

# QC Executive Summary From DB

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- The database has been set up to link an assembled APA to every component that goes into that APA: boards, mesh, frame, wire
- We track QC related information by filling out forms for each step of the APA assembly or component QC; the forms currently reflect the initial procedures
- Those forms are where we can add information if needed for the QC executive summary
- Every step performed in the assembly for an APA or a frame is done through a workflow that orders the steps according to the original procedures
- The DB can produce a pdf aggregating all forms in the DB in time-ordered sequence so that we can see what happened at each stage
- Any non-conformances are also tracked, but not through the workflow process
- Our goal is that all relevant QC information and sign-offs are captured as we go through the assembly process rather than the responsible people having to track those things down after the assembly



## DUNE APA Final Check List Summary

**Component UUID**

23def100-dd0d-11ed-9ed1-a9d6b1eaf785

**DUNE PID**

D00300100002-00008-UK106-01-00-00

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- The top of the page (or generated pdf file) shows the DB QR code/UUID and DUNE PID for the APA
- The QR code is etched into the cover headboards of each APA
- The page is autogenerated each time the link to it is clicked, so it is always up-to-date
- There are multiple sections related to different QC items
- The initial layout is based on a form circulated in May 2023



Section A - Properties

DUNE PID:  Top or Bottom:  Production Site:

Temp. Sensors Configuration:

Temp. Sensor #1 SN:  Temp. Sensor #2 SN:  Temp. Sensor #3 SN:  Temp. Sensor #4 SN:

Section C - Other Non-Conformances

Component: <input type="text" value="Assembled APA"/>	Description: <input type="text" value="There were not enough M4 screws of the correct type in stock when the mesh panels were installed. Therefore, screws of the same size and length but a different head type (BHCS) have been installed in place of the usual screws on five different mesh panels."/>
Type: <input type="text" value="Incorrect Fasteners"/>	
DB ID: <input type="text" value="64511dbeb195d91794231a74"/>	
Component: <input type="text" value="Assembled APA"/>	Description: <input type="text" value="One V-layer board type 8760024 has a missing tooth in the middle. This board was in position 21 on the high slot beam."/>
Type: <input type="text" value="Geometry Board Issue"/>	
DB ID: <input type="text" value="645109fdb195d917942319f7"/>	

- Section A of the May document and the current summary gives the PID, configuration, production location, temp sensor configuration and SNs
- Section B would list problematic channels, but those are also listed as NCRs. I suggest we order the section of NCRs to have problem channels at the top followed by any other NCRs



**Wire Bobbin**

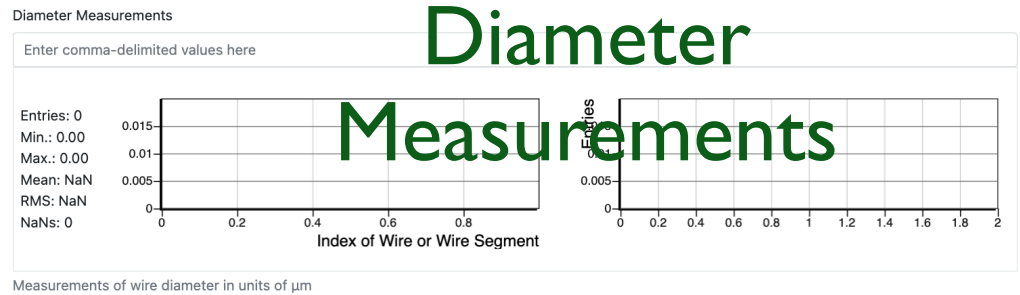
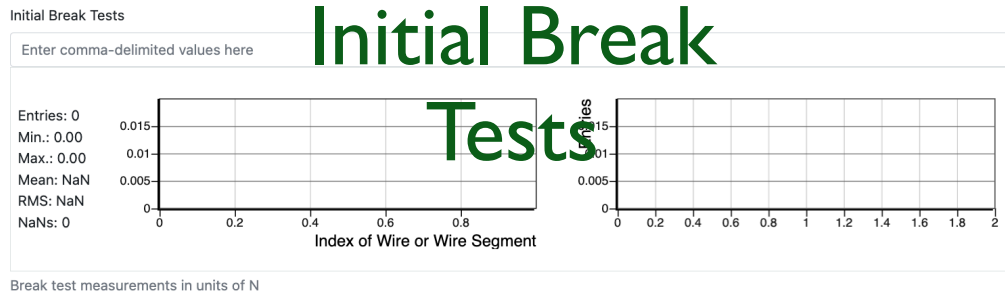
Manufacturer  
Little Falls

