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LHC-MAG-R-1015D
Page 1 of 4

1. Scope:

This specification describes the procedure for insulation of the LHC 8cm Dipole beam tube and for bumper application following insulation.

2. Applicable Documents:

The following documents, of the issue in effect at the time of release for manufacture, form a part of this procedure to the extent specified herein:

RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-OPM-8.1.1.27	Operation of Beam Tube Wrapper
RHIC-MAG-R-7261	Beam Tube Assembly Hypot Testing

BNL drawings

14010091	Beam Tube, Prototype Assembly
14010139	Beam Tube, D2/D4 Assembly
12010181	Insulation, Polyimide Film
14010199	Beam Tube Assembly (D3)

Materials:

12010008-SPM2	8cm dipole Bumper Application Fixture
12010181-21	Kapton Tape, Pressure Sensitive Adhesive Backed
BNL E54075	Alcohol
BNL I83312	Paper wipes

3. Requirements:

The beam tube shall be insulated in accordance with the drawings and parts lists, and the manufacturing sequence described below.

3.1 Traveler Data

The beam tube assembly procedure shall be performed in the listed sequence. Where indicated, the operation shall be initialed to indicate completion. Where conditions require a change in operations or sequence, it shall be noted.

3.2 Safety Precautions

3.2.1 Some of the electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES&H Standard.

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LHC-MAG-R-1015D
Page 2 of 4

3.2.2 Hypot and impulse testing pose a Class "C" electrocution hazard. At least two properly trained technicians must be present to perform this testing. When testing, a trained technician shall be stationed at any point where the item under test is accessible to unauthorized people, and barriers shall be set up. Signs shall be posted reading "DANGER HIGH VOLTAGE" and warning lights shall be turned on.

3.3 Procedure

3.3.1 Preparation

3.3.1.1 Operators shall be instructed by their cognizant technical supervisor in the details of wrapping of the beam tube.

3.3.1.2 Operators assigned to wrapping the beam tube, prior to assembly with the BPM, shall be qualified by their supervisor in the safe operation of the Beam Tube Wrapper, RHIC-OPM-8.1.1.27.

3.3.2 Handling - The beam tube may be damaged by improper handling. It must be supported to prevent permanent distortion during all wrapping operations.

3.3.3 Wrapping - The beam tube shall be supported by free rolling support rollers while moving through the wrapping station.

3.3.4 Insulation Procedure

3.3.4.1 Inspect the beam tube for bends, kinks and surface damage such as deep scratches.

3.3.4.2 Cleaning - Clean the beam tube surface with alcohol and clean wipes, until no contamination is evident on the wipe.

3.3.4.3 Set the controls to their initial settings (RHIC-OPM-8.1.1.27, Para.5.6).

3.3.4.4 A copy of the applicable drawing should be available at the wrapping machine. Any discrepancies between the drawing and this MAP must be brought to the attention of the cognizant engineer before work begins.

MAINTAIN INTERIOR CLEANLINESS IN THE BEAM TUBE DURING THE FOLLOWING OPERATIONS. REPLACE END CAPS PROMPTLY.

3.3.4.5 Remove protective end caps from the beam tube ends. Mount the beam tube on the rollers in the wrapping machine, with the serial numbered end projecting from the wrapping head.

3.3.4.6 Clean the chain attachment fittings thoroughly, using alcohol and clean paper wipes. Tighten the chain attachment fittings until they do not slide or move under heavy hand pressure. Attach the drive chain to the tube using the fittings, and take up the chain slack

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LHC-MAG-R-1015D
Page 3 of 4

in the wrapping machine.

CAUTION: In the setup of this machine, the operator may have to work within the guarded section of the wrapping head. The access doors to the wrapping head are electrically interlocked. When the doors are open the wrapping head is electrically de-activated and cannot rotate. An interlock test procedure is part of the OPM to assure that these door interlocks are operational. As an additional safety measure the operator should check that the door interlocks are operational before setting up the machine.

- 3.3.4.7 Using a 2 inch piece of adhesive backed tape, secure the end of the Kapton tape (12010181-13) to the beam tube in the location indicated on the applicable drawing.
 - 3.3.4.8 Set speed controls for proper pitch of tape.
 - 3.3.4.9 Wrap one layer at $46\% \pm 3\%$ overlap as shown on the assembly drawing. Secure the end of the tape with a 1 inch piece of adhesive backed tape. Maintain tape tension in the range of 5-10 lbs. during wrapping.
 - 3.3.4.10 Wrap a second layer at $46\% \pm 3\%$ overlap as shown on the assembly drawing. Secure the end of the tape with a 1 inch piece of adhesive backed tape. Maintain tape tension in the range of 5-10 lbs. during wrapping.
 - 3.3.4.11 Energize the oven and pass the wrapped tube back through the machine oven to the starting point to set the tape adhesive. Adjust the speed of the tube to 10 ± 1 inches per minute and allow the tube to cool before proceeding.
 - 3.3.4.12 After the tube cools, examine the tube for uniformity of the wrap, and verify that the Kapton has formed a continuous layer. Trim only the start end of the wrap to dimension shown on the drawing and remove excess.
 - 3.3.4.13 Secure the Kapton wrap with a hose clamp or lacing cord and adhesive as shown on the assembly drawing.
 - 3.3.4.14 Disconnect chain from attachment fittings. Remove fittings from tube and wipe inside of tube ends with alcohol and paper wipes to clean the tube. Replace the tube end caps to maintain cleanliness.
- 3.3.4 Bumper Application
- 3.3.5.1 Clamp the wrapped beam tube in bumper application fixture with the serial number end banked against the stop.
 - 3.3.5.2 Clamp a midplane bumper in each side plate. |
 - 3.3.5.3 Apply epoxy (P/N 12040041) to each bumper, install and clamp each side plate.

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LHC-MAG-R-1015D
Page 4 of 4

- 3.3.5.4 Allow epoxy to cure at room temperature for approximately 4 hours.
- 3.3.5.5 When the epoxy is fully cured, unclamp and remove the side plates.
- 3.3.5.6 Unclamp and remove the top plates and remove the tube from the fixture.
- 3.3.5.7 Reposition the tube in the application fixture and repeat steps 3.3.5.2 – 3.3.5.6 as required to complete the “midplane” bumper installation per the assembly drawing.
- 3.3.5.8 Rotate the tube 90⁰ and reposition the tube in the application fixture and repeat steps 3.3.5.2 – 3.3.5.6 to install the vertical bumpers per the assembly drawing.
- 3.3.5.9 Reposition the tube in the application fixture and repeat steps 3.3.5.2 – 3.3.5.6 as required to complete the vertical bumper installation per the assembly drawing.

3.3.6 Electrical Check

CAUTION: Be sure the Hypot and beam tube are grounded at all times. Failure to observe this caution may result in electrocution.

- 3.3.6.1 Place the beam tube assembly on the support stand. Hypot the assembly at 5kV per RHIC-MAG-R-7261.

4. Quality Assurance:

The Quality Assurance provisions of this procedure require that all instructions be complied with. All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

5. Preparation for Delivery:

N/A