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Large Hadron Collider
Magnet Division Procedure

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Title: LHC 8 cm Dipole Coil Curing in the NGC Long Press

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REVISION RECORD

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A	9/6/00		Initial Release.	
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1 Scope:

This procedure describes the methods used in curing an 8cm Dipole coil in the NGC long curing press. Appendix A provides the basic data used to program the NGC computer for the automatic curing cycle operation.

2 Applicable Documents:

BNL Dwg. No. 14010130	8cm Dipole Coil Winding & Curing Assembly
SMD-OPM 8.1.1.38	Operation of the NGC Long Coil Curing Press
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure

3 Requirements:

3.1 Material/Equipment - The following process materials are referenced for use in this procedure and shall be controlled for procurement, use, storage and handling by the documents or catalog descriptions listed below. Substitutions require prior approval by the Cognizant Engineer.

Procedure Reference	Technical Reference	Source/Control
Degreaser Cleaner	LPS Contact Tucker, GA	LPS Industries Inc.
	Zepspree	ZEP, Inc., GA
Frekote 700	Frekote Release Interface	Frekote Products Bulletin 700
Teflon	Film Type 200PH (.002 in.-thick x 6 in.-wide)	E.I. DuPont Co., Inc. Fabricated Products Dept.
Kapton	Tape ½ in.-wide 0.0005 in.-thick; 0.0005 in.-thick Silicone Adhesive	R.H. Carlson P.O. Box 1687 Greenwich, CT Part No. K104

Non-conducting Marker	Staedtler Permanent marker #317 WP4	BNL Stock #S-23755
Procedure Reference	Technical Reference	Source/Control
Velcro Straps	Velcro Strap 24 x 5/8	Gleicher Mfg. 851 Jerusalem Rd. Scotch Plains, NJ
Scouring pad	Scotch Brite	3M Company
Towels	Kim Wipes	Kimberly Clark Corp.
Precision Wipes	Scott Towel Corp.	
Tack rag	Gerson Tack Cloth	Gerson Co., Inc. Middleboro, MA
Gaussmeter	Gaussmeter	Magnetic Analysis Corp. Mt. Vernon, NY
Degausser	BNL Dwg. No. 25-953.01-5	
Tie wraps	BNL Stock No. A-59827	
Coil Transporter	BNL Dwg. No. 25-1796.01-5	

3.2 Safety Precautions:

3.2.1 Operators shall be qualified by their cognizant technical supervisor in the safe operation of the coil curing press, SMD-OPM 8.1.1.38.

3.2.2 Hard hats are required during crane operations.

3.2.3 All lifting and handling operations requiring overhead crane operations shall be performed by personnel who are holders of valid Safety Awareness Certificates and who have been trained and certified for the lifting device being used by the Cognizant Engineer or Technical Supervisor.

3.2.4 Proper eye protection (safety glasses, goggles) shall be worn while the hydraulic system is in use.

3.2.5 Specific steps of this procedure contain Electrical and Mechanical Assembly operations that impact the environment. Prior to performing these steps, personnel shall complete the applicable facility specific environmental training.

3.3 Procedure

3.3.1 Fixture Cleaning And Preparation For Cure:

3.3.1.1 Record the serial number of coil in the traveler.

3.3.1.2 Inspect all parts including; end pushers, fasteners and formblock, for magnetization using the gaussmeter. Demagnetize any tooling which reads greater than 10 gauss using the degausser.

3.3.1.3 Clean formblock and all tooling parts using scouring pads and degreaser to remove all foreign matter from surfaces to contact coil. Vacuum entire formblock including threaded hole locations.

3.3.1.4 Inspect all tooling surfaces to contact coil for burrs or scratches. Deburr if necessary using vacuum to remove chips.

3.3.1.5 Wipe formblock and tooling parts using degreaser and towel. Follow up with a clean tack rag.

3.3.1.6 Place coil end pushers in formblock against fully retracted threaded hydraulic cylinder rods. Be sure that lead end and non-lead end pusher bars are placed at proper end locations.