Wire Lot  
What is the manufacturer wire lot number of this wire?

Bobbin ID  
Which physical bobbin is this?

Initial Tensile Strength  
From supplied materials data sheet, units of PSI

Net Weight  
From supplied materials data sheet, units of pounds



Vendor and Lot

Bobbin ID

Initial Break Tests

Tests

Vendor Tensile

Strength and Net

Weight

Diameter

Measurements

- Section D of the May document captures tension information
- Each spool of wire has a unique ID in the DB
- DB records the vendor, lot, bobbin ID, vendor supplied data, initial break tests and diameter measurements
- No limits on number of measurements that can be input into the DB

# Wire Tensions II



## G Layer - Winding

Winder

Which winder is winding this layer?

Winder Maintenance Verification

### Maintenance Certifier

Name of the person certifying the winder is in operational condition

Tension Control Verification

### Tension Control Certifier

Name of person certifying the tension controls are ready for winding

Data Grid

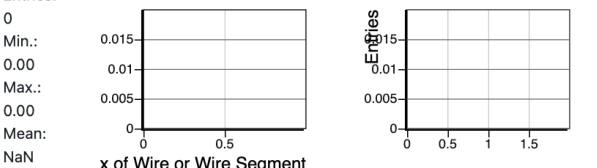
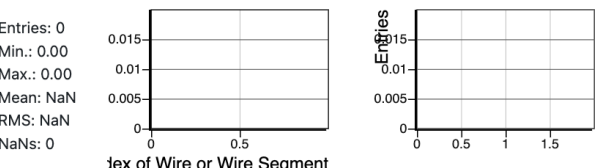
Winder Operator \*

### Operator Names

Who is operating the winder for this layer? Add rows for each operator

+ Add Another

Bobbins used for Winding

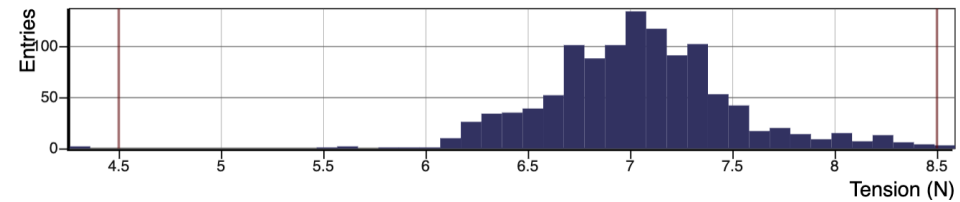
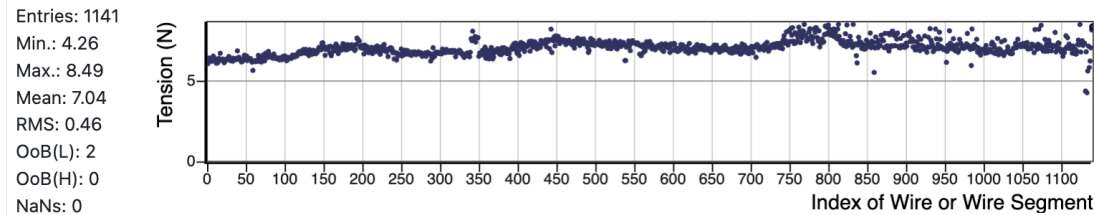
	Layer Wire Break Tests	End of Bobbin Break Tests	End of Bobbin Diameter
<p>Bobbin UUID <input type="text" value="Example: 123"/></p> <p>Bobbin Weight <input type="text"/></p> <h2>Bobbin Info</h2> <p>+ Add Another</p>	<p>Enter comma-delimited values here</p> <p>Entries:</p> <p>0</p> <p>Min.: 0.015</p> <p>0.00</p> <p>Max.: 0.01</p> <p>0.00</p> <p>Mean: 0.005</p> <p>NaN</p> <p>RMS:</p> <p>NaN</p> <p>NaNs: 0</p>  <p>x of Wire or Wire Segment</p> <p>Enter the comma separated values of the five break tests for this layer in units of N</p>	<p>Enter comma-delimited values here</p> <p>Entries: 0</p> <p>Min.: 0.00</p> <p>Max.: 0.00</p> <p>Mean: NaN</p> <p>RMS: NaN</p> <p>NaNs: 0</p>  <p>Index of Wire or Wire Segment</p> <p>Enter the five comma separate values of the break tests for the end of this bobbin, units of N</p>	<p>Enter the diameter of the wire at the end of the bobbin, units of <math>\mu\text{m}</math></p>

