

**Fermi National Accelerator Laboratory  
Batavia, IL 60510**

**LARGE HADRON COLLIDER  
FINAL COLD MASS ASSEMBLY TRAVELER**

**Reference Drawing(s)  
Final Cold Mass Assembly  
5520-ME-369655**

9/26/02

60

Budget Code: LPT

Project Code: LHC

Released by: *John J. Szostak*

Date: ~~11/6/01~~ 11/6/01

Prepared by: J. Larson, M. Cullen, J. Szostak

Title	Signature	Date
TD / E&F Process Engineering	<i>Bob Jensen</i> Bob Jensen / Designee	11/6/01
TD / LHC Production Supervisor	<i>Jim Rife</i> Jim Rife / Designee	11/6/01
TD / LHC Production Engineer	<i>Rodger Bossert</i> Rodger Bossert / Designee	11/6/01
TD / LHC Program Manager	<i>Jim Kerby</i> Jim Kerby / Designee	11/6/01

Revision Page

<b>Revision</b>	<b>Step No.</b>	<b>Revision Description</b>	<b>TRR No.</b>	<b>Date</b>
None	N/A	Initial Release	N/A	12/12/00
A	3.0	Added Picture of Heater Schematic.	1282	11/6/01
	4.6	Deleted Step. No Voltage Taps.		
	4.7	Deleted Step.		
	4.8	Deleted Step.		
	6.3	Added Note from Step 6.5. Updated Engineering Specification to (ES-369871).		
	6.4	Deleted Step.		
	6.5	Deleted Step.		
	6.7	Deleted Step.		
	7.2	Deleted Step. No Hipot necessary.		
	7.2	Added Step. "Verify torque on Pre-Load Bolts as per (ES-369871)".		
	8.6	New part number. Replaced (MD-344922) with (MD-369844).		
	8.11	Added Step. "Install Springboard Assembly (MC-369842 & MC-369843) onto the Cold Mass Assembly. Wrap the Springboard Assemblies in Kapton".		
	9.1	Deleted Step. No Strain Gauges.		
	9.2	Deleted Step. No Voltage Taps.		
	9.3	Deleted Step. No Strip Heaters.		
	9.5	Modified Step. Changed HiPot Table. Heaters grounded for Coil to Ground check. Coil grounded for Heaters to Ground check. Added Pictures.		
	9.7	Deleted Step. No Ring performed.		
	10.0 – 11.0	Steps added as per Jim Kerby.		

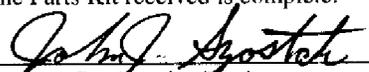
**Ensure appropriate memos and specific instructions are placed with the traveler before issuing the sub traveler binder to production.**

1.0 General Notes

- 1.1 White (Lint Free) Gloves (Fermi stock 2250-1800) or Surgical Latex Gloves (Fermi stock 2250-2494) shall be worn by all personnel when handling all product parts after the parts have been prepared/cleaned.
- 1.2 All steps that require a sign-off shall include the Technician/Inspectors first initial and full last name.
- 1.3 No erasures or white out will be permitted to any documentation. All incorrectly entered data shall be corrected by placing a single line through the error, initial and date the error before adding the correct data.
- 1.4 All Discrepancy Reports issued shall be recorded in the left margin next to the applicable step.
- 1.5 All personnel performing steps in this traveler must have documented training for this traveler and associated operating procedures.
- 1.6 Personnel shall perform all tasks in accordance with current applicable ES&H guidelines and those specified within the step.
- 1.7 Cover the product/assembly with Green Herculite (Fermi stock 1740-0100) when not being serviced or assembled.

2.0 Parts Kit List

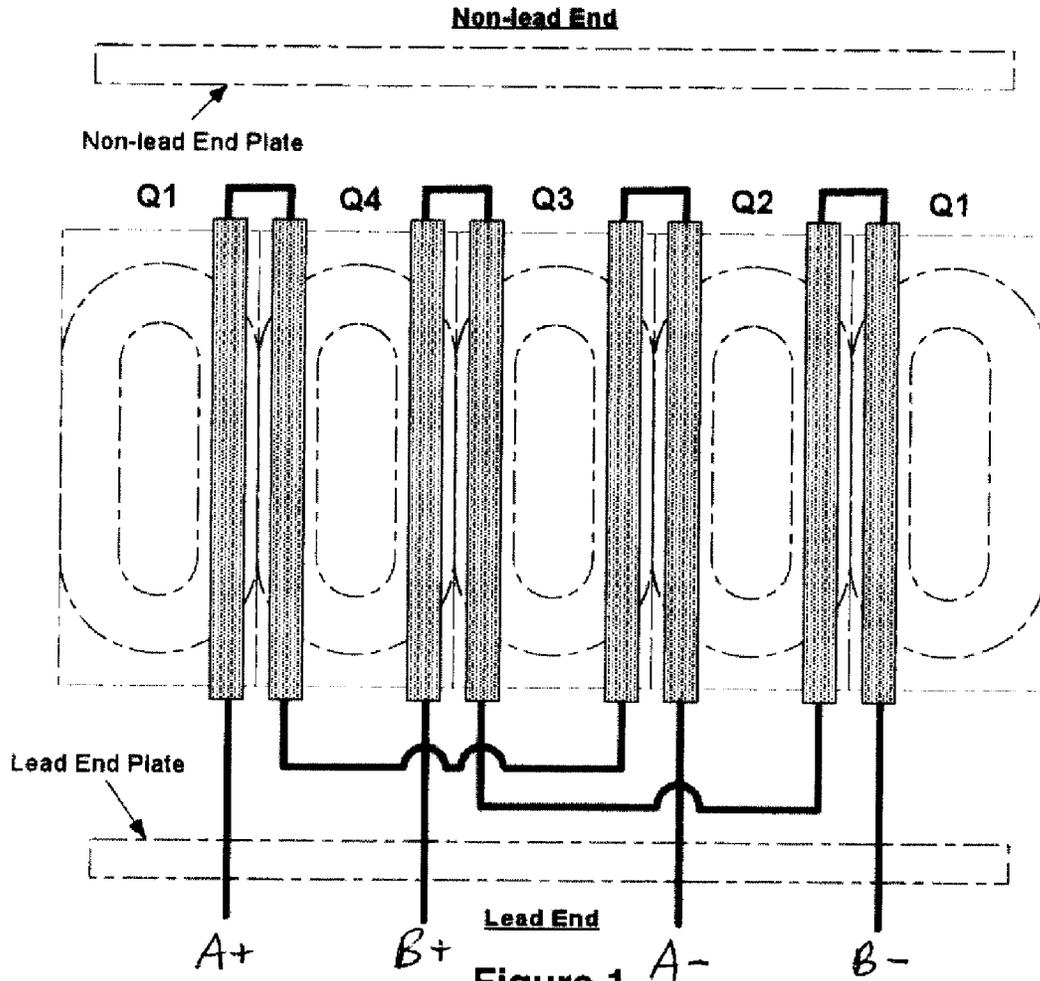
- 2.1 Attach the completed Parts Kit for this production operation to this traveler. Ensure that the serial number on the Parts Kit matches the serial number of this traveler. Verify that the Parts Kit received is complete.

  
\_\_\_\_\_  
Process Engineering Designee

11/6/01  
Date

3.0 Cold Mass Final Assembly Preparation

**MQXB Production Magnet Strip Heater Schematic**



**Figure 1**

DR#  
0270  
TRR#  
1293

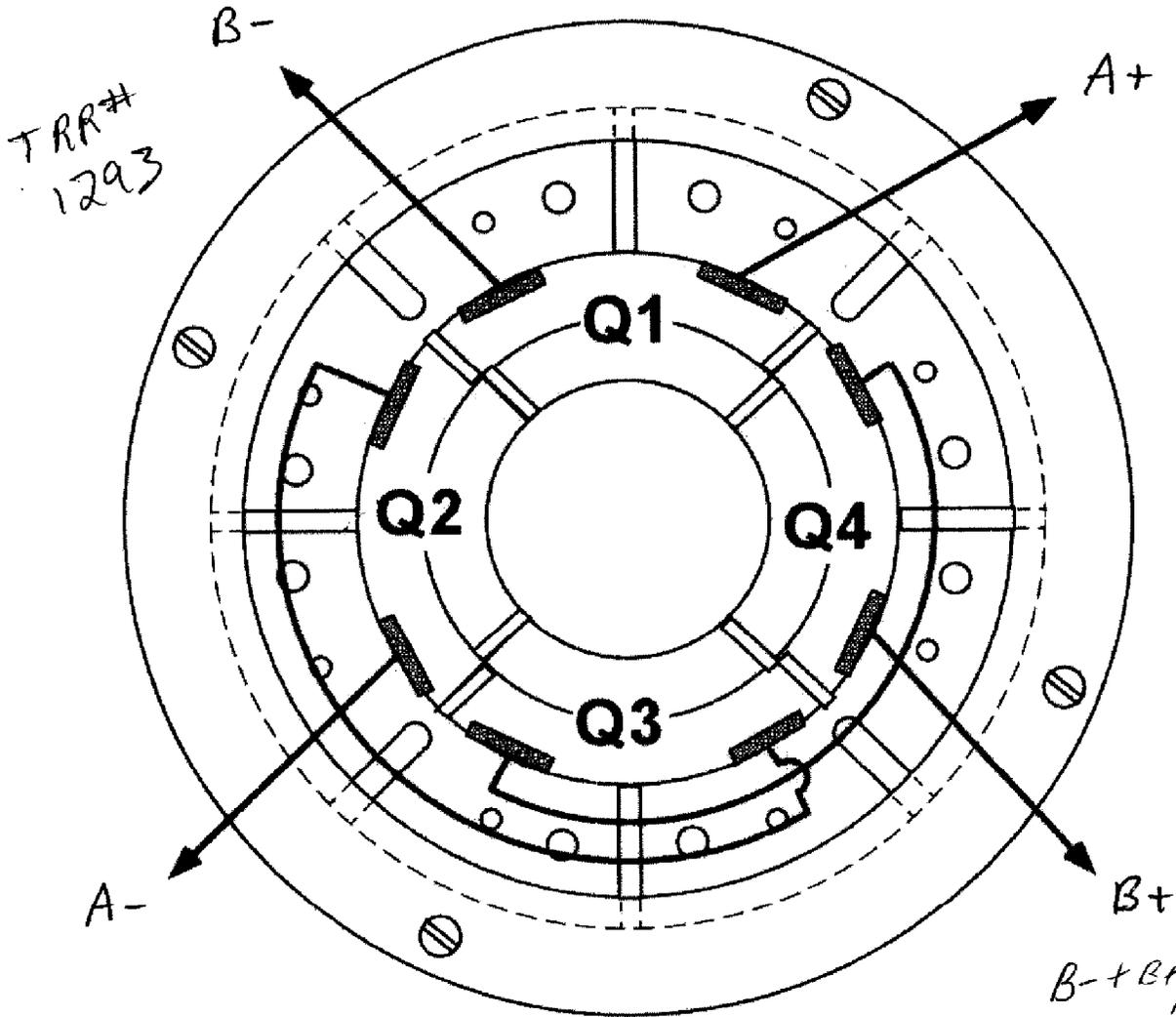
3.1 Install the Jumper Wires (length as required) (MA-369833) on the Heater Strips at the NQN-Lead End as per Figures 1 & 2.

