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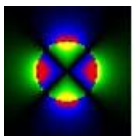
Magnet Division Procedure

Proc. No.: SMD-AGS-3012

Revision: A



Superconducting
Magnet Division

AGS Snake Dipole Corrector, Solenoid Coil Winding and Curing

- Prepared by: Signature on File
- Cognizant Engineer: Signature on File
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- Cognizant Electrical Engineer: Signature on File
- Q. A. Approval: Signature on File
- ES&H Review: Signature on File

Revision History

Rev A: Initial Release

1 Scope:

This MAP describes the procedure used for winding & curing of AGS Snake Dipole Corrector, and Solenoid Corrector Coils

2 Applicable Documents:

RHIC-MAG-Q-1000	Control of Measurement Test Equipment
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
RHIC-MAG-R-7242	RHIC Hypot Testing
RHIC-MAG-R-7227	Electrical Resistance Meas. Individual Coils
RHIC-MAG-R-7228	Magnet Coil Inductance and Q Measurement
RHIC-MAG-R-7318	Dipole /Quadrupole Inductance Testing
SMD-OPM-8.1.1.32	Operation of CBA Beam Tube Wrapper
SMD-OPM-8.1.1.36	DESY Wiring Machine
21010009	Coil Assembly
12010181	Insulation, Polyimide Film

3 Requirements:

3.1 Material/Equipment

Mounting Clamps	
Acetone	
Insulated Gloves	BNL Stock No. K-63025
PVC Gloves	BNL Stock No. K-62649
Nitril Gloves	BNL Stock No. K-62664(L); K62662(M)
Test Cart	ETS-001
Micrometer	

3.2 Safety Precautions

3.2.1 The operator shall be instructed by the Cognizant Technical Supervisor in the safe operation of the Helical Wiring Machine.

3.2.2 The operator shall be instructed by the Cognizant Technical Supervisor in the safe operation of the Beam Tube Wrapper.

3.2.3 Operators shall wear safety glasses with side shields, or goggles.

3.2.4 Operators shall wear insulated gloves when handling heated coil assembly.

3.2.5 Personnel shall wear Nitrile gloves while handling epoxies, acetone, ethanol, or methanol cleaning agents.

3.2.6 The technicians shall be instructed by their cognizant technical supervisor in the operation of the required test equipment and these electrical testing procedures. They shall be familiar with the latest revision of the applicable documents referenced in section 2. In addition, some of these tests require the technician to have special training. A list of qualified personnel shall be maintained with the Training Coordinator.

3.2.7 Some of these 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. Operators shall wear safety glasses with side shields or goggles.

3.2.8 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.

3.2.9 Caution: to avoid the possibility of static build-up during and discharge during coil winding operation, the following grounding must be installed. Attach a ground wire to the coil support tube. Attach incoming lead for coil block being wound to ground. After all the coil blocks are wound remove the ground wires.

4 Procedure

4.1 Insulation Procedure

4.1.1 Inspect the support tube for damage such as dents or deep scratches.

4.1.2 Clean the support tube surface with alcohol and clean wipes, until no contamination is evident on the wipe.

4.1.3 Butt wrap over tube with .003” B-stage impregnated fiberglass tape with a tension of approximately 10 lbs..

4.1.4 Using a 2 inch piece of adhesive backed tape, secure the end of the Kapton tape (12010181-44) to the support tube in the location indicated on the assembly drawing.

4.1.5 Wrap one layer at 66% + 3% overlap as shown on the assembly drawing. Secure the end of the tape with a 2 inch piece of adhesive backed tape. Maintain tape tension during wrapping.

4.1.6 Wrap coil with B-stage epoxy impregnated S-glass fibre roving @15lbs tension and 16 turns per inch. Wrap over full length of Kapton.

4.1.7 Wrap tube with a 50% overlap of .003" Teflon tape.

4.1.8 Cure tube assembly at 125^0C for 90 min. Remove Teflon tape.

CAUTION

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

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

4.2 Dipole Corrector #1 - Lead End

4.2.1 Mount support tube into winding machine making sure drive is engaged in lead end flange.

4.2.2 Adjust jaws of mounting chucks to minimize run out.

4.2.3 Using 2" wide material, apply substrate to tube in a spiral wrap in location of both dipole corrector coils as shown on the assembly drawing. Extend substrate 1" past calculated coil ends.

4.2.4 Measure and record diameter and run out measurements every 15^0 around circumference at 3 axial positions. Forward data to Cognizant Electrical Engineer.