- We are adding more fields in the form for each layer's wind to store the name of the person certifying the winder is in good operating condition and the tension control is working properly
- We also added wire break test fields for each bobbin used on the layer
- As each bobbin is only used on a single layer, do we need both the layer break test info and the end of bobbin break test info?



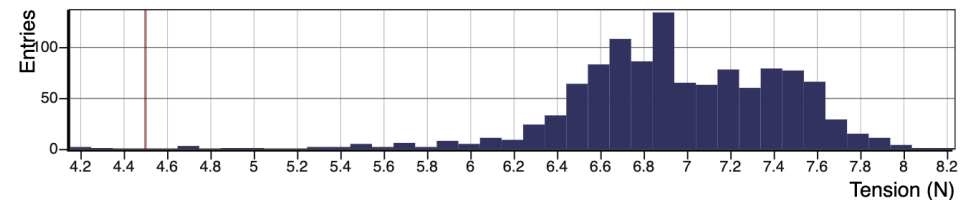
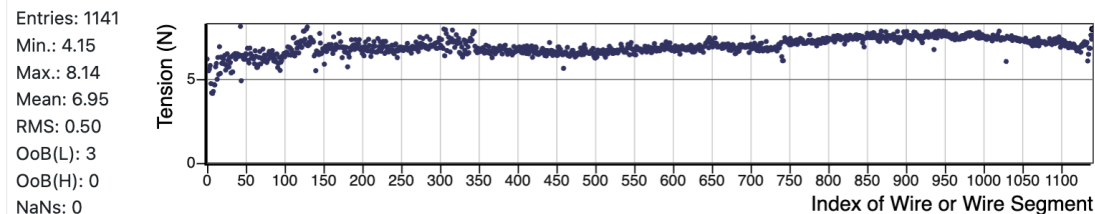
Measured Tensions (Side A)

6.39,6.06,6.4,6.21,6.39,6.22,6.2,6.36,6.52,6.4,6.29,6.31,6.08,6.17,6.12,6.38,6.28,6.7,6.28,6.3,6.34,6.22,6.11,6.31,6.25,6.33,6.35,6.31,6.5,6.45,6.25,6.24,6.26,6.21,6.39,6.36,6.36,6.3,6.38,6.85,6.34,6.45,6.37,6.33,6.17,6.17,6.35,6.27,6.58,6.34,6.3,6.53,6.25,6.33



Measured Tensions (Side B)

6.19,5.53,5.5,5.6,5.81,4.73,4.17,4.15,4.26,4.68,4.65,5.73,5.93,4.99,6.29,5.28,6.93,5.34,6.31,5.94,6.25,6.18,5.91,6.42,5.54,5.81,6.51,6.11,5.72,6.28,5.99,5.37,6.35,5.43,6.44,6.41,6.52,6.19,6.49,6.51,6.34,6.45,6.43,8.14,4.9,6.35,6.41,6.2,6.18,6.21,6.51,6.46,6.84,6.8



- The DB stores the tension for each segment on each layer and side, providing the above plots
- We are adding lines to the plots to indicate the desired limits for the tensions
- The stats info to the left gives min/max tension, mean tension, rms, and how many wires are out of bounds (OoB) low or high
- We are updating the code to add these plots to the summary



Frame Production Location \*

Durham Sheet Metal

Which institution or company made the frame?

