

**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**

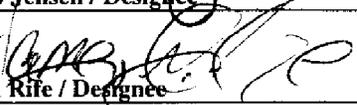
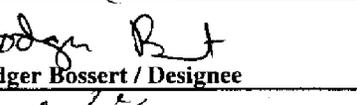
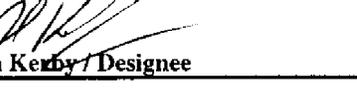
8/28/02

48

Budget Code: LPT **Project Code:** LHC

Released by: J. Szostak **Date:** 1/29/02

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

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

Revision Page

Revision	Step No.	Revision Description	TRR No.	Date
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 -	Steps added as per Jim Kerby.		
	11.0			

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.

John J. Brastak
Process Engineering/Designee

1/29/02
Date

3.0 Cold Mass Final Assembly Preparation

MQXB Production Magnet Strip Heater Schematic

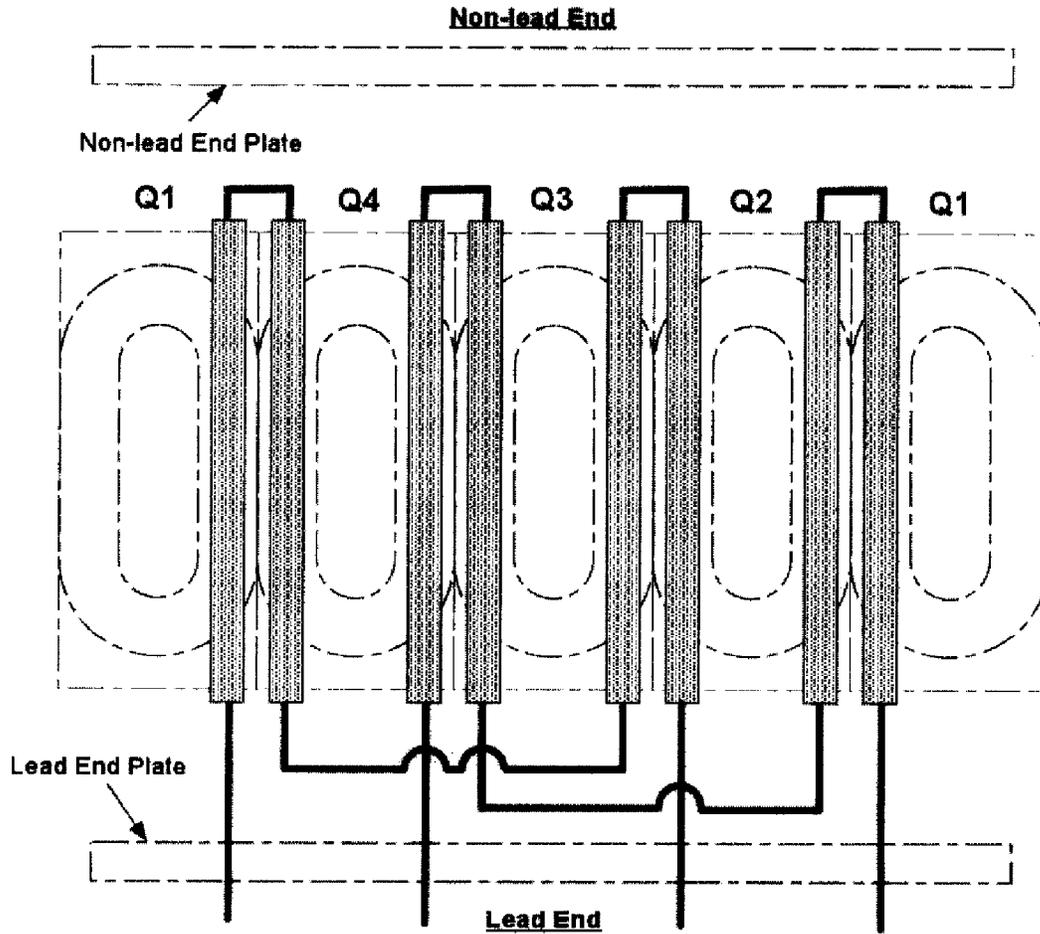


Figure 1

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

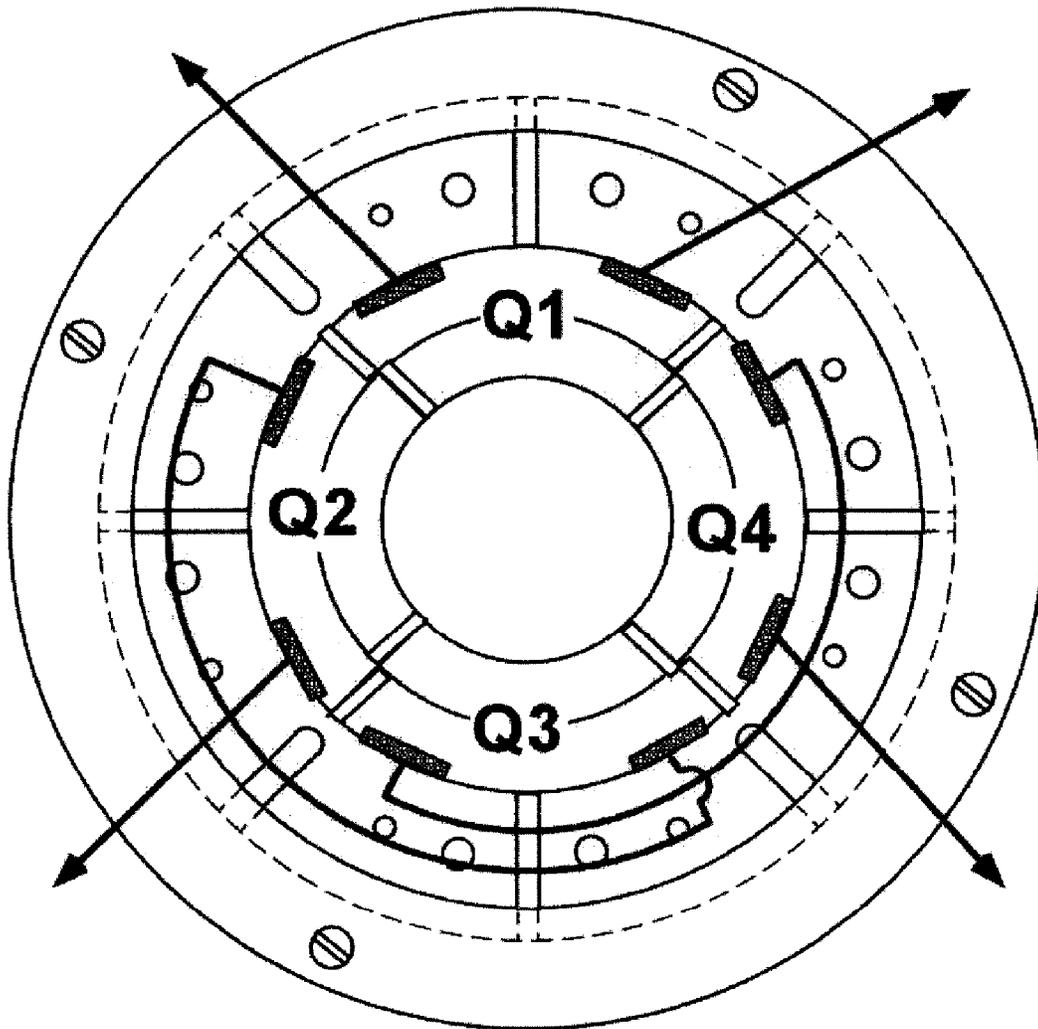
[Signature]
 Technician(s)

2/1/02
 Date

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)

2/1/02
 Date



LHCIRQ Lead End Strip Heater Wiring Layout
Figure 2

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

Diana Tringali
Technician(s)

2/1/02
Date

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

A. Howell
Technician(s)

2/1/02
Date

- 3.5 Verify that all Quadrant Leads are properly insulated.

