

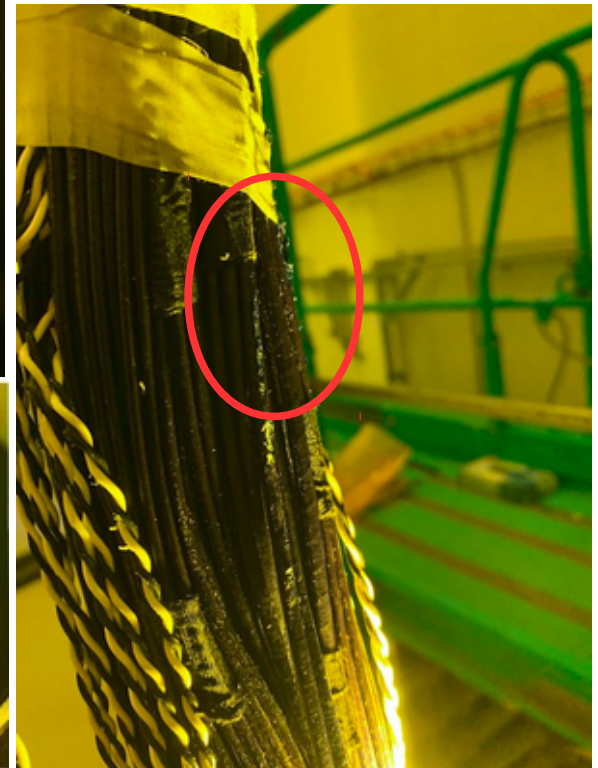
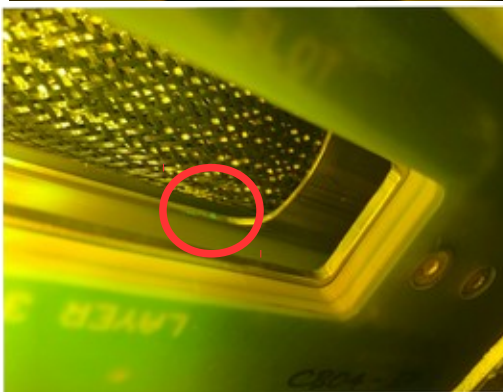
APA Cold Tests at CERN

Recent Works

- Cold testing of APAs 4 & 5 was planned at CERN from mid-April to mid-June.
- With support from Manchester, Imperial, Liverpool, Lancaster and Daresbury, we got through to mid-May on schedule.
 - We collected post-shipping tension data for APA 4 in both horizontal and vertical orientations.
- We then encountered a critical QC issue with APA 4 that led to the tests being aborted, and both APAs returning to Daresbury.
- We're currently left with a few open questions:
 - Technical:
 - How to rectify APA QC issue for production.
 - How to address operational issues with the DWA encountered at CERN.
 - Logistical:
 - When to resume testing.

QC Issue: Conduit Burrs

- The steel conduits inside the long tubes of the APA frame had sharp burrs on the slots cut for PD installation.
- We discovered this when we attempted to install the cold electronics cable through the conduit, and observed it came out damaged.
- The only defined procedure for removing/installing conduits is on a process cart \Rightarrow the frames have gone back to Daresbury.