Frame Number \*

21

Of the frames to be made at this location, which number is this one?

DUNE PID

D00300200001-00021-UK118-010000

EDMS URL for Compliance and Frame Inspection Documentation \*

<https://edms.cern.ch/document/2901108>

Where in EDMS is the compliance and frame inspection documentation stored?

Compliance Documentation missing from EDMS \*

- Nothing missing (all on EDMS)
- Frame Inspection
- EN1090 Exc2
- Welder Certification
- Weld Procedure Qualification
- Weld Compliance
- Material Test Report

Indicate which compliance documents are missing from EDMS for this frame. If all documents are present on EDMS choose "Nothing missing"

EDMS Location for Non-Conformance Documentation

<https://edms.cern.ch/document/2901102>

Where in EDMS is any non-conformance documentation for this frame kept?

Frame has non-conformance documentation

Are there non-conformance documents related to this frame? Check if yes.

- Section E of the May document captures frame information
- When a frame is accepted, it is entered into the DB and we store the EDMS location of where compliance and inspection and NCR documentation is stored (NCRs are also in the DB)
- We also indicate what documentation, if any, is missing - ideally none is missing, but that information can be edited later if needed
- The idea is that we should not be accepting frames if any documentation is missing





Measurement	Position	Nominal	Maximum deviation from nominal dimension	Actual	Max deviation from nominal	Measurement	Actual	Unit	Tolerance
Width of APA from the longitudinal axis, mm	LSS	1150	+2.0 (1)	1150.00	0.00	Cross corner deviation	1.6	mm	2.0 mm (1.0 target)
	HSS	1150	+2.0 (1)	1150.42	0.42				
Height of APA front the traversal axis, mm	-	6085	+1.1 (1)	6084.27	-0.73	Straightness of left side (HSS)	1.5	mm	1.5 mm (1.0 target)
Bow of foot beam in X-direction, mm	-	0	+4.2/2 - 0.75 = +1.35 (2)	0.35	0.35	Straightness of right side (LSS)	0.4	mm	1.5 mm (1.0 target)
Position of head tube connection interfaces holes from the longitudinal axis, mm	HE-9	575	±0.5 (3)	574.20	-0.8	Overall flatness	3.7	mm	11.0 mm
	HE-11	575	±0.5 (3)	574.18	-0.82	Overall bow	2.3	mm	11.0 mm
	HE-13	575	±0.5 (3)	576.23	1.23	<b>Twist</b>			
	HE-15	575	±0.5 (3)	575.33	0.33	Overall twist	-0.2	mm/m	1.0 mm/m
Angle between axis of head tube connection interfaces holes and the horizontal axis, degree	HE-9, HE-10	90	±0.5 degree (3)	89.81	-0.19	Twist zone 1	-0.3	mm/m	1.0 mm/m
	HE-11, HE-12	90	±0.5 degree (3)	89.42	-0.58	Twist zone 2	0.2	mm/m	1.0 mm/m
	HE-13, HE-14	90	±0.5 degree (3)	89.73	-0.27	Twist zone 3	0.2	mm/m	1.0 mm/m
	HE-15, HE-16	90	±0.5 degree (3)	89.52	-0.48	Twist zone 4	0.4	mm/m	1.0 mm/m
Position of Link M20 nut plate holes, mm	HSS-10	256.1	±0.4 (3)	256.19	0.09	Twist zone 5	0.5	mm/m	1.0 mm/m
	LSS-10	256.1	±0.4 (3)	255.97	-0.13	<b>Fold</b>			
	difference	0	±0.8 (3)	-0.22	-0.22	Foot tube	0.9	mm	1.2 mm
Angle between M20 nut plate axis from the longitudinal axis, degree	HSS-10, HSS-11	90	±0.5 degree (3)	89.76	-0.24	Rib 1	0.4	mm	1.2 mm
	LSS-10, LSS-11	90	±0.5 degree (3)	89.82	-0.18	Rib 2	0.2	mm	1.2 mm
Position of Foot tube vertical alignment pins holes from the longitudinal axis, mm	Alignment hole High slot side:	575	±0.5 (3)	575.12	0.12	Rib 3	0.5	mm	1.2 mm
	Alignment hole Low slot side:	575	±0.5 (3)	575.04	0.04	Rib 4	-0.3	mm	1.2 mm
Position of Link M20 nut plate holes (for ASF), mm	LSS-12	5880.1	±0.4 (3)	5879.43	-0.67	Head tube	0.7	mm	1.2 mm
	LSS-13	5584.1	±0.4 (3)	5583.74	-0.36	Maximum X deviation	2.1	mm	2.0 mm
	LSS-14	552.1	±0.4 (3)	551.61	-0.49	Maximum Y deviation	6.4	mm	2.0 mm
	HSS-12	5880.1	±0.4 (3)	5879.36	-0.74				
	HSS-13	5584.1	±0.4 (3)	5584.08	-0.02				
	HSS-14	552.1	±0.4 (3)	551.87	-0.23				

