
QA/QC thoughts for module construction

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What can go wrong?

- Bars out of tolerance (too wide, too thick, not straight enough, etc)
- Light leaks around light case (especially the end caps)
- Broken/damaged fibres
- Scintillator not bright enough
- SiPMs not functioning
- SiPMS responding incorrectly
- etc



This talk

- QA/QC plans at a module factory
- QA/QC plans at cassette assembly (likely FNAL)
- QA/QC plans during/after installation



Testing before building

- Bars and fibre should be checked before building a module
 - Check dimensions of bars
 - Check for cracks in fibre
 - How? It's spooled up...
- Other injection-moulded/extruded components less obvious
 - Manifold, end plugs, etc



Tests during building

- CDR plan included “quad counters” which were tested for functionality before being built into a module
 - We don’t plan to do that
 - Mini-review noted the risk of building a 32-bar module before testing
- *We can* check fibre continuity before potting/flycutting
 - Shine a light in one end, look at the other
 - What else can go wrong at the single-bar level?



Tests after module assembly

- Each factory can have a set of 4 SiPM connectors (32 channels), with LEDs, and a single CAEN readout card
 - Only used for QA/QC – we always use the same readout, so expect the same response
 - Note – do we also need a data concentrator?
- Finish a module, connect SiPMs
- Take a few minutes of cosmic data to measure signal amplitude and frequency
- Flash LED, check response
- Shine bright light all around, check for increase in signal rates
- Disconnect SiPMs, declare module good



A note on SiPMs/electronics

- My assumption is that modules leave the factory with a protective cover on the fibre ends
- SiPMs don't need to be installed until later (probably after/during cassette construction)
- I won't discuss the plans for those...



Mechanical module tests

- We should also measure the width/length of each module
- And the “squareness” of the corners
- These are important to ensure cassettes will fit together correctly
- We don’t currently have requirements for these



Cassette construction

- Modules will have had a long drive
- Likely we want to run a light-leak test again
 - Need another SiPM+readout test setup
 - Plus bright light
- After cassette construction – what additional tests do we want to do?



What I don't propose doing

- Carefully scanning the length of a given bar
 - Either with cosmics or a source
 - What would we learn from this, that we can't calibrate out later?
- Mechanical tests of any cassette
 - They're big and heavy and hard to move...



Needs/costs

- We likely need 3x:
 - CAEN board, plus a simple DAQ
 - Set of 32 SiPMs (in 4 8-SiPM connectors)
- 3 because two factories plus FNAL cassette construction
- These can all be spares
 - Unless we also need concentrator boards – I hope we don't...



Hardware database

- DUNE has a hardware database for FD construction
- Every component gets a “PID”
 - Ideally referenced by a QR code which is printed on the component
- Join two components together? New PID – database can now track one item, knowing which two it’s made of
- App-based interface allows workers to scan an item in, log measurements, and track it from procurement to installation
- We should probably plan to use this to track all measurements made during construction
 - e.g. I’d be able to scan a cassette, and see what dates the 32 bars inside were produced, get the factory-site data on channel responses, etc



Thoughts?

- This is incomplete, but hopefully not incorrect
- This is the first step to including a detailed QA/QC plan as part of our construction plan