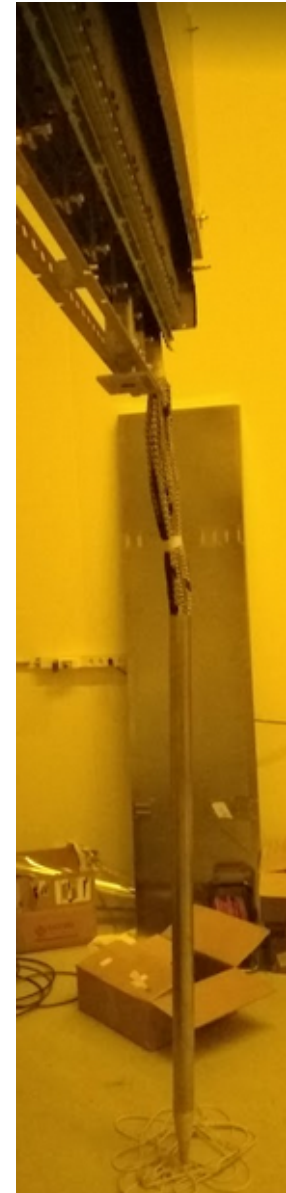
QC Issue: Conduit Burrs

The conduits should be deburred by the manufacturer, and inspected at Daresbury (Procedure: <https://edms.cern.ch/document/2881119/1>). Suggestions have been made to make this procedure more rigorous:

- Having an example length of conduit on the factory floor to show the standard to which edges should be smoothed.
- Having a final clean-up for all conduits at Daresbury as standard (not just inspection).

A number of further suggestions have been put forward to eliminate this hazard for future production and testing.

- Temporary covers for the unprotected cable section during installation.
- Modifications to cable installation to avoid friction against the conduit opening.

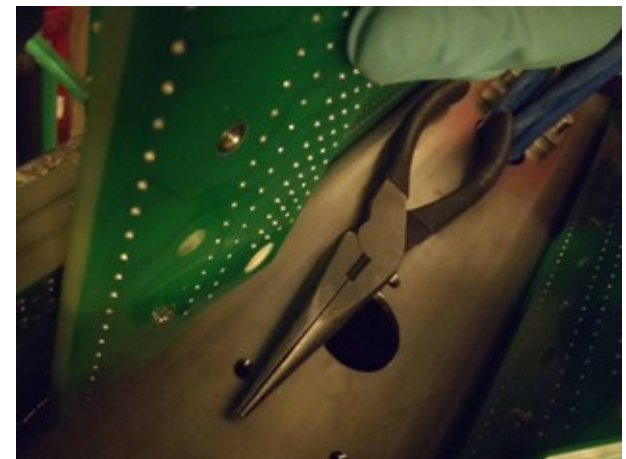
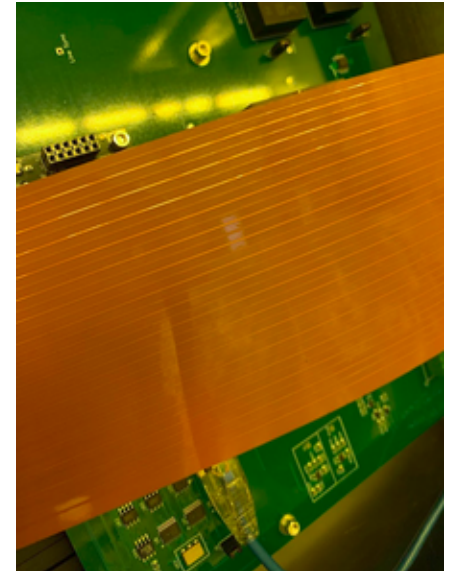


DWA

Operational Issues

Our tests required 2 full cycles of DWA measurement, carried out by Anyssa and Shion. These measurements proved challenging for multiple reasons.

- 1) Damage to the flex cable of the DWA unit at CERN disabled half its channels, doubling data collection time for the first cycle of testing.
- 2) The DWA power supply overheated during the second cycle, damaging one of its boards and preventing further tension measurements.
 - See Anyssa's slides for further details.
 - Design under review; any DWA units returning to CERN will require electrical inspection before being authorised for use.
- 3) Due to their spring-loaded pins, the DWA boards on APA5 became stuck when mounted with long screws, and had to be seriously damaged to be removed.



