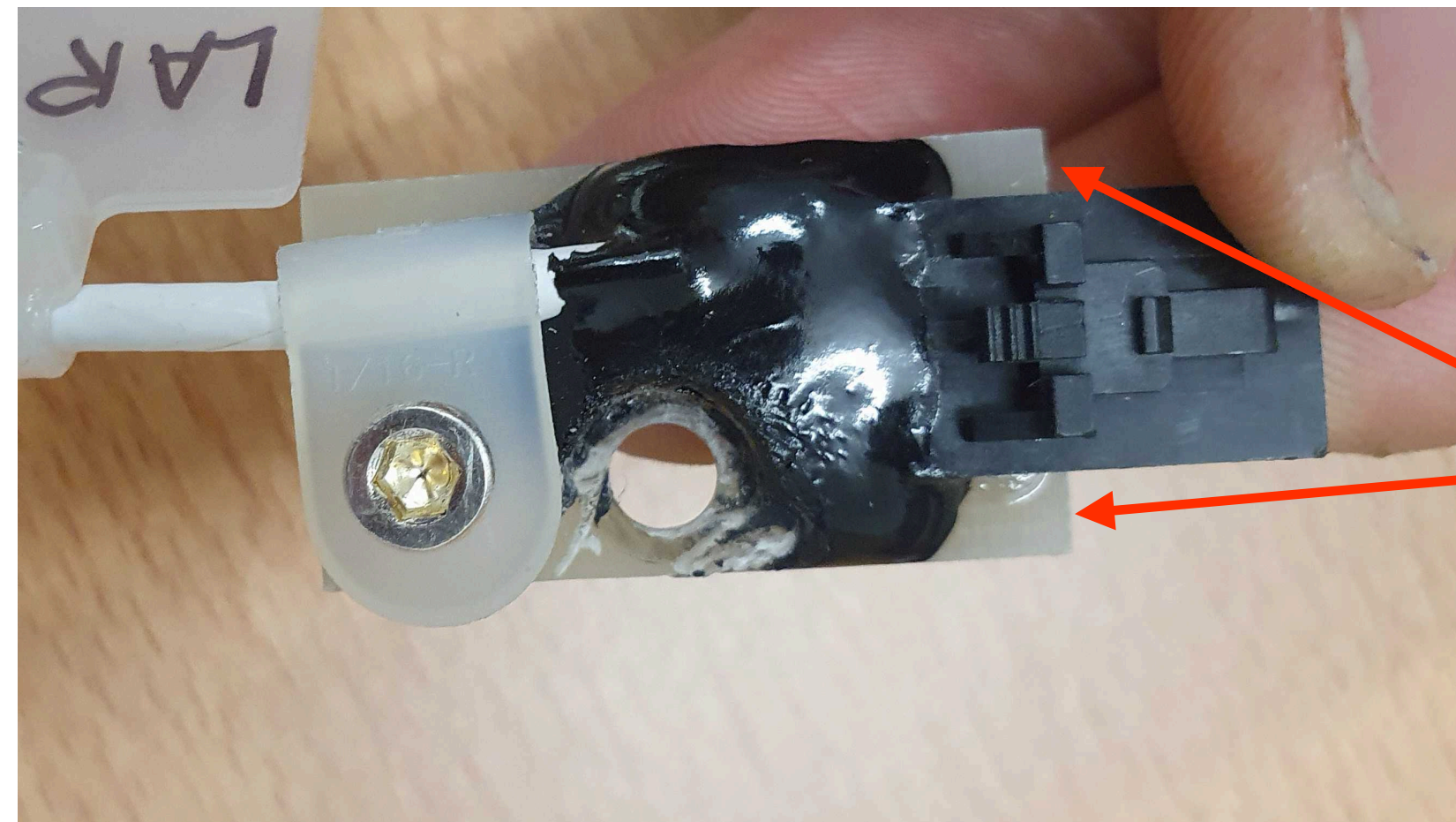


After



Problem 5: Sensor cannot be plugged in 9/60

- In some cases the IDC-4 female connector is not correctly placed on the cable PCB (too much inside the PCB) and the sensor cannot be plugged in
- **Repair:** remove FR4 material with flat lime
- **Changes in production:** use new tool to correctly place the IDC-4 connector
- **Changes in QA/QC:** make sure RTD can be plugged in