A. Howell
Technician(s)

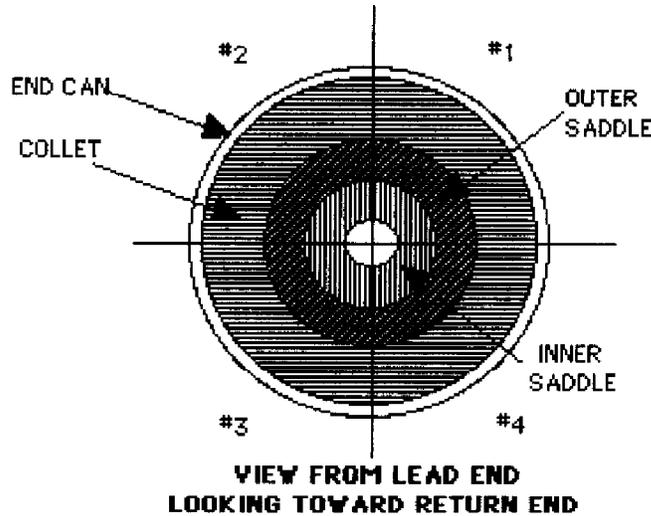
2/1/02
Date

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.

J. Gould
 Technician(s)

2/5/02
 Date



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

J. Gould
 Technician(s)

2/5/02
 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.

J. Gould
 Technician(s)

2/1/02
 Date

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

J. Gould
 Technician(s)

2/1/02
 Date

5.0 End Plate Installation

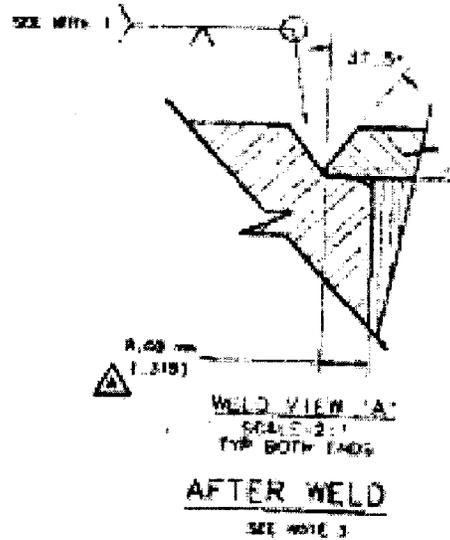
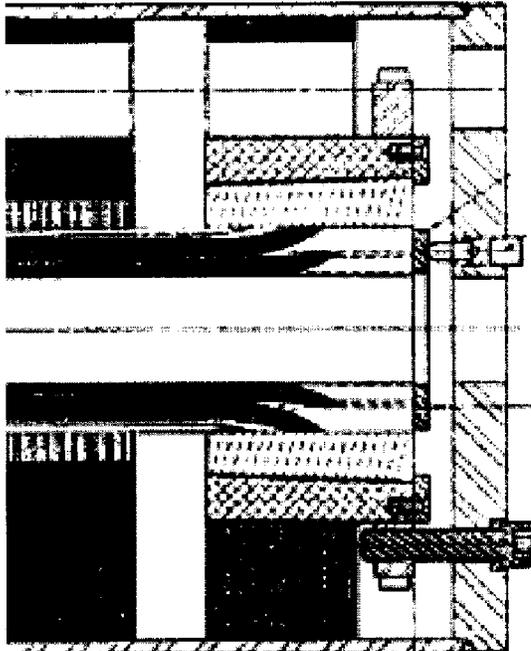
5.1 Clean the Non-lead End Plate area with Isopropyl Alcohol (Fermi stock 1920-0300) Kimwipes (Fermi stock 1660-2500) or equivalent, and a vacuum to remove all dirt and foreign materials.

[Signature]
Technician

2/4/02
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.

[Signature]
Technician

2/4/02
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	226 3/16
Q2	226 1/16
Q3	226 1/8
Q4	226 1/16

[Signature] Technician(s) 2/12/02 Date

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

[Signature] Production Engineer/Designee 2-12-02 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).

[Signature] Weldor 2/12/02 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.

[Signature] Technician(s) 2/12/02 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 2/13/02 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.

[Signature]
Technician(s)

2/13/02
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	226 1/16	225.926"
Q2	225 15/16	225.926"
Q3	225 7/8	225.926"
Q4	225. 9 31/32	225.926"

[Signature]
Technician(s)

2/13/02
Date

TAR

CHANGE TO DRY Moly ALSO!