Other DWA Recommendations

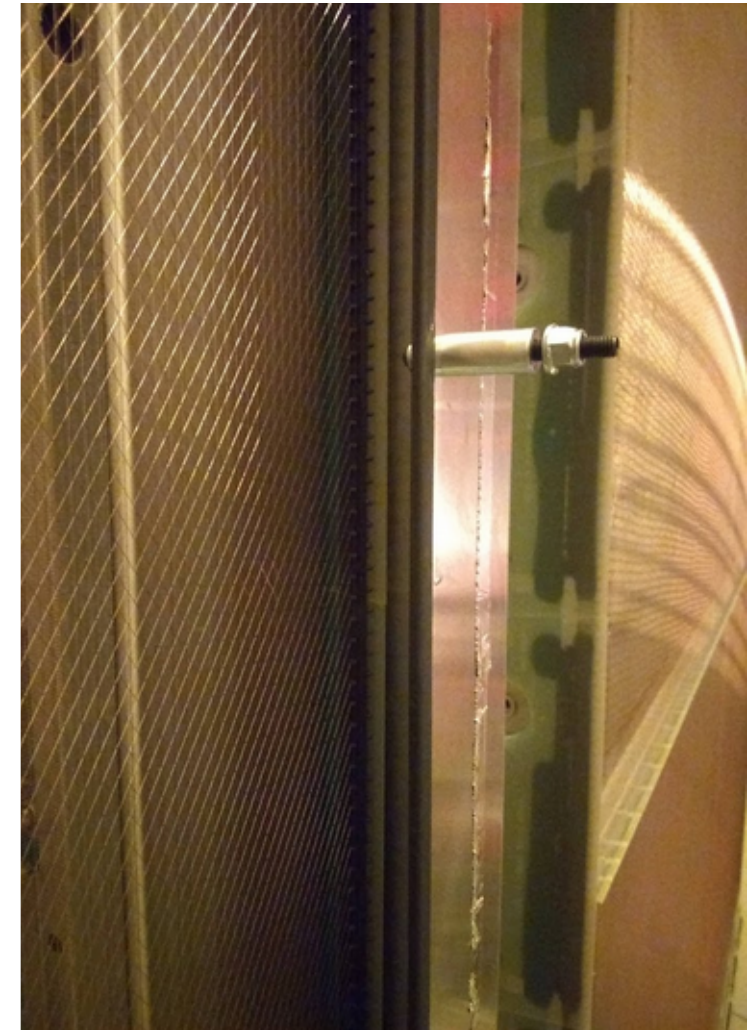
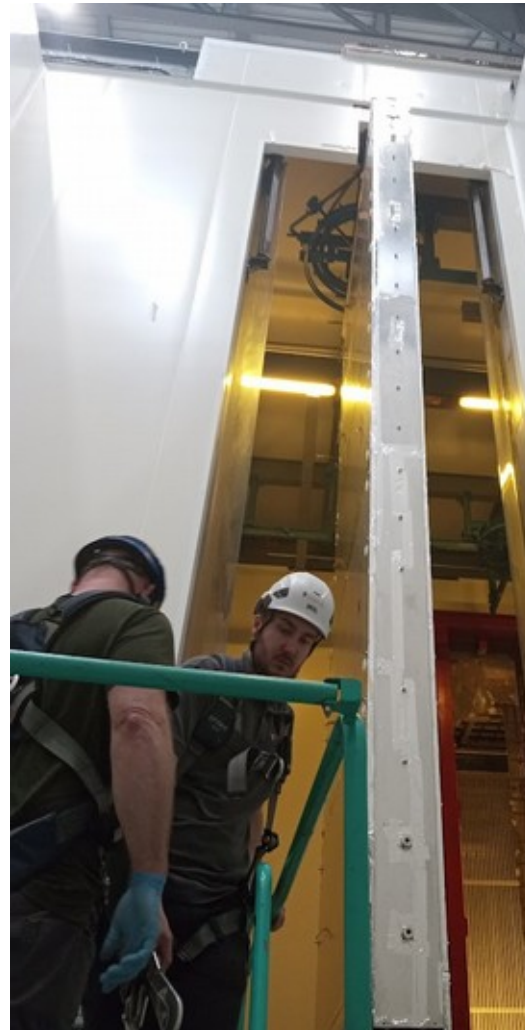
DWA tests are a crucial (critical path) part of production, and the time of DWA experts is valuable. Where we can avoid delays through simple hardware modifications, we should.

