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Large Hadron Collider  
Magnet Division Procedure

Proc. No.: LHC-MAG-R-1022

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Class: Dipole  
Title: D2/D4 Cradle and Fiducial Welding

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- ES&H Review: Signature on File

REVISION RECORD

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1. Scope:

This specification describes the procedure for cradle welding, mechanical survey measurements, and fiducial/cover disk welding on the D2/D4 Dipole Cold Mass Assemblies.

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-MAG-Q-1000	Procedure for Control of Measurement Test Equipment
RHIC-MAG-R-8792	Removal of Cold Mass Twist

BNL Drawings:

14010180	D2 Endplate and Cradle Welding Assembly
14010158	D4 Endplate and Cradle Welding Assembly

3. Requirements:

Assembly work shall be done in accordance with the drawings and parts lists, and the installation and welding sequence described below.

All welding shall be performed by welders qualified in accordance with ASME Section IX. The welding parameters shall be set in accordance with those specified during welding process development.

3.1 Material/Equipment

25-1785.01-5 Cradle Welding Fixture  
Electronic Digital Micrometer Depth Gauge (Starrett No. 735BZ-6RL)  
Electronic Digital Micrometer Height Gauge (Starrett No. 752)  
25-1782.02-5 LHC Cold Mass Lifting Beam

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### 3.2 Safety Precautions

3.2.1 Operators shall be trained by their cognizant technical supervisor and qualified in the operation of the welding equipment.

3.2.1 No welding shall take place unless all welding screens are in place around the welding station, and all personnel not directly involved with the welding process are outside the screens. Any personnel inside the screens shall wear protective gear to prevent eye injury, and shall be clothed to prevent burns caused by intense ultra-violet light.

3.2.2 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. They shall also be trained and certified in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor.

### 3.3 Procedure

#### 3.3.1 Cradle Welding

3.3.1.1 Using the inclinometer, measure and record the inclination of the 3 cradle support assemblies. Calculate and record the average.

3.3.1.2 Install the cradles onto the three cradle support assemblies.

3.3.1.3 Fit an insulating blanket over each cradle so that the angled legs of the cradle protrude through the mating cut-outs in the blanket.

3.3.1.4 Using 25-1782.02-5, crane lift the cold mass unit and rest it on the cradle assembly fixture rollers. Use the alignment angle to align the lead end plate with the scribe line on the fixture. Be certain that the shell with survey holes is facing up indicating that the unit is right-side up.

3.3.1.5 Using the twist bridge, measure and record the inclination at all available yoke survey notch locations. Calculate the average twist of the cold mass. Verify that the values are within tolerance,  $\leq 1$  milliradian RMS.

#### **NOTE**

**Power up the inclinometer LED display and allow it to warm up for at least one hour in order for it to stabilize.**

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- 3.3.1.6 If Cold Mass twist is out of tolerance, notify cognizant engineer. The twist shall be brought into tolerance by applying weld beads to the outside of the shell using RHIC-MAG-R-8792 as a guide. If twist correction is performed, repeat step 3.3.1.4 and record new inclination measurements.
- 3.3.1.7 Using the inclinometer, rotate the cold mass so that the average twist is equal to the cradle support angle. Release hydraulic pressure to rollers and lower the cold mass onto the cradles.
- 3.3.1.8 Position the axial restraints along side the cradle as shown on the assembly drawing and clamp in place.
- 3.3.1.9 Fillet weld the axial restraint blocks to the shell using filler wire (P/N 12010441-03) as shown on the assembly drawing.
- 3.3.1.10 Tack weld the cradles to the axial restraint blocks using filler wire (P/N 12010441-03) as shown on the assembly drawing. Monitor the cold mass inclination during welding and add additional weld as required to ensure that each cradle be parallel to within 0.2 milliradians with respect to the plane defined by the average cold mass twist after welding is complete and the welds have cooled.
- 3.3.1.11 Wrap each of the two blankets around the cold mass shell and secure the ends temporarily with masking tape.
- 3.3.1.12 Check each cradle with .002 feeler stock for full contact with the fixture.
- 3.3.2 Weld Cover Discs
  - 3.3.2.1 Transfer magnet to the power rollers.
  - 3.3.2.2 Install and weld the (24) cover discs. Leave the end shell holes and the holes above each cradle open per the assembly drawing.
- 3.3.3 Inspect Welds
  - 3.3.3.1 Call for a certified weld inspector to inspect and sign off on all welds.
- 3.3.4 Mark finished assembly with part number and serial number as shown on the assembly drawing.

4 Quality Assurance Provision:

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- 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