[Signature] Technician(s) 11/9/01 Date

and Label per fig. 1 & 2

3.2 Install Power Wires (19 meters) and Jumper Wires (length as required) (MA-369833) on the Heater Strips at the Lead End as per Figures 1 & 2.

[Signature] Technician(s) 11-12-01 Date



**LHCIRQ Lead End Strip Heater Wiring Layout**

**Figure 2**

TRR#  
1318

- 3.3 Clean the entire Cold Mass with a Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent.

Oliver Frimaya  
Technician(s)

11-12-01  
Date

- 3.4 Insert the Heater Strips into notch and cover with Green Putty (MA-103930).

D. Mungy  
Technician(s)

11-12-01  
Date

- 3.5 Verify that all Quadrant Leads are properly insulated.

D. Mungy  
Technician(s)

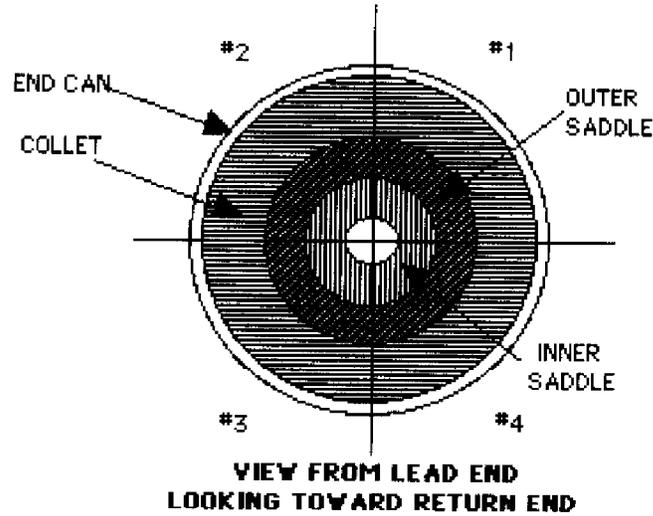
11-12-01  
Date

4.0 Bullet Pressure Plate Installation

- 4.1 Shim the Lead End Inner and Outer Saddles until they are flush, using 5 mil adhesive backed Kapton or equivalent and G-11CR Lead End Saddle Shim Stock (MD-369818 (Inner) & MD-369819 (Outer)) or equivalent.

D Murphy  
Technician(s)

11-21-01  
Date



- 4.2 Install the Lead End Full Preload Plate (MB-369060).

D Murphy  
Technician(s)

11-21-01  
Date

- 4.3 Shim the Non-Lead Inner and Outer Saddles until they are flush, using 5 mil adhesive backed Kapton or equivalent and G-11CR Non-Lead End Saddle Shim Stock (MD-369816 (Inner) & MD-369817 (Outer)) or equivalent.

J Howell  
Technician(s)

11/21/01  
Date

- 4.4 Install the Non-Lead End Full Preload Plate (MB-369061) as per (ME-369655).

J Howell  
Technician(s)

11/21/01  
Date

5.0 End Plate Installation

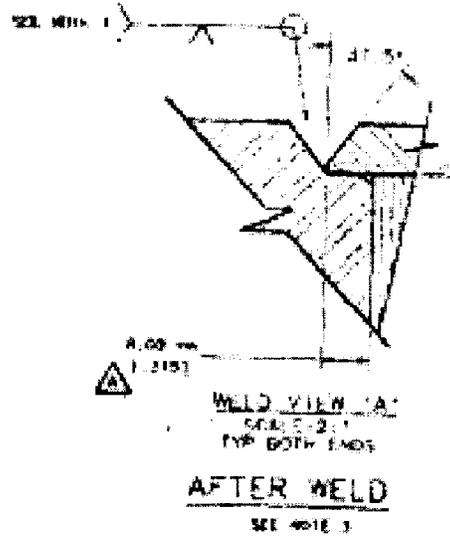
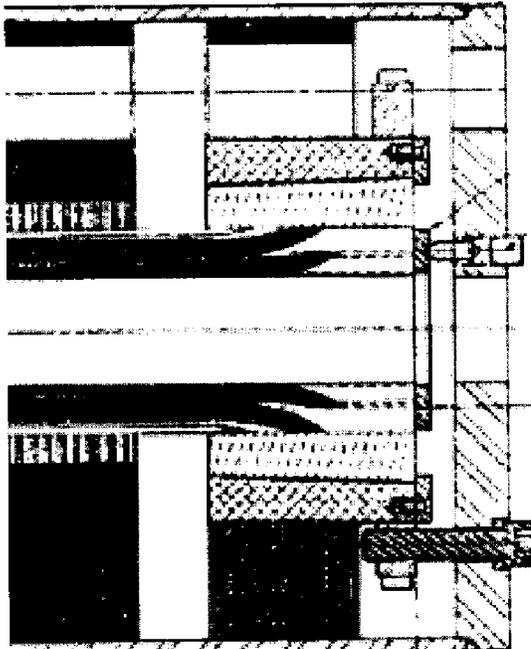
5.1 Clean the Non-lead End Plate area with Isopropyl Alcohol (Fermi stock 1920-0300) Kimwipes (Fermi stock 1660-2500) or equivalent, and a vacuum to remove all dirt and foreign materials.

*D. Murphy*  
Technician

11-19-01  
Date

5.2 Install the Non-Lead End - End Plate (ME-369750) as per (ME-369655).

**NON-LEAD END**



**Quadrant 1 is UP.**

**Note(s):**

The End Plate should be facing outward so the stamped or marked area with the nomenclature, part number, and "Top" is visible. Check the Tapped holes prior to installation for damage.

*D. Murphy*  
Technician

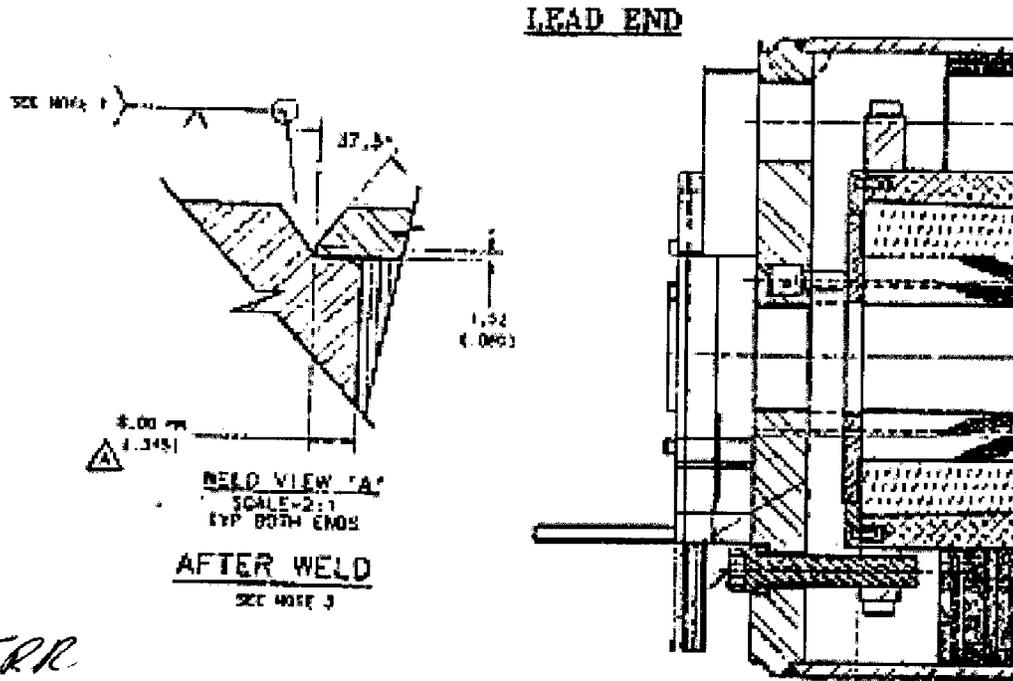
11-19-01  
Date

- 5.3 Clean the Lead End Plate Area with Isopropyl Alcohol (Fermi stock 1920-0300), Kimwipes (Fermi stock 1660-2500) or equivalent and vacuum to remove all dirt and foreign materials.

*D. Murphy*  
\_\_\_\_\_  
Technician(s)

*11-27-01*  
\_\_\_\_\_  
Date

- 5.4 Install the Lead End – End Plate (ME-369749) as per (ME-369655). While installing, pull out the Instrumentation and Power Lead Wires through the proper openings as per the figure below.



**Quadrant 1 is UP.**

**Note(s):**

The End Plate should be facing outward so the stamped or marked area with the nomenclature, part number, and "top" is visible.  
Check the Tapped holes prior to installation for damage.

*D. Murphy*  
\_\_\_\_\_  
Technician(s)

*11-27-01*  
\_\_\_\_\_  
Date

5.5 Record the Length from the Outer Edge of the Lead End Plate to the Outer Edge of the Non-lead End Plate before welding.

All Quadrant lengths must be within .030" of each other.

Position of the Measurement	Measurement in Inches (For Reference Only)
Q1	225.773
Q2	225.765
Q3	225.780
Q4	225.758

*D. Murphy* 11-27-01  
 Technician(s) Date

X 5.6 Verify that the End Plates are properly installed as per the Final Coldmass Assembly (ME-369655).

*[Signature]* 11-27-01  
 Production Engineer/Designee Date

5.7 While the Non-Lead End Plate is in position as per the Final Cold Mass Assembly (ME-369655), weld the Non-Lead End - End Plate to the Cold Mass Skin as per (ME-369655).

*[Signature]* 11/28/01  
 Welder Date

5.8 Clean the Weld area with a Stainless Steel Wire Brush (Fermi stock 1246-0860), Isopropyl Alcohol (Fermi stock 1920-0300), Kimwipes (Fermi stock 1660-2500) or equivalent and vacuum.

*D. Murphy* 11-28-01  
 Technician(s) Date

5.9 While the Lead End Plate is in position as per the Final Cold Mass Assembly (ME-369655). Weld the Lead End -End Plate to the Cold Mass Skin as per (ME-369655).

*[Signature]* 11/28/01  
 Welder Date

- 5.10 Clean the Weld with a Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent.

D. Murgyp  
 Technician(s)

11-28-01  
 Date

- 5.11 Record the Length from the Outer Edge of the Lead End Plate to the Outer Edge of the Non-lead End Plate after welding.

Note(s):

The measurement should be within 1/8" of the readings taken in step 5.5.