- 1) Spare parts should be kept on hand at sites where DWAs are deployed.
- 2) The DWA boards would benefit greatly from captive screws, as this would eliminate any concerns about dropping small screws into the APA volume at heights.
- 3) A set torque level for attaching the DWA boards would also allow novice users to make good electrical connections without the risk of over-tightening.
- 4) Deploying the DWA through both the base frame and the ASF is not impossible, but challenging – would recommend this be avoided where possible.



Protection Panels

Removing protection panels by hand at height requires **extreme care** not to strike wire planes (either with the panel or your hands). This could be made easier and safer by developing tools for manipulation (e.g. attachable handles).



Resumption of Testing

- We budgeted 8 weeks for this cycle of tests, from arrival of the APAs at CERN to warm-up of the 2nd APA.
- Currently, work to close the TCO is scheduled to begin in early September ⇒ we don't have another 8 weeks in hand.
 - The DWA investigations must also conclude before we can do more DWA tests at EHN1.
 - Availability of experts may be limited over the summer.
- Once beamline elements for ProtoDUNE running are installed in NP04, the rail path from the SAS to the cold box will be blocked.
 - We will need to make a new opening in the clean room ceiling to lower the APAs in.

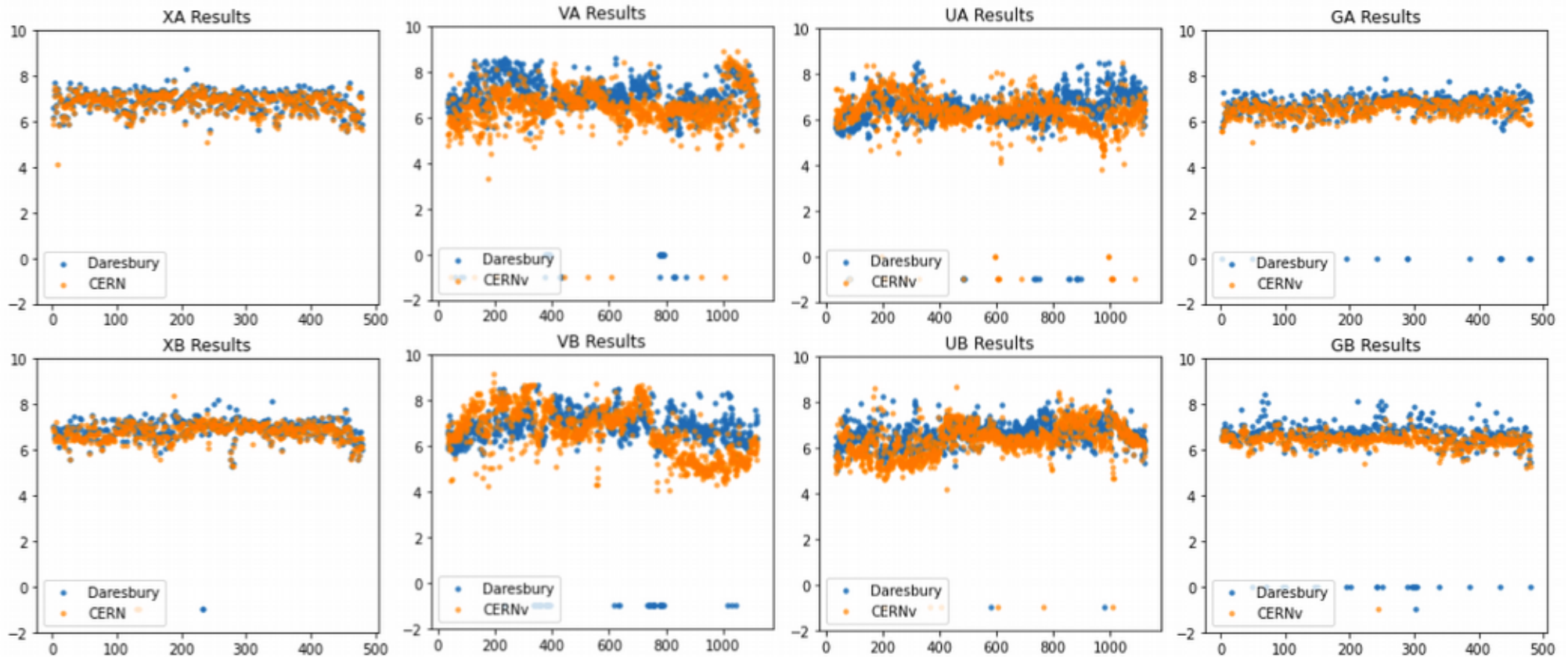
⇒ a fast return to CERN for testing does not seem likely. Our next opportunity may be in autumn – something we should start planning for now!