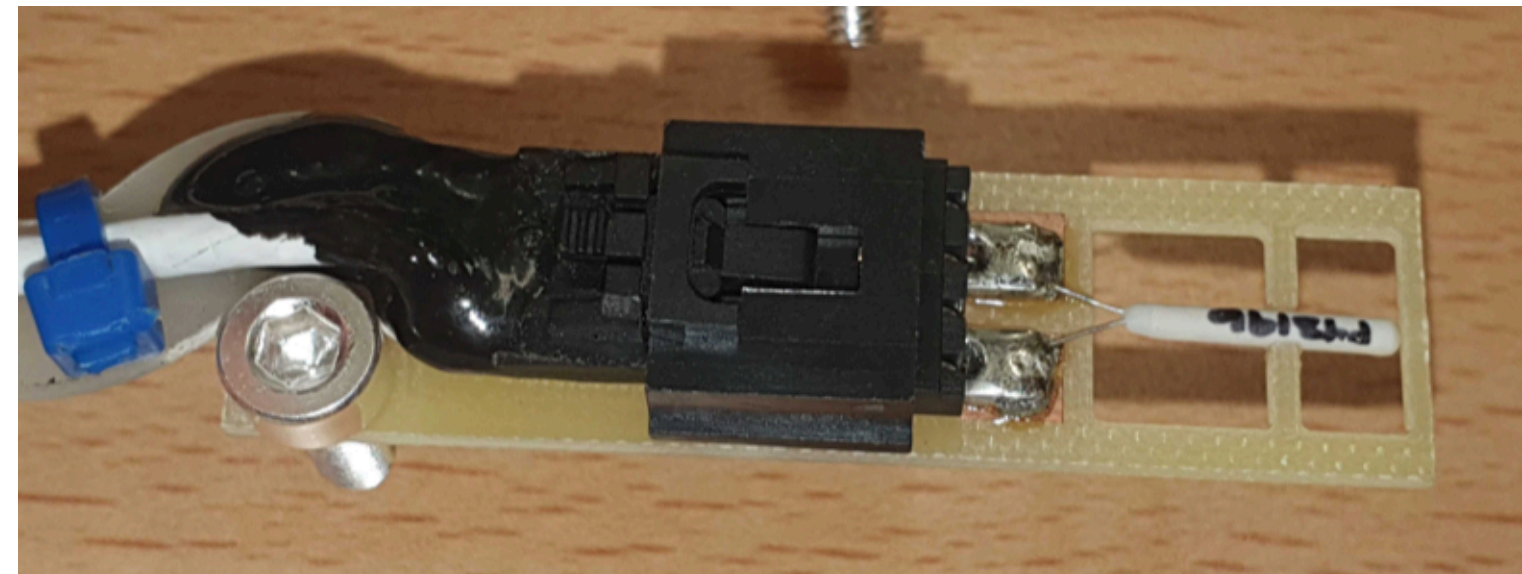


Remove a bit of material in these two points

Problem 6: Cable blocking M4 screw

- For lower APAs there is no hole in the PCB. Instead a narrower PCB with the appropriate curve is used. Sometimes the cable prevents adding the M4 bolt
- **Repair:** There is no quick solution for this. The cable must be cut as close as possible to the edge and a new PCB and connector should be installed
- **Changes in production:** Correctly position the cable before epoxying. Add a bit of loctite super glue to fix the cable
- **Changes in QA/QC:** Mount entire kit with M4 bolt

Good



Bad