Position of the Measurement	Measurement in Inches	Nominal
Q1	225.5/8	225.926"
Q2	225.9/16	225.926"
Q3	225.9/16	225.926"
Q4	225.5/8	225.926"

D. Murgyp  
 Technician(s)

11-29-01  
 Date

6.0 Bolt and Bullet Installation

6.1 Apply Areolex (open Purchase - Chemical Research Co.) to all threaded parts being installed onto the End Plates except the bolts. Apply anti-seize to the Axial Preload Bolts (MB-369267)

\_\_\_\_\_  
Technician */ J. Hamed* Date 11/30/01

6.2 Assemble the Bullet Assemblies (MD-369293) for the Lead and Non-Lead End.

\_\_\_\_\_  
Technician */ J. Hamed* Date 11/30/01

6.3 Install the Bullet Pusher Screws (MB-344583) and the Bullet Load Slugs (MB-344584) in (4) places on the Lead End and (4) places on the NON-Lead End as per (ES-369871). Be careful not to damage the wires or the solder connections.

Note(s):  
**Before the final torque is applied the Production Engineer and/or Magnet Physicist are to be present.**

\_\_\_\_\_  
Technician */ J. Hamed* Date 11/30/01

X 6.4 Verify the stabilization of the Torque applied to the Bullet Pusher Screws. If no anomalies occurred during this process, state "no anomalies", else comment below.

Comment:

*Need TRR. I witnessed the torque on the axial preload bolts (both ends) no anomalies. Not possible to take bullet readings -> no longer instrumented.*

\_\_\_\_\_  
Responsible Authority/Physicist Date 11-30-01

TRRS NEEDED:

6.1 - REMOVE ANTI-SEIZE FROM STEP

6.2 - CHANGE BULLET ASSY #1

6.3 - REFERENCE TORQUE SPEC.  
- ADD SIGN FOR PRO. ENG OR PHYS AT TORQUE STEP.

7.0 Electrical Inspection

7.1 Perform an electrical inspection on each of the individual Inner Coils, Outer Coils, Quadrants and the Magnet. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306), and the Procedure for Electrical Inspection of Voltage Taps (ES-301383).

Note(s):

Ensure that all measurements are recorded correctly, and have the proper value and symbol (i.e., mΩ, mH, etc.).

Valhalla 4300B settings:

Test current	_____	Off (not testing)
Power	_____	On
Full scale voltage	_____	20 mV
Amp selector knob	_____	1 A
Temperature compensator	_____	On
Test current	_____	On (testing)

Hp 4284:

Function \_\_\_\_\_ "Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla 32-858  
 HP 4284 2848500912

Resistance		Inner	Outer	Total	Pass	Fail
Nominal		345 mΩ to 390 mΩ	410 mΩ to 455 mΩ	560 to 585 mΩ		
Quadrant 1	Inner	.2578 mΩ				
	Outer		.3157 mΩ			
	Total			.5724 mΩ		
Quadrant 2	Inner	.2548 mΩ				
	Outer		.3203 mΩ			
	Total			.5759 mΩ		
Quadrant 3	Inner	.2575 mΩ				
	Outer		.3202 mΩ			
	Total			.5756 mΩ		
Quadrant 4	Inner	.2586 mΩ				
	Outer		.3199 mΩ			
	Total			.5769 mΩ		

Inductance		Inner	Outer	Total	Pass	Fail
Nominal		620-650 $\mu$ H	1.120 to 1.17 mH	2.880 to 2.935 mH		
Quadrant 1	Inner	523.361 $\mu$ H				
	Outer		855.837 $\mu$ H mH			
	Total			<del>2.29353</del> 1.3126 mH		
Quadrant 2	Inner	521.097 $\mu$ H				
	Outer		851.318 mH			
	Total			2,29703 mH		
Quadrant 3	Inner	520,867 $\mu$ H				
	Outer		850.295 mH			
	Total			2,29804 mH		
Quadrant 4	Inner	5,24,560 $\mu$ H				
	Outer		854,183 mH			
	Total			2,29593 mH		

Q-Factor		Inner	Outer	Total	Pass	Fail
Nominal		3.0 to 3.5	4.3 to 5.0	4.5 to 5.2		
Quadrant 1	Inner	2.95				
	Outer		2.79			
	Total			4.68		
Quadrant 2	Inner	2.94				
	Outer		2.79			
	Total			4.69		
Quadrant 3	Inner	2.93				
	Outer		2.77			
	Total			4.65		
Quadrant 4	Inner	2.92				
	Outer		2.76			
	Total			4.63		

*D. Musy*  
 Inspector

12-3-01  
 Date

	Nominal	Measurements
Resistance	2.3 $\Omega$	2,327 $\Omega$
Q @ 1 kHz	4.3	4,99
Inductance (Ls) @ 1 kHz	17 mH	13,4924 mH

Don Murphy  
 Inspector

12-3-01  
 Date

Limit  
 NEEDS TO  
 BE SWITCHED  
 +  
 LABELS  
 TRR  
 #1293

Resistance Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2	9.10 to 9.50 $\Omega$	19.858 B- $\Omega$		
Heater Strips 2/3	9.10 to 9.50 $\Omega$	19.844 A- $\Omega$		
Heater Strips 3/4	9.10 to 9.50 $\Omega$	19.858 B+ $\Omega$		
Heater Strips 4/1	9.10 to 9.50 $\Omega$	19.844 A+ $\Omega$		

Don  
 Inspector

12/3/01  
 Date

7.2 Verify torque on Pre-Load Bolts as per (ES-369871).

Don Murphy  
 Technician(s)

12-3-01  
 Date

8.0 Make Quadrant Splices

8.1 Attach the Coil Splice Block #1 (MD-344908), the Coil Splice Block #2 (MD-344909), the Coil Splice Block #3(MD-344910) and the Coil Splice Block #4 (MD-344911) to the Lead End Plate (ME-369572) as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

12/4/01  
Date

8.2 Attach all three Support Block - Bases (MB344942) and the Coil Support Block (MA-369215) to the Lead End Plate (ME-369572) as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

12-4-01  
Date

8.3 Form Power Leads into slots in Coil Splice Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

12-5-01  
Date

8.4 Attach the Coil Splice - Intermediate Block #1 (MD-344919), both the Coil Splice - Intermediate Block #2, #3 (MD-344920) and the Coil Splice - Intermediate Block #4A (MD-344921) to the Coil Splice Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

12-5-01  
Date

8.5 Form Power Leads into slots in Coil Splice - Intermediate Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

12-5-01  
Date

8.6 Attach the Coil Splice - Intermediate Block #4B (MD-369844) to the Coil Splice - Intermediate Block #4A as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

12-5-01  
Date

DR # 0284  
NOT written  
AFTER  
SOLDERING IS  
DONE  
TR  
369875  
8.2  
MOVE  
TO  
AFTER  
8.8

8.7 Form Power Leads into slots in Coil Splice - Intermediate Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
 Technician(s) 12/5/01  
 Date

8.8 Attach all four Support Block Covers to the Coil Splice - Intermediate Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
 Technician(s) 12-5-01  
 Date

8.9 Attach all three Support Block - Tops (MB-344795) to the Support Block - Base (MB-344942) and all three Fillers (MB-369214) as per Quadrant Splice Assembly (MD-344925).

[Signature]  
 Technician(s) 12-5-01  
 Date

8.10 Attach (2) Voltage Taps to each Quadrant Splice and (2) Voltage Taps to each Power Lead.

Locations	Wire Type (MA-369832)	Completed
Power Leads Q4I	26 Gauge	/
	26 Gauge	/
Power Leads Q3I	26 Gauge	/
	26 Gauge	/
QS A Q20 / Q10 (1/2 Coil Tap)	26 Gauge	/
	26 Gauge	/
QS B Q30 / Q11 (1/4 Coil Tap)	26 Gauge	/
QS C Q40 / Q2I (1/4 Coil Tap)	26 Gauge	/

[Signature]  
 Technician(s) 12-5-01  
 Date

8.11 Install Springboard Assembly (MC-369842 & MC-369843) onto the Cold Mass Assembly. Wrap the Springboard Assemblies in Kapton.

[Signature]  
 Technician(s) 12-10-01  
 Date

DR# 0296  
 SOLDERING IS DONE HERE! TRR NEEDED

TRR  
 HOW LONG? LOCATION?

9.0 Lead End Electrical Installations

9.1 Perform an electrical inspection on each of the individual Inner Coils, Outer Coils, Quadrants and the Magnet. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306), and the Procedure for Electrical Inspection of Voltage Taps (ES-301383).

**Note(s):**

**Ensure that all measurements are recorded correctly, and have the proper value and symbol (i.e., mΩ, mH, etc.).**

**Valhalla 4300B settings:**

Test current	_____	Off (not testing)
Power	_____	On
Full scale voltage	_____	20 mV
Amp selector knob	_____	1 A
Temperature compensator	_____	On
Test current	_____	On (testing)

**Hp 4284:**

Function	_____	"Ls-Q" selected
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Record the Serial Number of the test equipment used.

Valhalla	<u>32858</u>
HP 4284	<u>2848J00912</u>

Resistance		Inner	Outer	Total	Pass	Fail
Nominal		345 mΩ to 390 mΩ	410 mΩ to 455 mΩ	560 to 585 mΩ		
Quadrant 1	Inner	<del>3218</del> <sup>pm</sup> mΩ	2602			
	Outer		3218 mΩ			
	Total			5822 mΩ		
Quadrant 2	Inner	2595 mΩ				
	Outer		3232 mΩ			
	Total			5829 mΩ		
Quadrant 3	Inner	2574 mΩ				
	Outer		3225 mΩ			
	Total			5789 mΩ		
Quadrant 4	Inner	2590 mΩ				
	Outer		3240 mΩ			
	Total			5823 mΩ		

Inductance		Inner	Outer	Total	Pass	Fail
Nominal		620-650 μH	1.120 to 1.17 mH	2.880 to 2.935 mH		
Quadrant 1	Inner	525.91 μH				
	Outer		863.616 mH			
	Total			2.326 mH		
Quadrant 2	Inner	524.676 μH				
	Outer		860.567 mH			
	Total			2.31643 mH		
Quadrant 3	Inner	520.477 μH				
	Outer		850.712 mH			
	Total			2.29084 mH		
Quadrant 4	Inner	523.275 μH				
	Outer		854.983 mH			
	Total			2.29845 mH		

Q-Factor		Inner	Outer	Total	Pass	Fail
Nominal		3.0 to 3.5	4.3 to 5.0	4.5 to 5.2		
Quadrant 1	Inner	2.92				
	Outer		2.76			
	Total			4.60		
Quadrant 2	Inner	2.92				
	Outer		2.92 ± 0.04			
	Total			4.61		
Quadrant 3	Inner	2.92				
	Outer		2.74			
	Total			4.63		
Quadrant 4	Inner	2.91				
	Outer		2.74			
	Total			4.61		

D Murgyp  
Inspector

12-5-01  
Date

	Nominal	Measurements
Resistance	2.3 Ω	2.293 Ω
Q @ 1 kHz	4.3	4.99
Inductance (Ls) @ 1 kHz	17 mH	13.482 mH

D Murgyp  
Inspector

12/5/01  
Date

B- & B+  
~~A- & A+~~  
A- & A+

Resistance Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2	9.10 to 9.50 Ω	19.88 Ω		
Heater Strips 2/3	9.10 to 9.50 Ω	19.88 Ω		
Heater Strips 3/4	9.10 to 9.50 Ω	NA		
Heater Strips 4/1	9.10 to 9.50 Ω	NA		