- Manchester Metrology is doing the surveys and supplies coordinates for each surveyed point and tables related to the envelope and flatness
- We are finalizing a system to upload those data from the supplied spreadsheets into the database (we just recently got the formats)
- We can add these tables to the QC summary if desired
- We already include any NCRs from the frame in the summary



- The May document has tick-boxes for whether bolt torques were checked, is that still desired in the summary? When/where is the check to be done?
- We propose adding a final step to the frame workflow for the formal acceptance of the frame at Daresbury
- The accepting person would fill out the form and indicate they are the one certifying all QC information has been reviewed and is in the DB
- Final QC checks could be added to this section, or at least confirmation that relevant documents have been reviewed
- The name of the person doing the certifying would go into the Assembled APA QC summary



- Section G from the May document captures survey information for the completed APA - are we still doing that survey?
- As with the frames, we suggest adding a final step to the APA workflow whereby the certifying person ticks through a list of QC checks that they attest to having been done and provides their name
- The list of QC checks could/would include
  - Conduits allow for PD pass through
  - Wire certification has been verified for each layer
  - Tensions have been checked and any NCRs approved
  - Other NCRs, either on APA itself or components such as mesh panels or frames have been approved
  - Any other checked desired by the TB, Compliance Office, etc



- This proposal aims to keep the summary to a few pages or less
- The most important information is at the top
  - Configuration of APA
  - Who has signed off on the frame and final APA
  - Number and location of problem channels
  - Other NCRs
- Then follows plots for the tension and tables for frame survey information

## DUNE APA Final Check List Summary

**Component UUID**

23def100-dd0d-11ed-9ed1-a9d6b1eaf785

**DUNE PID**

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Configurations and Names of Frame and Assembled APA Certifiers

Channel Non-Conformances

Other Non-Conformances

Tension Information by Layer

Frame Survey Information



- Most importantly the full list of information desired in the summary needs to be finalized before we can complete our work
  - We should consider what the most essential information is because if the list is too long the summary becomes more cumbersome to use
  - We could develop a second level summary with more information if desired
- The coding necessary appears to be pretty straightforward, Krish M is working on that
  - Of course we still need some time to finish it and that requires having a settled list of information to provide
  - We are working to make tension plots more informative with lines to indicate nominal tension,  $\pm 1 N$ ,  $\pm 2 N$
  - We are working on the code to upload the Manchester Metrology results into the DB, need to be sure the format of results is constant
- DB side work will be completed before the next APAs are shipped from Daresbury, assuming we have the final list in time