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SMD
Magnet Division Procedure

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Title: LHC D2 Dipole Magnet – Insertion of Cold Mass into Cryostat

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REVISION RECORD

Rev. No.	Date	Page	Subject	Approval
A	11/07/01		Initial Release	
B	1/22/02		Revisions per ECR MG2079	
C	4/18/02		Revisions per ECR MG1028	
D	4/2/03		Revisions per ECR MG1028	
E	7/22/03		Revisions per ECR MG2155	
F	9/9/03		Revisions per ECR MG2160	

1 Scope:

This specification establishes the procedure for LHC D2 dipole cryostat insertion.

2 Applicable Documents:

The following documents, in effect on the date of issue of this specification, form a part of this specification:

RHIC-MAG-M-7422	CQS Multi-Layer Insulation Fabrication
RHIC-MAG-R-7423	Multilayer Insulation Installation
RHIC-MAG-Q-1000	Control of Measurement Test Equipment
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
LHC-MAG-R-1045	LHC LWR Heat Shield Pressure & Leak Check Proc.
14060023	D2 Lower Thermal Shield Weldment
14010340	D2 Cold Mass Assembly
14060008	D2 Magnet Assembly Cryostatted

3 Requirements:

3.1 Material/Equipment

Lifting Beam	BNL Dwg. 25-1782.02-5
Insertion Fixture	BNL Dwg. 25-1819.01-5

3.2 Safety Precautions

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

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

3.2.4 Operators shall be trained by their Cognizant Technical Supervisor in the operation of the Insertion Fixture.

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 Vacuum Vessel Preparation

3.3.1.1 Brush and vacuum the interior of the vacuum vessel, if required. Make sure that the threads in the leg surfaces are clean.

3.3.1.2 Check the vacuum vessel leg sealing surfaces for any damage (radial scratches, nicks, etc.).

3.3.1.3 Align the vacuum vessel on the insertion fixture using the pins and spherical bearings.

3.3.1.4 Place the movable cryostat support under the non-lead end of the cryostat.

3.3.1.5 Install three full dog-point set screws on each of the six Taylor-Hobson fiducial cups (14060209) so that the point extends 2mm (.079 in.) beyond the bottom. Install the cups and torque the locking screws to 8-10 ft-lbs.

3.3.1.6 Fill the rings around each Taylor-Hobson fiducial cup with stycast 2850 epoxy to a depth of about 3mm (.12 in.).

3.3.1.7 Fill the hex socket in both locking screw heads on each Taylor-Hobson fiducial cup with stycast 2850 epoxy.

3.3.2 Preparation of Lower Thermal Shield Weldment

3.3.2.1 Weld LE & NLE Caps to the appropriate end of the shield using aluminum welding rod 12060094. Weld a bimetallic transition piece to the cap on the lead end, and to the shield on the NLE using 12060094.

NOTE

The aluminum side of the bimetallic transition faces the shield.

3.3.2.2 On each end, complete welding of the extension pipe and Conflat flange to the assembly. Use an argon purge while affixing the extension pipe to the bimetallic transition piece.

CAUTION

Install shielding on /over flanges during pressure testing. Install barriers. Eye protection shall be worn during testing.

3.3.2.3 Pressure test assembly to 400 PSIG (pneumatic) per LHC-MAG-R-1045. After pressure test, perform leak check /LHC-MAG-R-1045. Max leak rate 2×10^{-10} Std. cc He /Sec.

NOTE

Pressure test shall be witnessed by the ES&H Coordinator or Safety Engineering

3.3.3 Cold Mass Build Up

NOTE

Prior to beginning work, perform a test of each Emergency Stop button on the insertion fixture. Record results of the test in the traveler.

3.3.3.1 Place the cold mass insertion sleds on the fixed tray of the insertion fixture.

3.3.3.2 Position the heat shield blankets over the sleds. Place the outer blanket first, heavy aluminized Mylar facing down (away from shield), splice on the right. Place the inner blanket second, heavy aluminized Mylar facing up (toward shield), splice on the left.

NOTE

Left / Right convention used: Standing at LE looking towards NLE - Top of magnet UP.

3.3.3.3 Mount the cold mass support post to the lower heat shield. Install bolts with spacers and bushings and torque to 12 ft-lbs. Posts were marked with magnet number and position when post height measurements were taken during cold mass assembly.