} DR No.  
H6Q-0270

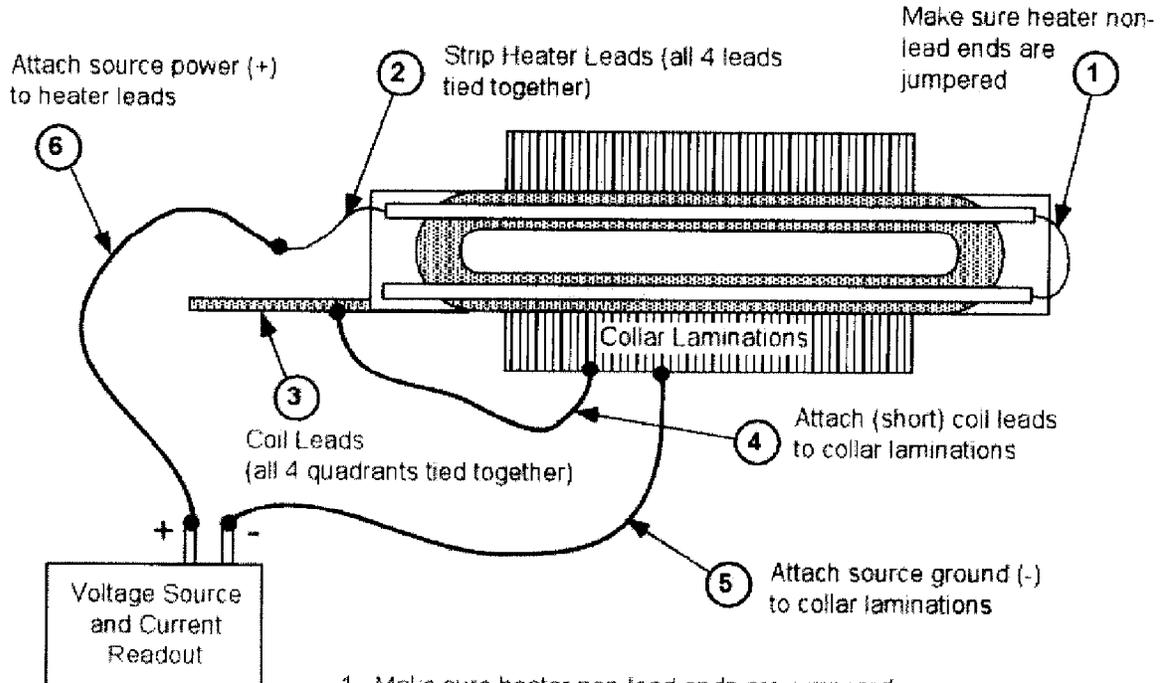
D Murgyp  
Inspector

12-5-01  
Date

DR No. x  
 HGO-0290<sup>0.2</sup>

Perform a Hipot on the Collared Coil Assembly (Maximum Leakage 3µA)

**1st Hipot - Heaters to both Coil and Ground**



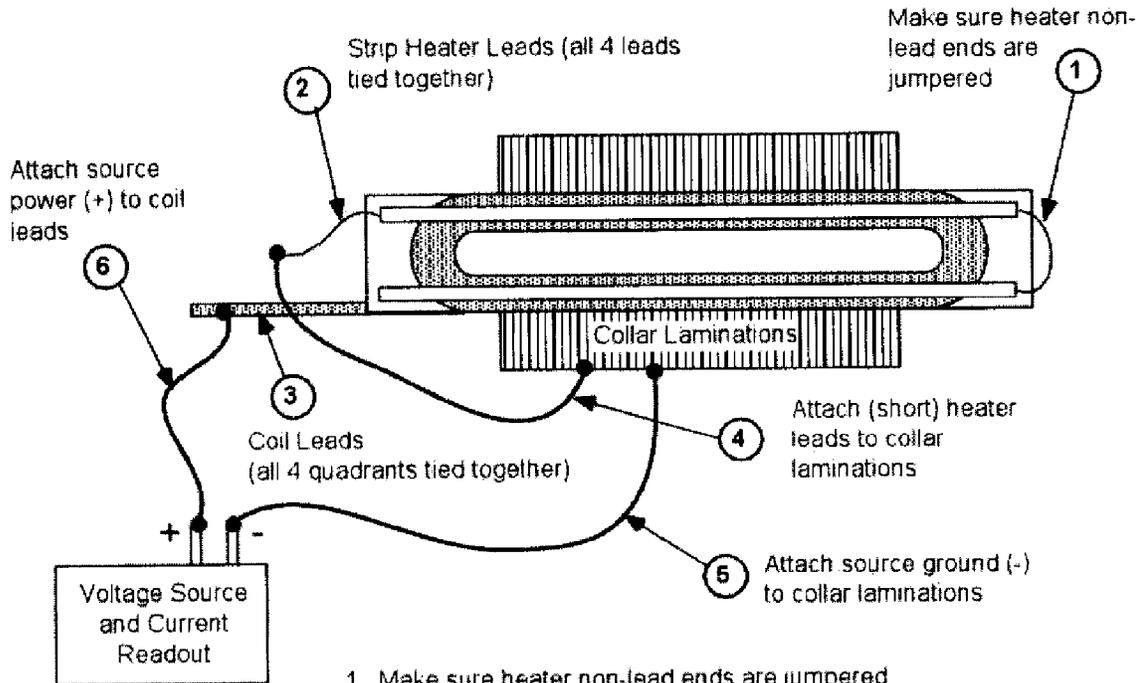
1. Make sure heater non-lead ends are jumpered
2. Tie all 4 heater leads together
3. Tie all 4 coil quadrants together
4. Attach (short) coil leads to collar laminations
5. Attach source ground (-) to collar laminations
6. Attach source power (+) to heater leads
7. Increase voltage to 5kv or until leakage exceeds 3µA. Voltage not in any circumstances to exceed 5kv.

5 KV	Measurement(s)
Heaters to Ground (Coils Grounded)	5µg <del>2.4</del> .4

*[Signature]*  
 Inspector

11/17/02  
 Date

**2nd Hipot - Coil to Ground Hipot**



1. Make sure heater non-lead ends are jumpered
2. Tie all 4 heater leads together
3. Tie all 4 coil quadrants together
4. Attach (short) heater leads to collar laminations
5. Attach source ground (-) to collar laminations
6. Attach source power (+) to coil leads
7. Increase voltage to 5kv or until leakage exceeds 3uA.  
 Voltage not in any circumstances to exceed 5kv.

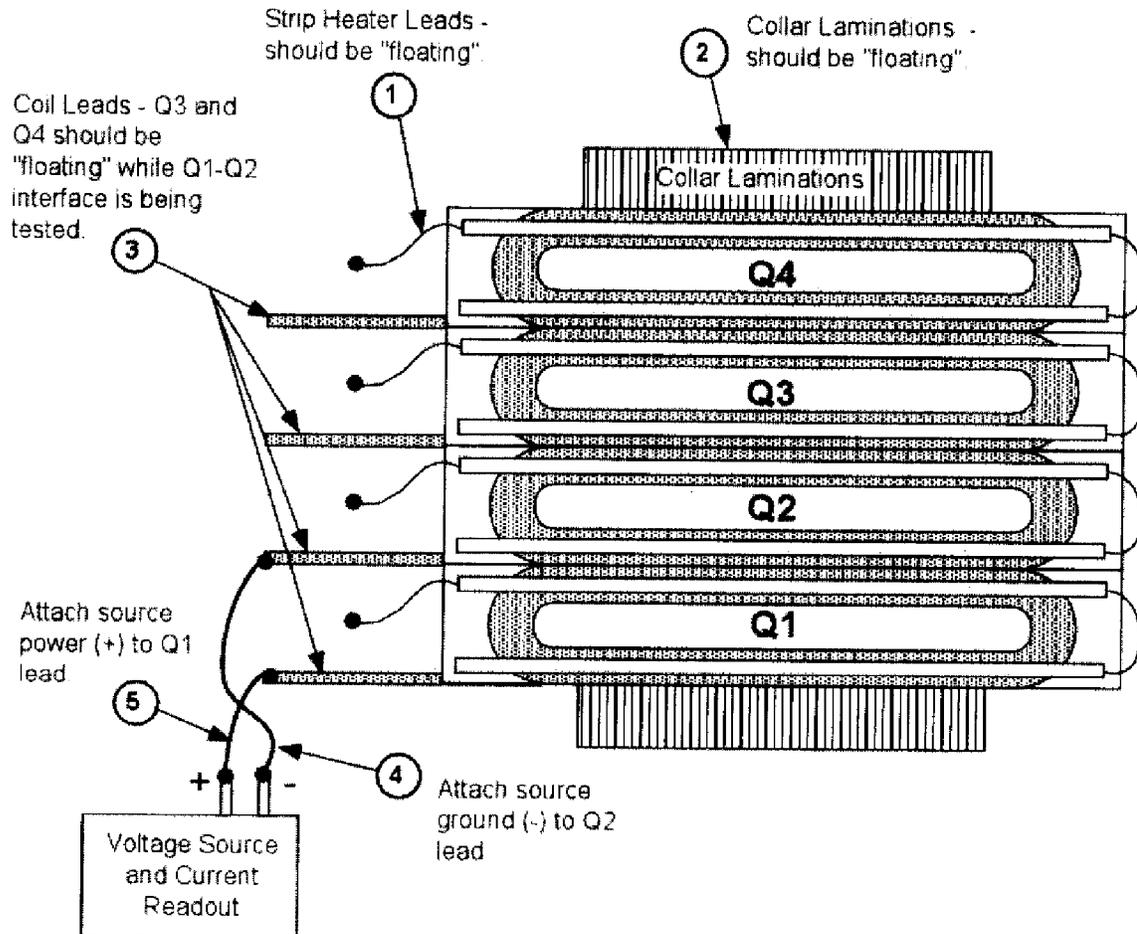
5 KV	Measurement(s)
Coils to Ground (Heaters Grounded)	.2

*[Signature]*  
 Inspector

*1/17/02*  
 Date

**3rd Hipot - Quadrant-to-Quadrant Hipot**

(4 quadrants shown "developed")



1. Make sure all heaters are "floating" (electrically isolated)
2. Make sure all collar laminations are "floating" (electrically isolated)
3. Make sure all leads from Q3 and Q4 coils are "floating" (electrically isolated).
4. Attach source ground (-) to Q2 lead (either inner or outer coil).  
Other end (either inner or outer coil) must be electrically isolated
5. Attach source power (+) to Q1 lead (either inner or outer coil)  
Other end (either inner or outer coil) must be electrically isolated.
6. Increase voltage to 3kv or until leakage exceeds 3uA. Voltage under any circumstances not to exceed 3kv
7. Repeat steps 3-6 for Q2-Q3 leads
8. Repeat steps 3-6 for Q3-Q4 leads
9. Repeat steps 3-6 for Q4-Q1 leads

