

1 Scope:

This specification describes the procedure for insulation of the LHC D1 (78mm) 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

12010181	Insulation, Polyimide Film
14010193	Beam Tube Assembly (D1)

Materials:

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.

- 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.
- 3.2.3 Operators shall be instructed by their cognizant technical supervisor in the details of wrapping of the beam tube.
- 3.2.4 Operators assigned to wrapping the beam tube shall be qualified by their supervisor in the safe operation of the Beam Tube Wrapper, RHIC-OPM-8.1.1.27.
- 3.2.5 Latex gloves should be worn when using alcohol cleaners to protect from incidental contact.
- 3.3 Procedure
 - 3.3.1 Preparation

NOTE 1

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

NOTE 2

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

- 3.3.1.1 Inspect the beam tube for bends, kinks and surface damage such as deep scratches or dents. Report any surface damage to the cognizant engineer.
- 3.3.1.2 If the tube is not clean from the vendor, Clean and degrease it thoroughly with alcohol and clean wipes until no residue is evident on the wipe.
- 3.3.2 Kapton Bumper Application
 - 3.3.2.1 Support beam tube on plastic rollers or plastic V-blocks. With the help of a straight-edge, mark locations of the kapton bumpers on the beam tube with a felt tip marker. Bumper locations are per the applicable engineering drawing (14010193). Make sure that bumpers on each side will be directly opposite one another and 180⁰ apart.

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LHC-MAG-R-1042A

Page 3 of 5

- 3.3.2.2 At each of the 31 bumper locations, use a micrometer to measure the O.D of the tube. At each location take two perpendicular measurements. Record diameters in traveler and calculate the average at each location.
- 3.3.2.3 To calculate the thickness of Kapton bumper required at each location, subtract the average diameter from 3.104". Apply a thickness of bumper equal to one-half this amount (within $\pm .002$ ") to each side of the tube on the locations marked in 3.3.2.1. The bumpers shall be cut to length prior to installation.
- 3.3.3 Insulation Procedure
- 3.3.3.1 Set the controls to their initial settings (RHIC-OPM-8.1.1.27, Para.5.6).
- 3.3.3.2 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.

NOTE

**Maintain interior cleanliness in the beam tube during the following operations.
Replace end caps promptly.**

- 3.3.3.3 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.
- 3.3.3.4 Clean the chain attachment fittings thoroughly, using alcohol and clean paper wipes.
- 3.3.3.5 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 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.

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LHC-MAG-R-1042A

Page 4 of 5

- 3.3.3.6 Using a 2 inch piece of adhesive backed tape, secure the end of the Kapton insulating tape to the beam tube in the location indicated on the applicable drawing.
- 3.3.3.7 Set speed controls for proper pitch of Kapton wrap, 60 rpm head speed, 20 inches per minute tube speed.
- 3.3.3.8 Wrap one layer of Kapton at $63\% \pm 3\%$ overlap as shown on the assembly drawing.
- 3.3.3.9 Secure the end of the Kapton with a 1 inch piece of adhesive backed tape. Maintain Kapton tension in the range of 5-10 lbs. during wrapping.
- 3.3.3.10 Apply a single layer of .005 x 1.00 in. non-adhesive kapton film using a 25% overlap, maintaining a tension of at least 25 lbs.
- 3.3.3.11 Energize the oven and pass the wrapped tube back through the machine oven to the starting point to set the Kapton adhesive. Adjust the speed of the tube to 10 ± 1 inches per minute and allow the tube to cool before proceeding.
- 3.3.3.12 After the tube cools, remove the .005 x 1.00 in. kapton overwrap. Examine the tube for uniformity and smoothness of the insulating wrap. Verify that the Kapton has formed a continuous layer with no bubbles or heavy ridges. Trim only the start end of the wrap to dimension shown on the drawing and remove excess.
- 3.3.3.13 Secure the Kapton wrap with a hose clamp or lacing cord and adhesive as shown on the assembly drawing.
- 3.3.3.14 At each of the 31 bumper locations, use a micrometer to measure the O.D of the tube across the bumpers. Record diameters in traveler.
- 3.3.3.15 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.

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LHC-MAG-R-1042A

Page 5 of 5

3.3.4 Electrical Check

CAUTION

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

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

NOTE

Max allowable leakage is 50 μ A

4 Quality Assurance:

- 4.1 The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.

- 4.2 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

- 4.3 All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

5 Preparation for Delivery:

N/A