3.3.3.4 Attach the laminated flexible thermal connections on the posts to the lower heat shield with rivets and weld.

3.3.3.5 Place the lower heat shield/post assembly on the sleds. Posts fit through the holes in the blankets.

3.3.3.6 Position the cold mass blankets over the posts. Place the outer blanket first, heavy aluminized Mylar facing down (away from cold mass), splice on the right. Place the middle blanket second, heavy aluminized Mylar facing up (toward cold mass), splice on the left. Place the inner blanket last, heavy aluminized Mylar on both sides, splice on the right.

NOTE

Left / Right convention used: Standing at LE looking towards NLE - Top of magnet UP.

3.3.3.7 Place the cold mass on the support posts using the lifting beam (25-1782.02-5). Install the mounting bolts and torque to 12 ft-lbs.

3.3.3.8 Mount the flexible heat station clamp to the IFS line. Torque all screws to 18 in-lb.

3.3.3.9 Trim the warm head tube on the IFS line.

3.3.3.10 Insulate the IFS line.

3.3.3.11 Interleave and ultrasonic weld approximately every six layers of the inner cold mass blanket. Spacer material (12060093-17) must be used on top of the outer layer of aluminized mylar to reinforce welds. Use stainless backing strip when welding.

3.3.3.12 Interleave and ultrasonic weld approximately every six layers of the middle cold mass blanket. Use stainless backing strip when welding.

3.3.3.13 Interleave and ultrasonic weld approximately every six layers of the outer cold mass blanket. Spacer material (12060093-17) must be used on top of the outer layer of aluminized mylar to reinforce welds. Use stainless backing strip when welding.

3.3.3.14 Install the BNL test pipes on the cold mass. Tack weld pipes to center supports.

3.3.3.15 Install the upper heat shield on top of the lower, making sure that the upper heat shield is even on both ends with the lower heat shield.

NOTE

Care should be taken to protect lower thermal shield weldment from accidental contact during rigging

3.3.3.16 Install the free end of the IFS heat station on the heat shield. Torque all screws to 18 in-lb.

3.3.3.17 Weld both sides of the heat shield and allow to cool. Make sure weld screen is in place during welding operation to avoid injury.

3.3.3.18 Interleave and ultrasonic weld approximately every ten layers of the inner heat shield blanket. Use a stainless steel backing strip when welding.

3.3.3.19 Interleave and ultrasonic weld approximately every ten layers of the outer heat shield blanket. Spacer material (12060093-17) must be used on top of the outer layer of aluminized mylar to reinforce welds. Use stainless backing strip when welding.

3.3.3.20 Wrap a temporary .010 in. thick mylar shield around the outside of the insulation blankets and tape into position at the end volumes.

3.3.3.21 Install the tie rods on the insertion sleds.

3.3.4 Spacer Shim Preparation

3.3.4.1 Mark the post spacer plates, LE, CTR, NLE. Measure thickness of each in four places, 90 degrees apart, to the nearest .001 in. Record readings in traveler and calculate average for each plate.

3.3.4.2 Mark the retaining rings, LE, CTR, NLE. Measure thickness of each in four places, 90 degrees apart, to the nearest .001 in. Record readings in traveler and calculate average for each ring.

3.3.4.3 Post shims thickness shall be selected so that the center post assembly is .89mm (.050 in.) higher than the two outer post assemblies. Machine the LE, CTR, NLE shims to the required thickness and mark each. Record the shim thickness data in the traveler.

NOTE

Nominal shim size for outer posts is .276 in. Nominal shim size for center post is .719 in. However, actual shim thickness shall be adjusted so that:
The height between the centerline of the cold mass and the bottom of the retaining ring at each end is 22.835". The height between the centerline of the

cold mass and the bottom of the retaining ring at the center is 22.885". The height of the posts was measured during cold mass assembly and the distance from the cold mass center line to the base of the cradles was established during cold mass survey.

3.3.5 Cold Mass Installation

3.3.5.1 Position the movable bridge/tray assembly. Tighten all bolts between sections to form a continuous structure.

3.3.5.2 Slide the cryostat trays into position. One tray slides into the cryostat from each end.

3.3.5.3 Install the tray alignment bushings in the cryostat legs.

3.3.5.4 Attach the pull chain to the sled assembly.

CAUTION

All non-essential personnel shall stand clear of the hydraulic assembly and hoisting chain while the cold mass is being pulled. Be aware of potential equipment failure and chain snap back.

3.3.5.5 Pull the cold mass assembly into the vacuum vessel. Align the center post on the cold mass with the center hole in the vacuum vessel.

