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| TITLE: FDC QUALITY ASSURANCE PLAN | DATE: 01/12/2011 |
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**FDC QUALITY ASSURANCE PLAN**

1. **Scope**

FDC (Forward Drift Chamber) construction consists of constructing 24 drift chambers. Most of the drift chamber construction will be done in a Class 10000 clean room. Production is broken down into two main components, Cathodes and Wireplanes.

* Cathodes consist of a thin Kapton film with chemically etched copper strips attached and tensioned on a G10 frame. Key product characteristics involved with cathode production includes:
  + Soldering of flex circuit boards to foil – This process is the most difficult to accomplish in the FDC construction. As the process stands solder paste is applied to the foil via a laser cut stencil. The paste is then flowed with heated air to tin the contacts. During this portion of the process it is easy to delaminate the foil from the G10 frame. After the contacts are tinned the flex circuit is hand soldered to the foil. This process is also difficult as the copper on the foil is only 2 microns thick. If the soldering iron is applied too long the copper can vaporize and leave an open trace. Repairing this nonconformity is difficult and if it is not able to be repaired the cathode becomes useless. After soldering, a continuity check with an ohm meter will be performed and data recorded.
  + Foil strip resistance – During incoming inspection a precision ohm meter and custom test probes will be used to measure the resistance of the foil strips. This test will be done on all channels of all incoming foils.
  + Cutting and aligning of foils - A custom cutting fixture and microscope will be used to cut and align the foils.
  + Foil tension – A custom tension fixture and distance measuring laser will be used to set and verify foil tension. During initial tensioning 600 N/m (+20N/m) will be set and allowed to relax for 12 hours. After the foil has relaxed the tension must be 500N/m or greater. At this time there is no upper specification however this should be specified to reduce cathode to cathode variation.
* Wireplanes are fabricated by laminating a circuit board to a G10/Rohacell frame. Fine gauge sense and field wires are then strung across the circuit board at 5mm spacing. Key product characteristics involved with Wireplane production include:
  + Proper wire tension - Custom ground weights will be hung from each wire to set initial tension. The Sense wires will be tensioned to 20gm (-5gm/+10gm). The Field wires will be tensioned to 120gm (+/-30gm). After gluing and soldering each wire will be electromagnetically excited by a function generator and magnet and resonant frequency will be measured with the distance laser and correlated to a tension.
  + Precision wire placement - A measurement laser mounted on a precision motion stage is used to measure the center of each wire. Single wire placement spec is +/-50um and the entire scanned distribution is +/-25um.
  + Soldering wire to circuit board - An optical and USB camera microscope will be used to solder and inspect the solder joints)

1. **Responsibilities**

FDC Construction Coordinator (Dave Butler) - has responsibility for the quality of the FDC construction. Duties include overseeing quality initiatives for daily production activities, maintaining quality records, overseeing inspection of incoming production material and controlling nonconforming material. The FDC Construction Coordinator will also implement corrective action in conjunction with FDC engineers and physicist. Assist in determining and resolving nonconformance issues.

FDC Lead Mechanical Engineer (William Crahen) - has responsibility for mechanical design of FDC and ancillary fixtures and tooling required for production. Provides drawings and keeps them up to date. Assist in determining and resolving nonconformance issues.

FDC Lead Electronics Engineer (Fernando Barbosa) - has responsibility for design of electronic systems for the FDC. Assist in determining and resolving nonconformance issues.

FDC Lead Physicist (Lubomir Pentchev) - has ultimate responsibility for providing specifications for FDC construction. Assist in determining and resolving nonconformance issues.

FDC Scientist (Beni Zihlmann) – is responsible for electrical testing of the FDC packages. Assist in determining and resolving nonconformance issues.

Technicians (Mark Stevens, Casey Heck, Al Johnson, Mike Beizer, Tina Mann) – Responsible for incoming inspection of production material, production quality, entering quality data into travelers, identifying and reporting quality issues and assist in implementing corrective action.

JLAB Machine Shop - is responsible for machining various in-house fixtures and tooling for FDC production.

Vision Machine (Local Vendor) - is responsible for machining and initial quality of the following FDC production components:

* SOLID SPACER RING PN- D00000-01-03-2024
* SOLID G10 CATHODE FRAME PN- D00000-01-03-2039 and D00000-01-03-2040
* SOLID G10 WIREFRAME BACK PN- D00000-01-03-2041

1. **Document Control**

During FDC construction the “HALL D ENGINEERING DOCUMENT STANDARDS” document will be utilized for revision control of drawings. Procedures will be maintained in OCE and will be revision controlled. Travelers will be maintained in the Pansophy system. Personnel implementing a change are responsible to inform the involved parties. The FDC Construction Coordinator must be informed immediately of any change that will affect production.

FDC Production Procedures

(OCE)

FDC Travelers

(Pansophy)

FDC Production Drawings

FDC Data Spreadsheets

(Large data sets i.e. cathode foil inspection)

1. **Procurements**

Adhesive - Several adhesives are utilized in the construction of the FDC. The adequacy of these adhesives was determined during FDC prototyping or from experience from other detector construction. The adhesives will be ordered in logical batch sized due to shelf life limitations. Lot numbers from epoxies will be recorded in quality records and will be stored per vendor instruction.

1. **Quality Records**
   1. Inspection Records

Records will be entered and maintained electronically using the Pansophy traveler system. Inspection data will be entered in a timely manner during construction. Each traveler will point to the appropriate procedure(s) and drawing(s). All travelers will include the following minimum information:

* Technician(s) Name
* Time / Date
* Temperature / Humidity (if operation is performed in the clean room)

Completed travelers will be checked and submitted to the Pansophy database by the FDC Construction Coordinator.

* 1. Calibration

All new equipment will assume initial factory calibration to be accurate.

* Electronic equipment such as multi-meters and function generators will be sent out to a calibration house at manufacturer suggested calibration interval. Calibration records will be maintained at JLAB.
* Mechanical measurement systems such as height gauges, micrometers, calipers and distance measurement lasers will be checked yearly using in-house gauge blocks. If discrepancies are found they will be sent out for repair or will be replaced.
  1. Personnel Qualification

Personnel taking part in production will be trained in areas unique to the FDC construction by JLAB personnel that established the construction methods during prototype fabrication. Personnel will demonstrate the construction methods before being allowed to use them on a production basis when possible. All personnel will complete the construction methods in as close to the same manner as possible to reduce production variation. Basic technician skills will be assumed per interview and previous lab work.

1. **Non-Conforming Items**

Procedure QACI-015 (Control of Nonconforming Material or Product Procedure) will be used for all nonconforming material issues during FDC construction. The FDC Construction Coordinator will be responsible for the handling of Nonconforming Material. If required quarantine areas will be established inside the cleanroom and in the high bay work area of the Bluecrab facility. Nonconforming material should not be removed from the cleanroom until it has been determined it will not be used for production.