*J. B. Rice*  
11-27-02

MQXB01

<b>Prog. #12 5000 V., 3 V/S, 5 uA Max, Ramp 100 uA</b>	
Heaters to ground w/ coils grounded:	150 nA
Coils to ground w/ heaters grounded:	248 nA

Coil to Coil @ 3.0 KV	Measurement(s)
Quadrant 1 to Quadrant 2	
Quadrant 2 to Quadrant 3	
Quadrant 3 to Quadrant 4	
Quadrant 4 to Quadrant 1	

N/A

Inspector \_\_\_\_\_

Date \_\_\_\_\_



9.3 Verify that the results in Step 9.0 are acceptable.  
Approved for next Assembly Procedure.

\_\_\_\_\_  
Responsible Authority/Physicist

1-17-02

\_\_\_\_\_  
Date

9.4 Perform Mole Measurement per (ES-344801).

[Signature]

\_\_\_\_\_  
Technician(s)

2-27-02

\_\_\_\_\_  
Date

10.0 Cold Mass Straightness Measurement

10.1 Move the completed Cold Mass assembly to rollers on the granite table. The rollers should be placed 124" apart, center to center, on the table

J. Gould  
Technician(s)

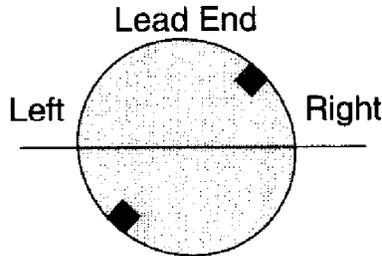
4/5/02  
Date

10.2 Roll the Cold Mass such that the Yoke/Skin Weld Key is at approximately 45°.

J. Gould  
Technician(s)

4/8/02  
Date

10.3 Stretch a wire from End Plate to End Plate in the horizontal plane. Measure the distance between the Wire and the Skin every 1' along the length.

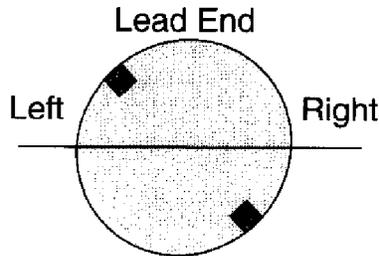


Location on Cold Mass	Left	Right
Lead End Plate	0	0
1'	0	0
2'	0	0
3'	0	.004
4'	0	.004
5'	0	.005
6'	0	.004
7'	0	.006
8'	0	.005
9'	0	.005
10'	0	.004
11'	.001	0
12'	.001	0
13'	0	0
14'	0	0
15'	0	0
16'	0	0
17'	0	0
18'	0	0
Return End Plate	0	0

J. Snel  
 Technician(s)

4/15/02  
 Date

- 10.4 Roll the Cold Mass 90°. Stretch a wire from End Plate to End Plate in the horizontal plane. Measure the distance between the Wire and the Skin every 1' along the length.



Location on Cold Mass	Left	Right
Lead End Plate	0	0
1'	0	.001
2'	0	SWG <del>0.004</del> 0
3'	0	0
4'	0	.004
5'	0	.002
6'	0	.002
7'	0	.003
8'	0	.004
9'	0	.006
10'	0	.006
11'	0	.004
12'	0	.005
13'	0	.005
14'	0	.007
15'	0	.003
16'	0	SWG <del>.003</del> 0
17'	0	0
18'	0	0
Return End Plate	0	0

J. Hall  
 Technician(s)

4/8/02  
 Date

- 10.5 Roll the Cold Mass back to the orientation such that the leads exit the lead block at the bottom of the assembly.

*J. Gould*  
Technician(s)

4/8/02  
Date

11.0 Cold Mass Lug Attachment Point Determination

11.1 Review the Cold Mass Mechanical Twist measurements taken in Step 9.3 of the LHC Yoke & Skinning Assembly Traveler (5520-TR-333497). Determine the position of the Average Magnetic Field Axis from a plot of the Mechanical Twist Measurements. Attach the Twist Plot and record the distance from the Magnet Lead End.

Distance from Magnet Lead End 150"

T. Poy  
Responsible Authority/Physicist

4/8/02  
Date

11.2 Mark the distance from the Magnet Lead End, as recorded above, on the Cold Mass Skin on both sides with a marker.

Hould  
Technician(s)

4/8/02  
Date

11.3 Place the Mechanical 'Twist' Measurement fixture on the Cold Mass at the marked location.

Hould  
Technician(s)

4/8/02  
Date

11.4 Place and secure an Angle Block on the Twist Measurement Fixture such that there is a level surface to place the precision level on.

Hould  
Technician(s)

4/8/02  
Date

11.5 Rotate the Cold Mass, as needed, to zero out the Bench Level (Moro 150mm #031534 or equivalent).

Hould  
Technician(s)

4/8/02  
Date

X 11.6 Verify that the Cold Mass was properly rotated.

J. R. Ne  
Lead Person

4-8-02  
Date

11.7 Using Machinist's Blue Ink, blue the area around where the lug will be placed, on both sides of the Cold Mass, and color the location of the reference center of the Cold Mass as per Cold Mass Welded Assembly (ME-390309).

*J. Gould* Technician(s) 4/9/02 Date

11.9 Using a Height Gauge, scribe Centerlines on both sides of the Cold Mass at the approximate location that the Cold Mass Support Lug will be placed.

*J. Gould* Technician(s) 4/9/02 Date

11.10 Measure from the Lead End to determine the location of the reference center.

*J. Gould* Technician(s) 113.263" JPK Location of Magnetic Center 4/9/02 Date

11.11 Measure from the Reference Center and scribe the location of the edges of the lug that will be placed on the Cold Mass as per Cold Mass Welded Assembly (ME-390309).

*J. Gould* Technician(s) 4/9/02 Date

11.12 Using a piece of Mylar, wrap the Cold Mass at the position of the lugs. Mark the location of the scribed centerlines and the notch in the Yoke/Skin Alignment Key.

*J. Gould* Technician(s) 4/9/02 Date

11.13 Unroll the Mylar and measure the distances between the marks to confirm the scribe marks are placed 180° apart on the Cold Mass, and are accurate with respect to the key.

*J. Gould* Technician(s) 4/9/02 Date

12.0 Production Complete

12.1 Process Engineering verify that the Large Hadron Collider Cold Mass and Final Assembly Traveler (5520-TR-333498) is accurate and complete. This shall include a review of all steps to ensure that all operations have been completed and signed off. Ensure that all Discrepancy Reports, Nonconformance Reports, Repair/Rework Forms, Deviation Index and dispositions have been reviewed by the Responsible Authority for conformance before being approved.

Comments:

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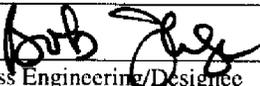
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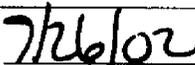
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\_\_\_\_\_  
Process Engineering/Designee

  
\_\_\_\_\_  
Date

ORIGINAL

PARIS KIT REQUEST

TD/ENGINEERING & FABRICATION

IMPORTANT NOTES:

- 1) MAGNET NUMBER MUST BE FILLED IN
- 2) ONLY ONE FORM PER MAGNET.
- 3) PARTS COORDINATOR OR DESIGNER MUST SIGN THIS FORM.
- 4) MATERIAL CONTROL WILL ISSUE PARTS AND RECORD ROUTING NUMBER.
- 5) ANY QUANTITIES NOT AVAILABLE WILL HAVE COMMENTS RETURNED TO THE PARTS COORDINATOR FOR REVIEW.

DELIVER TO: JCB

BUDGET CODE: 100

MAGNET NUMBER: MOXB-01

RELEASED BY: \_\_\_\_\_ PRODUCTION SIGNATURE: T J Gardner

TODAY'S DATE: 15-Jun-01

NEED DATE: 20-Jun-01

ISSUE VERIFICATION: \_\_\_\_\_

MATERIAL CONTROL SIGNATURE: Paula Schmidt

DATE ISSUED TO STOCKROOM: 6/15/01

THIS KIT LIST IS FOR: ME-369578 A FINAL COLD MASS ASSEMBLY

PART NUMBER	REV	DESCRIPTION	REQUIRED QTY/ASSY
- 344583	A	BULLET PUSHER SCREW	8 EA
- 344795	A	QUADRANT SPICE TOP SUPPORT BLOCK	3 EA
- 344886	G1	WIRE-FEED-THRU-TUBE-60" LONG	3 EA
- 344908	A	COIL SPICE BLOCK #1	1 EA
- 344909	B	COIL SPICE BLOCK #2	1 EA
- 344910	B	COIL SPICE BLOCK #3	1 EA
- 344911	B	COIL SPICE BLOCK #4	1 EA
- 344919	A	INTERMEDIATE SPICE BLOCK #1	1 EA
- 344970	A	INTERMEDIATE SPICE BLOCK #2 & #3	2 EA
- 344921	A	INTERMEDIATE SPICE BLOCK #4 PART A	1 EA
- 344922	A	INTERMEDIATE SPICE BLOCK #4 PART B	1 EA
- 344923	A	SUPPORT BLOCK COVER	4 EA
- 344942	B	QUADRANT SPICE BOTTOM SUPPORT BLOCK	3 EA
- 369060	C	LE FULL PRELOAD PLATE	1 EA
- 369061	A	RE FULL PRELOAD PLATE	1 EA
- 369214	A	FILLER, G-11	3 EA
- 369215	A	COIL SUPPORT BLOCK	1 EA
- 369265	A	SHCS 3/4-10x4.88	4 EA
- 369274	A	SOCKET HEAD CAP SCREW 10-32 X 1-1/4"	6 EA
- 369276	A	FLAT HEAD CAP SCREW #10-32 X 1-1/2"	28 EA
- 369277	A	SOCKET HEAD CAP SCREW 7/4-20 X 3/4"	6 EA
- 369278	A	SOCKET HEAD CAP SCREW #10-24 X 1-1/4"	8 EA

MATERIAL		CONTROL		FILLED OUT BY EXPEDITER		PROD. VERIFY PART		SUPT. VERIFY PART	
QTY ISSUED	ROUTE FORM	NOI AVAIL	DATE AVAIL	COMMENTS TO PRODUCTION MANAGER	DATE	NAME	DATE	NAME	DATE
8	74220		6/15/01						
3	74293								
3	69566	736							
1	74537								
1	74538								
1	74525								
1	74524								
1	69293								
2	69294								
1	74541								
1	74539								
4	69397								
3	74343								
1	74303								
1	74791								
3	74560								
1	74558								
4	69533								
6	72764								
28	72770								
6	69537								
8	69782								

RETURN THIS COMPLETED PARTS KIT REQUEST WITH THE ISSUED PARTS TO THE PARTS COORDINATOR.