Thank you!

Backups

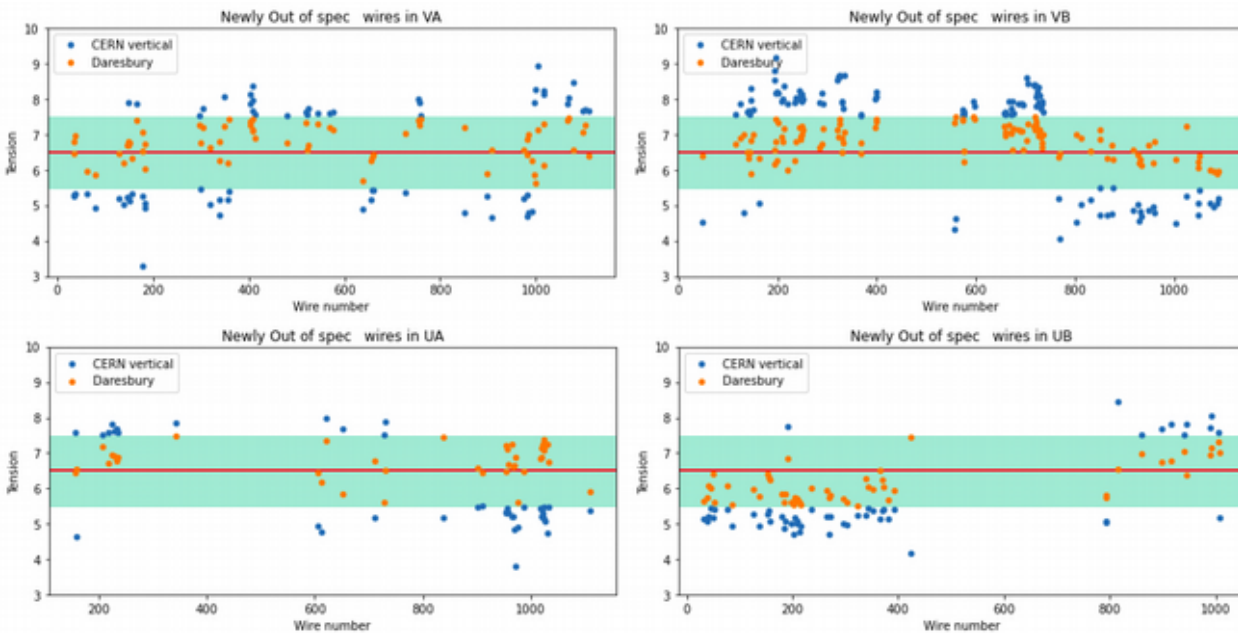
Vertical Tension Results (Bottom APA)



Vertical Tension Results (Bottom APA)

Measurement	Daresbury (horizontal orientation)	CERN (vertical orientation)
No. of wires out of spec	550	967

- Almost all wires measured to be **newly** out of spec at CERN are in the U & V planes.



- Migration goes in both directions.
- Daresbury measurement was simultaneous for U, V, X, but not G.
- See **Anyssa's talk** from Tuesday for deeper analysis.