3.3.1.7 Apply Frekote 700 mold release to the inside surface of the formblock. Let dry for five minutes.

3.3.1.8 Using strongback/hoist lift mandrel/coil/blade assembly and remove batman wings and hose clamps.

CAUTION

Hardhats are required when overhead crane is in use. Failure to observe this caution may result in head injury.

3.3.1.9 Carefully lower mandrel/coil/blade assembly into the formblock using overhead crane and strongback assembly. The mandrel is positioned using the lead end of the formblock and the first thru-hole in the lead end of the mandrel.

3.3.1.10 Detach strongback/hoist and return to storage.

3.3.1.11 Bolt the coil down into the formblock using through holes in the blade assembly and mandrel.

3.3.1.12 Torque each bolt three times minimum to assure the mandrel is seated properly. Use a spiral pattern starting with the center bolt. Torque 5/16" bolts to 300 in-lbs. (25 ft-lbs.). When torqueing last two bolts at each end, apply 6000-7200 PSI to the mandrel using the hydraulic press (12010036-MCA5). Verify that the mandrel is fully seated using mandrel gage or depth micrometer with parallels.

3.3.1.13 Attach mandrel thermocouples at the lead end.

3.3.1.14 Attach mandrel hot oil lines.

NOTE

The mandrel assembly has an internal volume of oil used for curing. If leakage is detected from the mandrel quick disconnects (located on its end), the oil shall be cleaned up immediately and disposed of as regulated industrial waste

3.3.1.15 Set the pusher bar system to seat the end saddles against coil by manually pushing on end pushers.

3.3.1.16 Extend threaded hydraulic cylinder rods until they contact the end pusher bars. Insert shims if necessary.

3.3.1.17 Make up the proper cure shim using steel shim stock. Tape the shim stock together using a non-lapping spiral wrap of .0005" Kapton tape.

NOTE

Shim size is determined by the cognizant engineer.

3.3.1.18 Check overall thickness of each shim using a micrometer.

3.3.1.19 Install cure shims on formblock making sure shims are centered on flats on the top of the formblock.

3.3.1.20 Remove all collaring blocks, corner blocks and LVDT blocks from the press.

3.3.1.21 Check all hot oil lines for correct attachment.

3.3.1.22 Open the curing press feed and return line hot oil valves located on the floor near flex hose carrier. Open mandrel return line valve located at non-lead end of the form block.

CAUTION

Be sure no one is standing at the front of the formblock when it is moved. Failure to observe this caution may result in personnel injury.

3.3.1.23 Start up the press as per SMD-OPM 8.1.1.38. Use process #1 & recipe #2.

3.3.2 Cure Cycle:

NOTE

The parameters for the automatic cure cycle and an explanatory sheet are given in Appendix A.

3.3.2.1 Start the automatic cure cycle as per SMD-OPM-8.1.1.38.

3.3.2.2 Verify that all LVDT's and thermocouples are providing accurate data and the "NO WARNING" lights are illuminated.

3.3.2.3 When the cure cycle is complete, shut down the press as per SMD-OPM-8.1.1.38.

3.3.2.4 Download cure summary to floppy and to network database.

3.3.3 Cured Coil Removal:

3.3.3.1 Roll formblock assembly out of press per SMD-OPM-8.1.1.38.

3.3.3.2 Disconnect thermocouples from mandrel only. Close the curing press feed and return line hot oil valves.

3.3.3.3 Close mandrel hot oil valve and disconnect mandrel hot oil lines.

NOTE

The mandrel assembly has an internal volume of oil used for curing. If leakage is detected from the mandrel quick disconnects (located on its end), the oil shall be cleaned up immediately and disposed of as regulated industrial waste

3.3.3.4 Unbolt mandrel from formblock.

CAUTION

Hardhats are required when overhead crane is in use. Failure to observe this caution may result in head injury.