TRAVELER NO. TR-333498 KIT IS COMPLETE (PARTS COORDINATOR SIGNATURE): \_\_\_\_\_

STOCKROOM SIGNATURE AND DATE: [Signature] 06-21-01

DATE: 21 JUL 01

Revision Request Control Number: 1293

Specification Number: 5520 - TR - 333498 Current Revision: A

Traveler or Document Title LHC Final Cold Mass Assembly Traveler

Step #/Description of Revision:

- 3.1 Deleted Step. Step performed in "Yoke & Skinning Traveler", Step 9.1.
- 3.2 Modified Step. Included labeling of Power Wires as per Figure 1. DR No. HGQ-0273.
- 7.1 Modified Step. Revised Resistance Test Table per figure 2 in Step 3.2. Updated nominals. R=2.305 W, Q=5.036, Ls=13.3376 mH.
- 9.1 Modified Step. Revised Resistance Test Table per figure 2 in Step 3.2. Updated nominals. R=2.305 W, Q=5.036, Ls=13.3376 mH.

Jim Rife

Originator

Jim Rife

Responsible Authority

1/9/2002

Date

Revision Incorporated into the Traveler:

*John A. Sestak*

Revision Incorporated By

3/20/02

Date

Process Engineering Final Review:

*Bob Jwa*

Process Engineering Designee

3/20/02

Date

### **Instructions for the completion of the Revision Request Form**

Note(s):

Multiple steps may be effected by one Revision Request Form but only one specific Traveler or Document may be effected by each Revision Request Form.

If completing this form by hand, a Revision Request Control Number must be obtained before processing.

If completing this form entirely by electronic means, the printed copy to be filed in the Process Engineering Office is to be initiated by the individual incorporating the Revision Request and the individual who reviewed the Traveler or Document.

Originator Instructions:

- 1) Specification Number: - Enter the Specification Number of the Traveler or Document to be revised. (Document title is inserted automatically from the spec. #)
- 2) Current Revision: - Enter the Revision of the Traveler or Document to be revised.
- 3) Step# / Description of the Revision: - Enter a description of the revision to be made and the step# it applies to, if applicable. If needed to describe the revision attach a copy of the page(s). If the revision is coming from a related document such as a Discrepancy Report or an Engineering Order attach a copy of that document to the Revision Request Form.
- 4) Originator: - Originator is the person generating the form. (Select Name from List)
- 5) Responsible Authority: - Responsible Authority is person responsible for the process in question. (Select Name from List)

Process Engineering Office Instructions:

- 1) Revision Incorporated into the Traveler: - Signature of the individual who incorporated the revision.
- 2) Process Engineering Final Review: - Review the Traveler or Document revised, sign and date the form. The original completed Revision Request Form will be retained by the Process Engineering Office in the Revision Request Binder.

Revision Request Control Number: 1318

Specification Number: 5520 - TR - 333498 Current Revision: A

Traveler or Document Title LHC Final Cold Mass Assembly Traveler

Step #/Description of Revision:

- 6.2 Modified Step. Changed MD-369293 to MD-369731. DR No. HGQ-0281.
- 8.2 Modified Step. Changed Part Number (MB-344942) to (MB-369875).DR No. HGQ-0284.
- 8.2 Moved Step. Moved to after Step 8.8. (Becomes New Step 8.8)
- 8.3 Modified Step. Added "...add all three Filler Pieces (MB-369214) and modify as needed...".
- 8.9 Modified Step. Changed Part Number (MB-344942) to (MB-369875).DR No. HGQ-0284.
- 8.10 Deleted Step. No Voltage Taps.
- 8.10 Modified Step (New Step 8.10) Changed last sentence to "Wrap the Springboard Assemblies in Kapton and then wrap with Kevlar String(MA-369912) every 1/2 - 3/4" over Kapton." DR No. HGQ-0288.

Donald Nurczyk

Originator

Jim Rife

Responsible Authority

1/2/2002

Date

Revision Incorporated into the Traveler:

*John L. Apostole*

Revision Incorporated By

3/20/02

Date

Process Engineering Final Review:

*Bob Jase*

Process Engineering/Designee

3/20/02

Date

## **Instructions for the completion of the Revision Request Form**

### Note(s):

Multiple steps may be effected by one Revision Request Form but only one specific Traveler or Document may be effected by each Revision Request Form.

If completing this form by hand, a Revision Request Control Number must be obtained before processing.

If completing this form entirely by electronic means, the printed copy to be filed in the Process Engineering Office is to be initiated by the individual incorporating the Revision Request and the individual who reviewed the Traveler or Document.

### Originator Instructions:

- 1) Specification Number: - Enter the Specification Number of the Traveler or Document to be revised. (Document title is inserted automatically from the spec. #)
- 2) Current Revision: - Enter the Revision of the Traveler or Document to be revised.
- 3) Step# / Description of the Revision: - Enter a description of the revision to be made and the step# it applies to, if applicable. If needed to describe the revision attach a copy of the page(s). If the revision is coming from a related document such as a Discrepancy Report or an Engineering Order attach a copy of that document to the Revision Request Form.
- 4) Originator: - Originator is the person generating the form. (Select Name from List)
- 5) Responsible Authority: - Responsible Authority is person responsible for the process in question. (Select Name from List)

### Process Engineering Office Instructions:

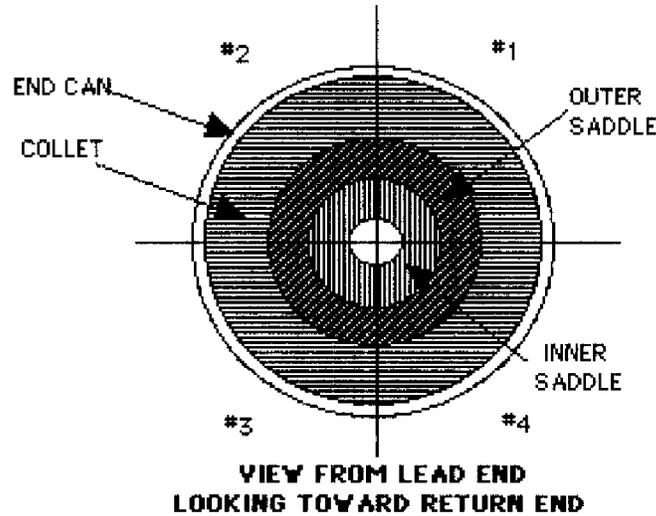
- 1) Revision Incorporated into the Traveler: - Signature of the individual who incorporated the revision.
- 2) Process Engineering Final Review: - Review the Traveler or Document revised, sign and date the form. The original completed Revision Request Form will be retained by the Process Engineering Office in the Revision Request Binder.

4.0 Bullet Pressure Plate Installation

- 4.1 Shim the Lead End Inner and Outer Saddles until they are flush, using 5 mil adhesive backed Kapton or equivalent and G-11CR Lead End Saddle Shim Stock (MD-369818 (Inner) & MD-369819 (Outer)) or equivalent.

*D. Murphy*  
 Technician(s)

*11-21-01*  
 Date



- 4.2 Install the Lead End Full Preload Plate (MB-369060).

*D. Murphy*  
 Technician(s)

*1-3-02*  
 Date

- 4.3 Shim the Non-Lead Inner and Outer Saddles until they are flush, using 5 mil adhesive backed Kapton or equivalent and G-11CR Non-Lead End Saddle Shim Stock (MD-369816 (Inner) & MD-369817 (Outer)) or equivalent.

*NA*  
 Technician(s)

\_\_\_\_\_  
 Date

- 4.4 Install the Non-Lead End Full Preload Plate (MB-369061) as per (ME-369655).

*NA*  
 Technician(s)

\_\_\_\_\_  
 Date

5.0 End Plate Installation

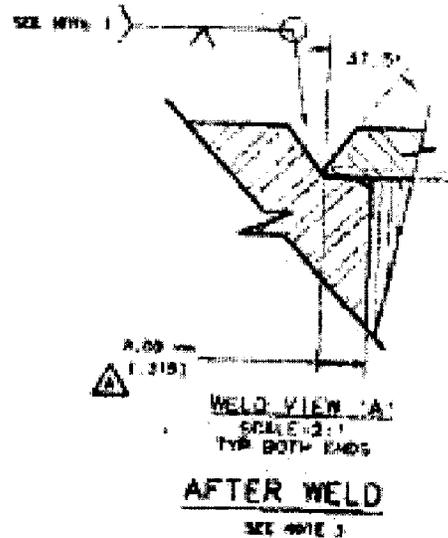
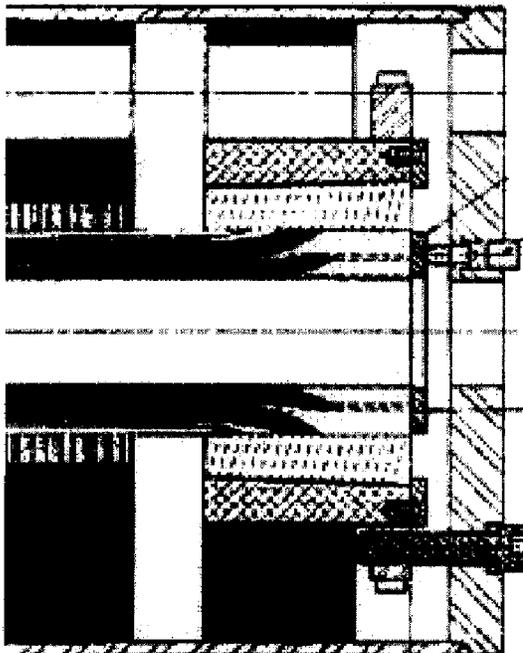
- 5.1 Clean the Non-lead End Plate area with Isopropyl Alcohol (Fermi stock 1920-0300) Kimwipes (Fermi stock 1660-2500) or equivalent, and a vacuum to remove all dirt and foreign materials.

\_\_\_\_\_  
 Technician *NA*

\_\_\_\_\_  
 Date

- 5.2 Install the Non-Lead End – End Plate (ME-369750) as per (ME-369655).