NOTE

Watch for interference during pull-in.

3.3.5.6 Install the spacer plate, machined shim and snap ring over the center lifting mechanism.

3.3.5.7 Install the center lifting post so that it engages in the hole in the base of the center cold mass cradle.

3.3.5.8 Mount the lifting plates to the end volumes at each end and tighten all bolts.

CAUTION

Operating in JOG Mode Only

3.3.5.9 Using the appropriate buttons on the Duff-Norton control panel, individually activate each lifting mechanism to take up any slack in the system.

3.3.5.10 Using the Duff-Norton panel, lift the cold mass by simultaneously activating the lift mechanisms for the center and both the ends.

NOTE

Prior to magnet movement, operator and spotters should be aware of the location of the nearest Emergency Stop button on the fixture

3.3.5.11 Remove the insertion sleds.

3.3.5.12 Remove the insertion tray alignment bushings and the insertion trays.

3.3.5.13 Install keys on each of the end post spacer plates.

3.3.5.14 Apply molybdenum disulfide lubricant MIL-M-7866 to top surface of each end spacer and to the sides of the keys.

3.3.5.15 Install spacer plates, machined shims and retaining rings in each cryostat leg.

3.3.5.16 Using the Duff-Norton ,lower cold mass and remove lifting tooling.

NOTE

Prior to magnet movement, operator and spotters should be aware of the location of the nearest Emergency Stop button on the fixture

3.3.5.17 Tighten the set screws in the end post spacer plates until they make light contact with the inside surface of the cryostat leg. Then torque each set screw to 75 ft-lbs.

3.3.5.18 Install IFS warm head into port in cryostat and manually TIG weld.

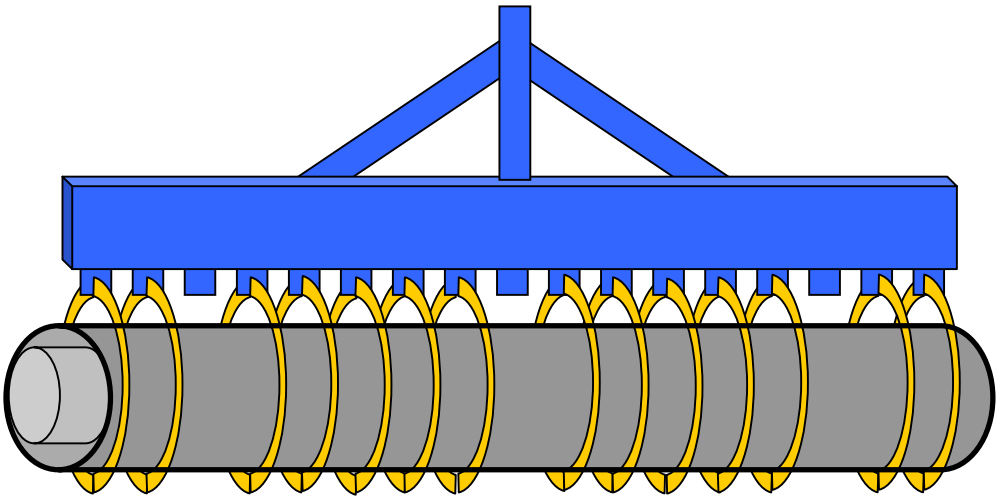
3.3.5.19 Remove mylar that was temporarily installed over outer blanket.

3.3.6 Vacuum Vessel Sag Measurement

CAUTION

Weight of D2 Magnet Assembly exceeds rating of the Lifting Beam (BNL Dwg. 25-1782.02). Use of this device is permitted to lift the D2 Magnet Assembly only if load is equally distributed on 14 of 17 lifting lugs (center lug and lugs 3 from each end are not used).

3.3.6.1 Using 14 slings and Lifting Beam 25-1782.02 as shown below, move the magnet assembly to the precision support stands, supporting the cryostat at the two outer leg castings. Center leg is unsupported.



Magnet Assembly Rigging

3.3.6.2 For each leg, measure height from table to bottom of retaining ring at four locations 90^0 apart. Enter data into the traveler and calculate the average for each leg.

3.3.6.3 Select the averages for the LE & NLE legs. Average them together and subtract the average for the middle leg. Record this in the traveler.

NOTE

The resultant should be .050 +.040/ - .000".

4 Quality Assurance Provisions:

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.

5 Preparation for Delivery:

N/A