3.3.3.5 Using the overhead crane and strongback/hoist assembly carefully move curing mandrel and coil onto the rollover dolly. Rotate mandrel so that the centerpost is facing up. Remove rotating supports.

3.3.3.6 Install tie wraps every two feet. Do not tighten.

3.3.3.7 Tighten pusher blade bolts.

CAUTION

Care must be taken when using a razor blade. Failure to observe this caution may result in personal injury.

3.3.3.8 Run razor blade horizontally along the top of the blades to cut the Teflon wrap. Do not cut against the blades; this might cause chips to be formed and damage the coil and blades.

3.3.3.9 Peel the Teflon wrap off the coil.

NOTE

Replace any Tie-Wraps that are removed.

3.3.3.10 Tighten Tie-Wraps after blade is removed.

CAUTION

All personnel working with centerpost tensioner must wear safety glasses

3.3.3.11 Install centerpost tensioner at non-lead end of coil. Remove any centerpost bolts that are located in a straight thru-hole.

3.3.3.12 Apply only enough hydraulic pressure to the tensioner to allow removal of the non-lead end locating pin.

3.3.3.13 Remove centerposts starting at centerpost #10 and working towards the non-lead end.

3.3.3.14 Ease tension and remove centerpost #16.

3.3.3.15 Remove remaining centerposts. Tighten all tie wraps.

3.3.3.16 Using the overhead crane, lift coil lifting beam and center over coil. Lower onto mandrel to engage center post filler.

3.3.3.17 Starting with the center blade #4, unbolt & remove the left and right #4 blades. Engage lifting tabs to secure coil to coil transport assembly. Remove remaining blades in the same manner. Be sure to lock all lifting tabs.

3.3.3.18 Remove all tie wraps. Carefully lift the coil off the mandrel and transfer to coil assembly area.

3.3.3.19 Using a non-conductive green marker, record coil serial number, part number and revision letter on the inside diameter of the non-lead end coil end saddle.

3.3.3.20 Secure midplane and pole leads to coil with Velcro straps.

3.3.3.21 Remove coil end force rings from saddles at each end.

3.3.3.22 Using a fine cut file, remove the flashing from the coil end saddles. To avoid damaging the coil leads, temporarily fold them back and secure them with Velcro straps.

3.3.3.23 Roll up the coil excess leads and secure with tie wraps.

3.3.3.24 Enter all data into the Magnets Database.

4 Quality Assurance:

4.1 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.

4.2 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.

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

4.4 Calibration:

Verify the calibration for the following equipment is current.

- Pressure Gauges
- Temperature Gauges
- Gaussmeter

5 Preparation for Delivery:

N/A

APPENDIX A-1
Explanation of Cure Cycle Program

1. Program Steps:

00 HEAT to 135^0C	Heat the fixture to bring it from 25^0C to 135^0C while holding the coil under medium pressure (cycling).
01 1st Sizing Step @ 135^0C	Close the mold and hold the coil under high pressure while at 135^0C for 30 minutes to size the coil.
02 HEAT to 225^0C	Unload the coil completely and heat the fixture to bring it from 135^0C to 225^0C.
03A MOLD @ 225^0C	Hold the fixture @ 225^oC for 5 minutes while holding the coil under low pressure to bond the cable turns together.
03B Begin Cooling	Cool the fixture to 200^0C (5 minutes) while holding the coil under low pressure.
04 COOL to 135^0C	Unload the coil completely and cool to 135^0C.
05 2nd Sizing Step @ 135^0C	Same as Step 01.
06 COOL to 25^0C	Cool the fixture to 25^0C while holding the coil under high pressure (cycling).

NOTE: All temperatures listed are average mandrel temperatures.

NOTE

Cycling the hydraulic pressure allows release of stresses produced by non-uniform thermal expansion or contraction of the coil and curing fixture components.