4.2.5 Allowing a minimum of 6' coil leads, wind the coil layer using the appropriate wiring file.

4.2.6 Allowing a minimum of 6' coil lead, cut coil lead from wiring machine.

4.2.7 Solder voltage tap wires (2) between first and second pole at midplane and insulate with Kapton tape.

4.2.8 Install Nomex wedge spacers into coil. Temporarily hold in place by applying a few drops of acetone to uncured substrate. Nomex end spacers should be flush with ends of substrate. Route exiting voltage tap wires through gaps in Nomex end spacers.

NOTE

Blue epoxy, Teflon tape and substrate will all be wrapped around this wire.

4.2.9 Apply blue epoxy (2850 FT [12011227] + 24 LV catalyst [12011228]) to coil filling in all voids between Nomex and conductor and between conductors. Squeegee away any excess.

4.2.10 Immediately wrap coil with a 50% overlap wrap of .003" Teflon tape.

4.2.11 Over Teflon, butt wrap .005" thick x 2" wide Nomex with a minimum of 5 lbs. tension.

4.2.12 Allow to cure overnight.

4.2.13 Perform electrical measurements per Appendix 1.

4.3 Dipole Corrector #2 - Non-Lead End

4.3.1 Measure and record diameter and run out measurements every 15^0 around circumference at 3 axial positions. Forward data to Cognizant Electrical Engineer.

4.3.2 Allowing a minimum of 9' coil leads, wind the coil layer using the appropriate wiring file.

4.3.3 Allowing a minimum of 9' coil lead, cut coil lead from wiring machine.

4.3.4 Solder voltage tap wires (2) between first and second pole at midplane and insulate with Kapton tape.

4.3.5 Install Nomex wedge spacers into coil. Temporarily hold in place by applying a few drops of acetone to uncured substrate. Nomex end spacers should be flush with ends of substrate. Route exiting voltage tap wires through gaps in Nomex end spacers.

NOTE

Blue epoxy, Teflon tape and substrate will all be wrapped around this wire.

4.3.6 Apply blue epoxy (2850 FT [12011227] + 24 LV catalyst [12011228]) to coil filling in all voids between Nomex and conductor and between conductors. Squeegee away any excess.

4.4 Over-Wrap & Final Checks of Corrector

4.4.1 Immediately wrap coil with a 50% overlap wrap of .003" Teflon tape.

4.4.2 Over Teflon, butt wrap .005" thick x 2" wide Nomex with a minimum of 5 lbs. tension.

4.4.3 Cure coils at 175° C. for 90 minutes.

4.4.4 Remove Nomex and Teflon tape from both coils.

4.4.5 Perform electrical measurements on both coils per Appendix 1.

4.4.6 Take diameter measurements and record (data sheet).

4.5 Solenoid Corrector – Layer #1

NOTE

Make sure cut coil leads (4) are out of the way and secured to the tube

4.5.1 Apply transfer tape in a spiral wrap over the insulated tube.

4.5.2 Allowing a minimum of 8' coil leads, wind the first layer using the appropriate wiring file.

4.5.3 Solder voltage tap wires (2) between first and second coil layers and insulate with Kapton tape.

4.5.4 Install G-10 end parts into coil. Temporarily hold in place by applying a few drops of acetone to transfer tape if necessary.

4.5.5 Make sure coil wire, still attached to winding machine, is up and out of the way.

NOTE

Blue epoxy, Teflon tape and substrate will all be wrapped around this wire.

4.5.6 Trim transfer tape to be flush with G-10 parts at both ends of the coil.

4.5.7 Apply blue epoxy (2850 FT [12011227] + 24 LV catalyst [12011228]) to coil filling in all voids between G-10 and conductor and between conductors. Squeegee away any excess.

4.6 Overwrap - Solenoid Layer #1

4.6.1 Using a 2 inch piece of adhesive backed tape, secure the end of the Kapton tape (12010181-44) to the support tube in the location indicated on the assembly drawing.

4.6.2 Immediately wrap one layer at 66% + 3% overlap as shown on the assembly drawing. Secure the end of the tape with a 2 inch piece of adhesive backed tape. Maintain tape tension during wrapping.

4.6.3 Wrap coil with a 50% overlap wrap of .003" Teflon tape.

4.6.4 Over Teflon, butt wrap .005" thick x 2" wide Nomex with a minimum of 5 lbs. tension.

4.6.5 Allow to cure overnight. Remove Nomex and Teflon tape.

4.7 Solenoid Corrector – Layer #2

4.7.1 Apply transfer tape in a spiral wrap over 1st layer.

4.7.2 Reposition wiring head and rewind any slack wire.

4.7.3 Using the appropriate wiring file wind the second layer of the solenoid corrector.

4.7.4 Allowing a minimum of 8' coil lead, cut coil lead from wiring machine.

4.7.5 Take diameter measurements and record (data sheet).

4.7.6 Perform electrical measurements per Appendix 1.

4.7.7 Install G-10 end parts into coil. Temporarily hold in place by applying a few drops of acetone to transfer tape if needed.