**NON-LEAD END**



**Quadrant 1 is UP.**

**Note(s):**

**The End Plate should be facing outward so the stamped or marked area with the nomenclature, part number, and "Top" is visible. Check the Tapped holes prior to installation for damage.**

\_\_\_\_\_  
 Technician *NA*

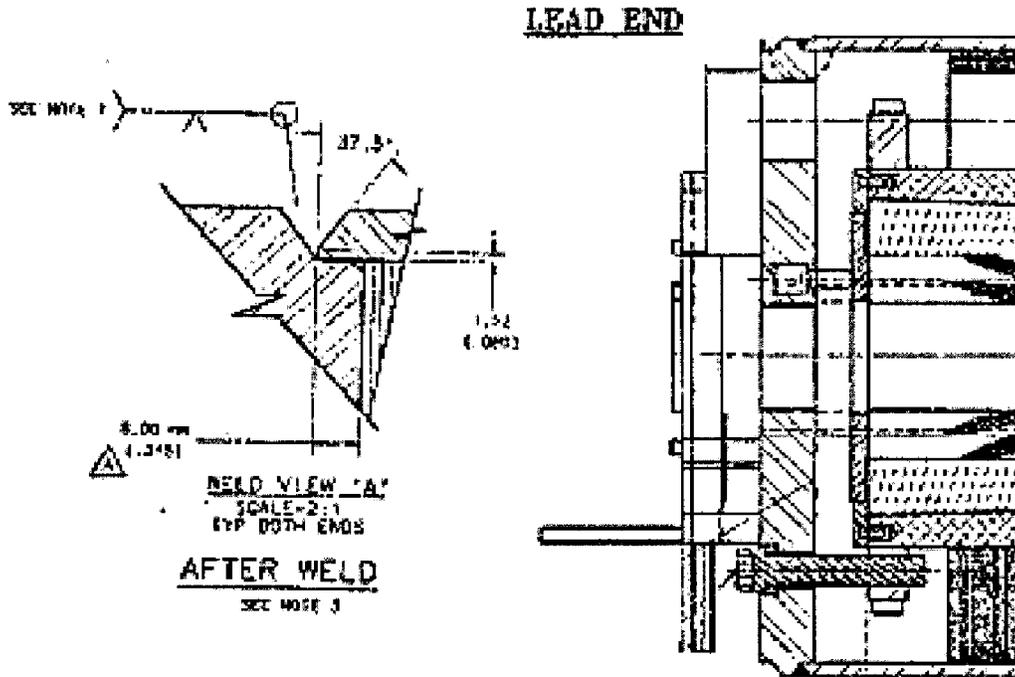
\_\_\_\_\_  
 Date

- 5.3 Clean the Lead End Plate Area with Isopropyl Alcohol (Fermi stock 1920-0300), Kimwipes (Fermi stock 1660-2500) or equivalent and vacuum to remove all dirt and foreign materials.

*[Signature]*  
 Technician(s)

1-4-02  
 Date

- 5.4 Install the Lead End - End Plate (ME-369749) as per (ME-369655). While installing, pull out the Instrumentation and Power Lead Wires through the proper openings as per the figure below.



**Quadrant 1 is UP.**

**Note(s):**

The End Plate should be facing outward so the stamped or marked area with the nomenclature, part number, and "top" is visible.  
 Check the Tapped holes prior to installation for damage.

*[Signature]*  
 Technician(s)

1-4-02  
 Date

- 5.5 Record the Length from the Outer Edge of the Lead End Plate to the Outer Edge of the Non-lead End Plate before welding.

All Quadrant lengths must be within .030" of each other.

Position of the Measurement	Measurement in Inches (For Reference Only)
Q1	225 13/16
Q2	225 5/8
Q3	225 11/16
Q4	225 11/16

[Signature]  
 Técnico(s)

1-4-02  
 Date

- X 5.6 Verify that the End Plates are properly installed as per the Final Coldmass Assembly (ME-369655).

[Signature]  
 Production Engineer/Designee

1-4-02  
 Date

- 5.7 While the Non-Lead End Plate is in position as per the Final Cold Mass Assembly (ME-369655), weld the Non-Lead End – End Plate to the Cold Mass Skin as per (ME-369655).

NA  
 Weldor

\_\_\_\_\_  
 Date

- 5.8 Clean the Weld area with a Stainless Steel Wire Brush (Fermi stock 1246-0860), Isopropyl Alcohol (Fermi stock 1920-0300), Kimwipes (Fermi stock 1660-2500) or equivalent and vacuum.

NA  
 Técnico(s)

\_\_\_\_\_  
 Date

- 5.9 While the Lead End Plate is in position as per the Final Cold Mass Assembly (ME-369655). Weld the Lead End –End Plate to the Cold Mass Skin as per (ME-369655).

[Signature]  
 Weldor

1-7-02  
 Date

- 5.10 Clean the Weld with a Stainless Steel Wire Brush (Fermi stock 1246-0860), Vacuum, Isopropyl Alcohol (Fermi stock 1920-0300) and Kimwipes (Fermi stock 1660-2500) or equivalent.

*D. Murgyp*  
Technician(s)

1-7-02  
Date

- 5.11 Record the Length from the Outer Edge of the Lead End Plate to the Outer Edge of the Non-lead End Plate after welding.

**Note(s):**

**The measurement should be within 1/8" of the readings taken in step 5.5.**

Position of the Measurement	Measurement in Inches	Nominal
Q1	225 5/8	225.926"
Q2	255 9/16	225.926"
Q3	225 <del>5/8</del> 1/16	225.926"
Q4	225 9/16	225.926"

*D. Murgyp*  
Technician(s)

1-7-02  
Date

6.0 Bolt and Bullet Installation

6.1 Apply Arcolox (open Purchase - Chemical Research Co.) to all threaded parts being installed onto the End Plates except the bolts. Apply anti-seize to the Axial Preload Bolts (MB-369267)

[Signature]  
Technician

1-7-02  
Date

6.2 Assemble the Bullet Assemblies (MD-369293) for the Lead and Non-Lead End.

[Signature]  
Technician

1-7-02  
Date

6.3 Install the Bullet Pusher Screws (MB-344583) and the Bullet Load Slugs (MB-344584) in (4) places on the Lead End and (4) places on the NON-Lead End as per (ES-369871). Be careful not to damage the wires or the solder connections.

Note(s):

**Before the final torque is applied the Production Engineer and/or Magnet Physicist are to be present.**

[Signature]  
Technician

1-7-02  
Date

X 6.4 Verify the stabilization of the Torque applied to the Bullet Pusher Screws. If no anomalies occurred during this process, state "no anomalies", else comment below.

Comment:

NO ANOMALIES

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

[Signature]  
Responsible Authority/Physicist

1-8-02  
Date

7.0 Electrical Inspection

7.1 Perform an electrical inspection on each of the individual Inner Coils, Outer Coils, Quadrants and the Magnet. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306), and the Procedure for Electrical Inspection of Voltage Taps (ES-301383).

Note(s):

Ensure that all measurements are recorded correctly, and have the proper value and symbol (i.e., mΩ, mH, etc.).

Valhalla 4300B settings:

Test current	_____	Off (not testing)
Power	_____	On
Full scale voltage	_____	20 mV
Amp selector knob	_____	1 A
Temperature compensator	_____	On
Test current	_____	On (testing)

Hp 4284:

Function \_\_\_\_\_ "Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla 32-858  
 HP 4284 2848J00912

Resistance		Inner	Outer	Total	Pass	Fail
Nominal		345 mΩ to 390 mΩ	410 mΩ to 455 mΩ	560 to 585 mΩ		
Quadrant 1	Inner	2543 mΩ				
	Outer		3170 mΩ			
	Total			5714 mΩ		
Quadrant 2	Inner	2537 mΩ				
	Outer		3176 mΩ			
	Total			5713 mΩ		
Quadrant 3	Inner	2582 mΩ				
	Outer		3182 mΩ			
	Total			5764 mΩ		
Quadrant 4	Inner	2573 mΩ				
	Outer		3179 mΩ			
	Total			5752 mΩ		

Inductance		Inner	Outer	Total	Pass	Fail
Nominal		620-650 $\mu$ H	1.120 to 1.17 mH	2.880 to 2.935 mH		
Quadrant 1	Inner	520.905 $\mu$ H				
	Outer		854.646 mH			
	Total			2.29236 mH		
Quadrant 2	Inner	519.182 $\mu$ H				
	Outer		850.840 mH			
	Total			2.28610 mH		
Quadrant 3	Inner	520.801 $\mu$ H				
	Outer		849.526 mH			
	Total			2.28740 mH		
Quadrant 4	Inner	522.074 $\mu$ H				
	Outer		853.301 mH			
	Total			2.29470 mH		

Q-Factor		Inner	Outer	Total	Pass	Fail
Nominal		3.0 to 3.5	4.3 to 5.0	4.5 to 5.2		
Quadrant 1	Inner	2.94				
	Outer		2.79			
	Total			4.68		
Quadrant 2	Inner	2.94				
	Outer		2.78			
	Total			4.69		
Quadrant 3	Inner	2.93				
	Outer		2.77			
	Total			4.64		
Quadrant 4	Inner	2.91				
	Outer		2.76			
	Total			4.62		

*D. J. Murphy*  
Inspector

1-8-02  
Date

	Nominal	Measurements
Resistance	2.3 $\Omega$	2.536 $\Omega$
Q@ 1 kHz	4.3	4.92
Inductance (Ls) @ 1 kHz	17 mH	13.4892 mH

D. Murgoff  
Inspector

1-8-02  
Date

Resistance Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2	9.10 to 9.50 $\Omega$	19.837 D $\Omega$		
Heater Strips 2/3	9.10 to 9.50 $\Omega$	19.847 A $\Omega$		
Heater Strips 3/4	9.10 to 9.50 $\Omega$	19.837 B $\Omega$		
Heater Strips 4/1	9.10 to 9.50 $\Omega$	19.847 A $\Omega$		

D. Murgoff  
Inspector

1-8-02  
Date

7.2 Verify torque on Pre-Load Bolts as per (ES-369871).

D. Murgoff  
Technician(s)

1-8-02  
Date

8.0 Make Quadrant Splices

DR #  
HGQ-0298

8.1 Attach the Coil Splice Block #1 (MD-344908), the Coil Splice Block #2 (MD-344909), the Coil Splice Block #3(MD-344910) and the Coil Splice Block #4 (MD-344911) to the Lead End Plate (ME-369572) as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

W. Schewe 1-9-02  
Technician(s) Date

8.2 Attach all three Support Block - Bases (MB344942) and the Coil Support Block (MA-369215) to the Lead End Plate (ME-369572) as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

W. Schewe 1-9-02  
Technician(s) Date

8.3 Form Power Leads into slots in Coil Splice Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

W. Schewe 1-9-02  
Technician(s) Date

8.4 Attach the Coil Splice - Intermediate Block #1 (MD-344919), both the Coil Splice - Intermediate Block #2, #3 (MD-344920) and the Coil Splice - Intermediate Block #4A (MD-344921) to the Coil Splice Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

W. Schewe 1-9-02  
Technician(s) Date

8.5 Form Power Leads into slots in Coil Splice - Intermediate Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

W. Schewe 1-9-02  
Technician(s) Date

8.6 Attach the Coil Splice - Intermediate Block #4B (MD-369844) to the Coil Splice - Intermediate Block #4A as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

W. Schewe 1-9-02  
Technician(s) Date

- 8.7 Form Power Leads into slots in Coil Splice - Intermediate Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

1-10-02  
Date

- 8.8 Attach all four Support Block Covers to the Coil Splice - Intermediate Blocks as per the Final Coldmass Assembly (ME-369655) and the Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

1-10-02  
Date

- 8.9 Attach all three Support Block - Tops (MB-344795) to the Support Block - Base (MB-344942) and all three Fillers (MB-369214) as per Quadrant Splice Assembly (MD-344925).

[Signature]  
Technician(s)

1-10-02  
Date

- 8.10 Attach (2) Voltage Taps to each Quadrant Splice and (2) Voltage Taps to each Power Lead.

Locations	Wire Type (MA-369832)	Completed
Power Leads Q4I	26 Gauge	/
	26 Gauge	/
Power Leads Q3I	26 Gauge	/
	26 Gauge	/
QS A Q20 / Q10 (1/2 Coil Tap)	26 Gauge	/
	26 Gauge	/
QS B Q30 / Q11 (1/4 Coil Tap)	26 Gauge	/
QS C Q40 / Q21 (1/4 Coil Tap)	26 Gauge	/

[Signature]  
Technician(s)

1-14-02  
Date

- 8.11 Install Springboard Assembly (MC-369842 & MC-369843) onto the Cold Mass Assembly. Wrap the Springboard Assemblies in Kapton.

