

Please add the following to LAT-PS-00635 Tracker SSD Ladder Assembly Procedure:

- A) In addition to BTEM success, please add details and summary from LAT-TD-00879, LAT-TD-00880 and lessons learned. This will show that this procedure is based on ladders assembled using a similar process that had success during testing.
- B) **Section 4 references** Item 16 details should be corrected to LAT-MD-00228-D2-GLAST LAT CAL TKR and DAQ Contamination Control Plan. Item 17 should be 8739.7 Electrostatic Discharge Control. Add new item MIL-STD-45662 Calibration System Requirement or the ISO 9001 equivalent. Add new item D2240- Identification Hardness of Plastics by means of a Durometer.
- C) **Add: New sections for materials.** Material vacuum out-gassing will be determined in accordance with ASTM-E-595. Only material that has total mass loss (TML) less than 1.00% and a collected volatile condensable Mass (CVCMM) of less than .10% will be used. The complete materials details should be added. **Add: New section for equipment.** Add details of the equipment planned to use.
- D) **Add: New section for Electrostatic Discharge.** This section should describe ESD work stations, use of ESD protective clothing, personnel grounding when required, certification of personnel handling ESD items, wrist strap verification, work station verification for surface resistivity, chair and stool of static dissipative materials, etc.
- E) **Add: New section for transportation of SSD and Ladder Assembly.** Controls are required during transportation and verification of shocks attached to transportation container.
- F) **Section 5.1 Personnel Training.** Add only trained personnel and competent technicians shall perform processing of various operations described here. All personnel in contact with hardware shall be trained and certified for:
 - 1) ESD
 - 2) Clean room
 - 3) Wire Bonding Machine
 - 4) Bonding of SSD's
 - 5) Handling of SSD'sTraining records shall be maintained
- G) **Add: Facilities Approval Inspection.** Facilities approval inspection is performed using a checklist. Verification shall be performed on sample units produced with equipment and procedures used for production. Facility approval inspection shall consist of all the examination and test in this specification
- H) **Add: Material Control.** All material used shall be verified against the appropriate documentation for conformance to specifications via material certification or certificate of compliance from the manufacturer for proprietary items. All materials shall be within the original shelf life and stored per the manufacturer's recommendations in terms of proper containers and storage environment. The adhesive trade name, mix ratio, lot number, expiration date, material usage time, etc., should be recorded in the manufacturer's traveler.

All materials received without the proper documentation shall be placed on hold until the documentation problems are resolved. All safety requirements prescribed in the Material Safety Data Sheets (MSDS) must be followed in the use of, handling or mixing the materials listed in the specification. Personnel handling chemicals and involved with the bonding operation must wear nitrile un-powdered gloves impervious and resistant to solvents. Care must be exercised to avoid the possibility of introducing contamination in the epoxies or onto prepared surfaces. Mix log records shall be used for all processes and filled out in its entirety and shall be included on the traveler. Add first 2 sentences to 635.

- I) **Section 5.2 Add: This database will be linked to a Configuration Control system.** The traveler will reflect the latest revision of the procedure and documents being used for the specific operation. This database shall also be linked to a non-conformance control system. Various reports shall be made available if required, such as open travelers (work incomplete), closed travelers (work completed), NCMR's associated with the traveler, open NCMR's, and status of each. Put procedure rev in database.
- J) **Section 5.3 Independent Source Inspections.** Add: Mandatory inspection points selected by SLAC will be communicated to INFN. By Darren
Figure 1 add: Add to figure
i) Inspection points after WS2, which involves alignment and gluing (bonding of Silicon detectors).
ii) Inspection points after WS4 wire bonding
iii) Sample electrical test of Ladders in the beginning of the wire bonding shift, end of the shift, and when the wire-bonding machine requires maintenance after WS4
iv) Inspection (visual) after WS8 prior to storage.
- K) **Section 6 Table 1** To be revised with new encapsulation and dam materials, which meets NASA out-gassing requirements. All wire requires special storage requirements and shelf life, to be added to this document. Incomplete information in the table should be completely filled out. Part of source inspection
- L) **Section 7**
Correct the name of the Tracker Contamination Control Plan. Latex gloves should be powder free and limit the usage of disposable lab coats, which are used in the contamination control room.
Paragraph 7.2 Handling. Expand this section to include handling of SSD's from receipt at INFN, to inspection at INFN, and the shipping of the SSD's to assembly contractors. Change clean paper envelope to lint free, clean room paper to avoid contamination and re-cleaning of SSD's . This section should also include the handling of the Ladder Assembly during bonding (gluing), wire bonding, storage, inspection, and shipping to INFN. Please define precautions to be taken during handling. The vacuum pen and vacuum tool should be verified frequently for wear on the cups and contamination. A

special training seminar should be conducted to prevent damage during handling

Paragraph 7.3 Material Receiving and Inspection. Define the criteria for acceptance and rejection of the SSD's that can't be cleaned with Nitrogen. Also define the types of defects that are acceptable. If large physical damage then specify retest. Change judge to determine.

Paragraph 7.4 SSD Edge Bonding Working Stage 2. Please define the acceptance/ rejection criteria for voids, cracks, bubbles, thickness and width of edge bonding. Define the criteria for bond and adhesion verification. Please add shear strength, tensile test, and pull verification test requirements. Hardness verification on adhesive sample should be added to the traveler. Does this material require vacuum degassing prior to application to avoid voids and bubbles? Ladder assembly jig and adhesive deposit tools should be verified at a regular frequency.

Section 7.5 Metrology (working Stage 3). Acceptance / rejection criteria should be clearly defined and nothing should be left for judgment.

Section 7.6 Wire bonding (Working Stage 4) Because of the high incidence of failure due to wire bonds and the large numbers of variables that can affect wire bond reliability, a thorough inspection and wire bond testing criteria is important. A visual Inspection criterion is specified in MIL-STD-883 method 2017, which defines and pictorially depicts acceptance and rejection criteria for wire bonds. The criteria's are largely based on geometries, locations, and appearance of the bonds. An over bond condition caused by excessive force or temperature should be rejected because of the highly deformed shape and thin cut edges. A visual inspection by trained personnel is helpful in detecting and removing marginal bonds, but is not fool proof.

Hence, this section should define the criteria for wire control (shelf life and storage), cleanliness of wire bond pads, process control (M/C and operator controls), criteria for non-destructive bond pull, acceptance / rejection force limits, qualifications of wire bond, shaping of wire bond, visual examination criteria for wire bond, operator certification, and plots of SPC control.

List some of the items that the operator should look for visually. Sandro will ask about visual inspection standard

Section 7.7 Electrical Test This section is to be modified for sample electrical test. Limit backlog

Section 7.8 Encapsulation of wire bonds Since the materials do not meet NASA outgassing criteria, alternate materials to meet these requirements should be selected. I have used Hysol FP4451, FP4451TD, FP4450, FP4450LV, and FP4651 in NASA chip on board applications.

Section 7.10 Complete this section with the relevant details.

Section 711 The storage box will allow the Ladders to move inside the box during handling and shipping.

M) **Section 8** Complete the missing details.

N) **Section 9** MIPOT details should be deleted.