4.7.8 Install coil assembly into fiberglass wrapping machine.

4.7.9 Apply blue epoxy (2850 FT [12011227] + 24 LV catalyst [12011228]) to coil filling in all voids between G-10 and conductor and between conductors. Squeegee away any excess.

4.8 Cure

4.8.1 Using a 2 inch piece of adhesive backed tape, secure the end of the Kapton tape (12010181-44) to the support tube in the location indicated on the assembly drawing.

4.8.2 Immediately wrap one layer of Kapton at 66% + 3% overlap as shown on the assembly drawing over all three coils. Secure the end of the tape with a 2 inch piece of adhesive backed tape. Maintain tape tension during wrapping.

4.8.3 Allow to cure overnight.

4.8.4 Butt wrap over all coils with .003" B-stage impregnated fiberglass tape.

4.8.5 Wrap coils with B-stage epoxy impregnated S-glass fibre roving @28lbs.tension and 18 turns per inch over full length of coils and Kapton.

4.8.6 Take diameter measurements and record (data sheet).

4.8.7 Prepare all exiting coil leads. Add (1) superconducting lead stabilizer and (2) voltage tap wires to each exiting lead and insulate with Kapton tape. Route leads over other coils as necessary and to end of tube, adding Nomex on either side of exiting leads and over exiting leads for support, and extra Kapton between exiting leads and coil layers underneath. Secure in place.

4.8.8 Wrap exiting leads with B-stage epoxy impregnated S-glass fibre roving @15lbs. tension and 16 turns per inch. Wrap over full length of leads until the end of the tube.

4.8.9 Cure coil assembly at 125^0C for 90 min.

4.8.10 Perform electrical measurements per Appendix 1.

4.8.11 Perform warm magnetic measurements.

5 Quality Assurance Provisions:

5.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.

5.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC- MAG-Q-1004.

5.3 Measuring and test equipment used for this procedure shall contain a valid

calibration label in accordance with RHIC-MAG-Q-1000.

6 Preparation for Delivery:

6.1 N/A

Appendix 1 - Testing of Coil Assembly

1. Perform Coil Hypot

CAUTION

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

- Perform an ohmmeter check of the resistance between the coil under test and ground following RHIC-MAG-R-7243. Verify that the resistance is at least 20 mega-ohms.

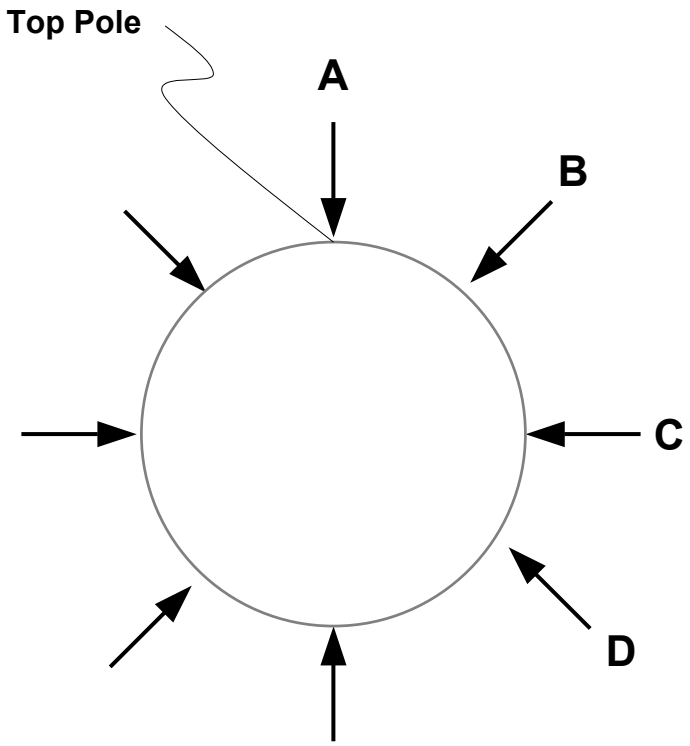
- Perform a 5 Kv hypot between the coil under test and ground per RHIC-MAG-R-7242 and RHIC-MAG-R-7243.

NOTE

The leakage current must be less than 50 µa.

2. Measure coil temperature. Measure voltage drop across each coil at 1 amp DC, following RHIC-MAG-R-7227. Complete the measurements of inductance and quality factor (Q) following RHIC-MAG-R-7228.

3. Attach computer printouts of electrical test data to the traveler.



	AXIAL POSITION		
	1″ In from LE (*)	Center	1″ In from NLE (*)
A			
B			
C			
D			

* Dimensions are from end of coil winding

Figure 1
Sample Data Sheet