[Signature]  
Technician(s)

1-14-02  
Date

9.0 Lead End Electrical Installations

9.1 Perform an electrical inspection on each of the individual Inner Coils, Outer Coils, Quadrants and the Magnet. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306), and the Procedure for Electrical Inspection of Voltage Taps (ES-301383).

**Note(s):**

**Ensure that all measurements are recorded correctly, and have the proper value and symbol (i.e., mΩ, mH, etc.).**

**Valhalla 4300B settings:**

Test current	_____	Off (not testing)
Power	_____	On
Full scale voltage	_____	20 mV
Amp selector knob	_____	1 A
Temperature compensator	_____	On
Test current	_____	On (testing)

**Hp 4284:**

Function	_____	"Ls-Q" selected
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Record the Serial Number of the test equipment used.

Valhalla	<u>32858</u>
HP 4284	<u>2848500912</u>

Resistance		Inner	Outer	Total	Pass	Fail
Nominal		345 mΩ to 390 mΩ	410 mΩ to 455 mΩ	560 to 585 mΩ		
Quadrant 1	Inner	255.7 mΩ				
	Outer		318.2 mΩ			
	Total			573.9 mΩ		
Quadrant 2	Inner	254.6 mΩ				
	Outer		318.4 mΩ			
	Total			573.0 mΩ		
Quadrant 3	Inner	256.3 mΩ				
	Outer		318.9 mΩ			
	Total			575.2 mΩ		
Quadrant 4	Inner	254.9 mΩ				
	Outer		318.2 mΩ			
	Total			573.1 mΩ		

TPR →

Inductance		Inner	Outer	Total	Pass	Fail
Nominal		620-650 μH	1.120 to 1.17 <del>mH</del>	2.880 to 2.935 mH		
Quadrant 1	Inner	SNG 546.711 <del>546.80</del> μH				
	Outer		SNG 883.328 <del>883.3</del> μH			
	Total			2.3361 <del>2.3186</del> SNG mH		
Quadrant 2	Inner	544.993 μH				
	Outer		879.619 μH			
	Total			2.3291 mH		
Quadrant 3	Inner	542.812 μH				
	Outer		875.682 μH			
	Total			2.3161 mH		
Quadrant 4	Inner	544.886 μH				
	Outer		878.629 μH			
	Total			2.3233 mH		

Q-Factor		Inner	Outer	Total	Pass	Fail
Nominal		3.0 to 3.5	4.3 to 5.0	4.5 to 5.2		
Quadrant 1	Inner	1.06				
	Outer		1.36			
	Total			1.99		
Quadrant 2	Inner	1.05				
	Outer		1.36			
	Total			1.99		
Quadrant 3	Inner	1.05				
	Outer		1.36			
	Total			1.98		
Quadrant 4	Inner	1.05				
	Outer		1.35			
	Total			1.97		

A. Gould  
Inspector

11/17/02  
Date

	Nominal	Measurements
Resistance	2.3 Ω	2.292 Ω
Q@ 1 kHz	4.3	5.01
Inductance (Ls) @ 1 kHz	17 mH	13.4704 mH

A. Gould  
Inspector

11/17/02  
Date



Resistance Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2	9.10 to 9.50 Ω	_____ Ω		
Heater Strips 2/3	9.10 to 9.50 Ω	19.864 Ω		
Heater Strips 3/4	9.10 to 9.50 Ω	_____ Ω		
Heater Strips 4/1	9.10 to 9.50 Ω	19.862 Ω		

A. Gould  
Inspector

11/17/02  
Date

Traveler Title:

LHC Final Cold Mass Assembly Traveler

Specification No:

5520-TR-333498

Revision:

A

DR No:

HGQ-0270

Step No:

3.1

Drawing No:

5520-ME-369655

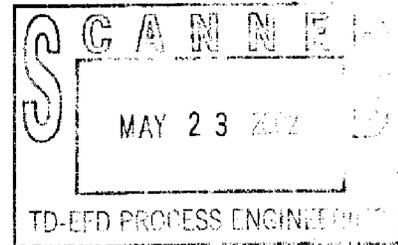
Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

The non-lead end outer saddles are cracked in the center of each saddle and they are bulging out from the face of the magnet.



Originator:

Steve Gould

Date:

11/9/01

Cause of Nonconformance:

The last 2 cm of parting plane saddle shim have been removed, allowing the saddles to fill the gaps by bending, causing the cracks.

Responsible Authority:

Rodger Bossert

Date:

11/9/01

**Disposition:**

Shim the uneven areas longitudinally and continue.

**Responsible Authority:**

Rodger Bossert

**Date:**

11/9/01

**Corrective Action to Prevent Recurrence:**

Consider lengthening Non-Lead End Outer Saddles by approximately 1/2 cm. This will provide more strength in the saddle section as well as lengthening the outer coils to be the same as the inner coils after springback.

**Responsible Authority:**

Rodger Bossert

**Date:**

11/9/01

**Corrective Action/Disposition Verified By:**

Rodger Bossert

**Date:**

11/9/01

**Will Configuration be affected?:**

YES  NO

**Identified problem area:**

- Material       Manpower       Method       Machine       Measurement

**Reviewed By:**

Bob Jensen

**Date:**

5/22/02

Traveler Title:

LHC Final Cold Mass Assembly Traveler

Specification No:

5520-TR-333498

Revision:

A

DR No:

HGQ-0284

Step No:

8.2

Drawing No:

5520-ME-369655

Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

One of the support block bases has been changed. Need the new base.

Originator:

Steve Gould

Date:

12/7/2001

Cause of Nonconformance:

The part change has not yet been incorporated into the parts kit list.

Responsible Authority:

Rodger Bossert

Date:

12/7/2001

**Disposition:**

Get proper block (MB-369875) and use in Assembly.

**Responsible Authority:**

Rodger Bossert

**Date:**

12/7/2001

**Corrective Action to Prevent Recurrence:**

Add new block to parts kit list and traveler. Replace previous part (3449420) with (369875). (TRR No. 1318)

**Responsible Authority:**

Rodger Bossert

**Date:**

12/7/2001

**Corrective Action/Disposition Verified By:**

Rodger Bossert

**Date:**

12/7/2001

Will Configuration be affected?:  YES  NO

**Identified problem area:**

Material  Manpower  Method  Machine  Measurement

**Reviewed By:**

Bob Jensen

**Date:**

3/20/2002

<b>Traveler Title:</b> LHC Final Cold Mass Assembly Traveler	<b>Specification No:</b> 5520-TR-333498	<b>Revision:</b> A	<b>DR No:</b> HGQ-0286
-----------------------------------------------------------------	--------------------------------------------	-----------------------	---------------------------

<b>Step No:</b> 8.9	<b>Drawing No:</b> 5520-ME-369655	<b>Routing Form No:</b> 	<b>Serial No:</b> MQXB01
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**Discrepancy Description:**

Fastener for the support block top does not fit for base #369875.

**Originator:**  
Steve Gould

**Date:**  
12/7/2001

**Cause of Nonconformance:**

Screw is too long. (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**  
Rodger Bossert

**Date:**  
12/7/2002

**Disposition:**

Obtain screws of proper length. (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**

Rodger Bossert

**Date:**

12/7/2001

**Corrective Action to Prevent Recurrence:**

Modify drawing to shorten screws. (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**

Rodger Bossert

**Date:**

12/7/2001

**Corrective Action/Disposition Verified By:**

Rodger Bossert

**Date:**

12/7/2001

Will Configuration be affected?:  YES  NO

**Identified problem area:**

Material  Manpower  Method  Machine  Measurement

**Reviewed By:**

Bob Jensen

**Date:**

2/13/2002

Traveler Title:

LHC Final Cold Mass Assembly Traveler

Specification No:

5520-TR-333498

Revision:

A

DR No:

HGQ-0290

Step No:

9.2

Drawing No:

ME-369655

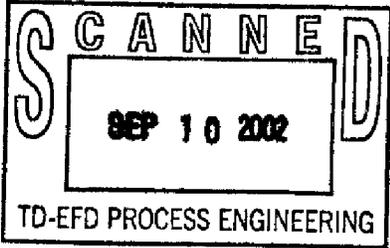
Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

Magnet was found to have a circuit A heater to ground failure at 3 kV.



Originator:

Jim Rife

Date:

12/11/2001

Cause of Nonconformance:

Heater wire was shorted to End pre-load plate. This happened because the heater wires were routed in a non-conventional manner. (Entered into Database on 7/11/02 - John Szostak)

Responsible Authority:

Rodger Bossert

Date:

1/8/2002

**Disposition:**

Remove End Plate, re-route heater wires in the conventional manner (adjacent to the leads), and continue. (Re-issue 333498, Steps 4.0 to 9.1 omitting steps not applicable.) (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**

Rodger Bossert

**Date:**

1/8/2002

**Corrective Action to Prevent Recurrence:**

Heater wires will, in the future, be routed in the conventional manner. (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**

Rodger Bossert

**Date:**

1/8/2002

**Corrective Action/Disposition Verified By:**

Rodger Bossert

**Date:**

1/8/2002

Will Configuration be affected?:  YES  NO

**Identified problem area:**

Material  Manpower  Method  Machine  Measurement

**Reviewed By:**

Bob Jensen

**Date:**

1/8/2002

Traveler Title:

LHC Final Cold Mass Assembly Traveler

Specification No:

5520-TR-333498

Revision:

A

DR No:

HGQ-0298

Step No:

8.1

Drawing No:

5520-ME-369655

Routing Form No:

Serial No:

MQXB01

Discrepancy Description:

Due to replacing endplate the bullets stick out of endplate. Splice Support blocks now rest upon bullets, not flat end plate surface. (Entered into Database on 7/11/02 - John Szostak)

Originator:

Donald Nurczyk

Date:

1/8/2002

Cause of Nonconformance:

End plate was replaced, making Lead End slightly shorter for this magnet only. Bullets therefore stick out beyond End plate surface. (Entered into Database on 7/11/02 - John Szostak)

Responsible Authority:

Rodger Bossert

Date:

1/8/2002

**Disposition:**

Grind out areas of interference on splice blocks, then proceed with assembly. (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**

Rodger Bossert

**Date:**

1/8/2002

**Corrective Action to Prevent Recurrence:**

This problem will not exist when hipotting failure problem is solved. Refer to DR No. HGQ-0290. (Entered into Database on 7/11/02 - John Szostak)

**Responsible Authority:**

Rodger Bossert

**Date:**

1/8/2002

**Corrective Action/Disposition Verified By:**

Rodger Bossert

**Date:**

1/8/2002

**Will Configuration be affected?:**     YES     NO

**Identified problem area:**

Material     Manpower     Method     Machine     Measurement

**Reviewed By:**

Bob Jensen

**Date:**

1/8/2002