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)

[Signature] Technician Date

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

[Signature] Technician 2-13-02 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 2-13-02 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:

[Signature] Responsible Authority/Physicist 13-Feb-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	_____	200V
Amp selector knob	_____	1 A
Temperature compensator	_____	On
Test current	_____	On (testing)

~~FOR RECORD!~~
CHANGE
GFA

Hp 4284:

Function _____ "Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla 30-858
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	258 mΩ				
	Outer		320 mΩ			
	Total			578 mΩ		
Quadrant 2	Inner	259 mΩ				
	Outer		320 mΩ			
	Total			579 mΩ		
Quadrant 3	Inner	259 mΩ				
	Outer		319 mΩ			
	Total			578 mΩ		
Quadrant 4	Inner	259 mΩ				
	Outer		321 mΩ			
	Total			579 mΩ		

TRR# 1439 CHANGE
~~170 to 17 mH~~

Inductance		Inner	Outer μH	Total	Pass	Fail
Nominal		620-650 μH	170 to 17 mH	2.880 to 2.935 mH		
Quadrant 1	Inner	537.331 μH				
	Outer		869.567 mH			
	Total			2.2939 mH		
Quadrant 2	Inner	537.983 μH				
	Outer		869.903 mH			
	Total			2.2970 mH		
Quadrant 3	Inner	540.138 μH				
	Outer		872.582 mH			
	Total			2.3058 mH		
Quadrant 4	Inner	539.057 μH				
	Outer		873.643 mH			
	Total			2.3048 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	1.28				
	Outer		1.59			
	Total			4.67		
Quadrant 2	Inner	1.30				
	Outer		1.60			
	Total			4.68		
Quadrant 3	Inner	1.32				
	Outer		1.61			
	Total			4.65		
Quadrant 4	Inner	1.31				
	Outer		1.61			
	Total			4.69		

A. Gould
 Inspector

2/13/02
 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).

J. Gould 2/14/02
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).

J. Gould 2/20/02
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).

J. Gould 2/18/02
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).

J. Gould 2/18/02
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).

J. Gould 2/18/02
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).

J. Gould 2/18/02
Technician(s) Date

TRR #1318
move
DR #
HGQ-0307
HGQ-0308
HGQ-0315

Solder
LEADS
TRR #1439

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).

J. Howell Technician(s) 2/18/02 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).

J. Howell Technician(s) 2/19/02 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).

J. Howell Technician(s) 2/22/02 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 / Q2I (1/4 Coil Tap)	26 Gauge	✓

J. Howell Technician(s) 2/22/02 Date

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

J. Howell Technician(s) 2/22/02 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	_____
HP 4284	_____

Resistance		Inner	Outer	Total	Pass	Fail
Nominal		345 mΩ to 390 mΩ	410 mΩ to 455 mΩ	560 to 585 mΩ		
Quadrant 1	Inner	516 254.2 mΩ				
	Outer		317.6 mΩ			
	Total			516 571.6 mΩ		
Quadrant 2	Inner	254.2 mΩ				
	Outer		317.3 mΩ			
	Total			571.3 mΩ		
Quadrant 3	Inner	253.6 mΩ				
	Outer		317.7 mΩ			
	Total			571.2 mΩ		
Quadrant 4	Inner	254.1 mΩ				
	Outer		317.5 mΩ			
	Total			571.4 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	555.508 μH				
	Outer		893.946 μH			
	Total			2,34539 mH		
Quadrant 2	Inner	558.732 μH				
	Outer		894.718 μH			
	Total			2,35695 mH		
Quadrant 3	Inner	562.406 μH				
	Outer		892.334 μH			
	Total			2,34749 mH		
Quadrant 4	Inner	545.233 μH				
	Outer		894.864 μH			
	Total			2,33609 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	.73				
	Outer		1.00			
	Total			1.99		
Quadrant 2	Inner	.74				
	Outer		1.01			
	Total			2.00		
Quadrant 3	Inner	.75				
	Outer		1.01			
	Total			1.99		
Quadrant 4	Inner	.94				
	Outer		1.01			
	Total			2.33		

J. Howell
 Inspector

2/25/02
 Date

	Nominal	Measurements
Resistance	2.3 Ω	2.292 Ω
Q @ 1 kHz	4.3	4.94
Inductance (Ls) @ 1 kHz	17 mH	13.564 mH

J. Howell
 Inspector

 Date

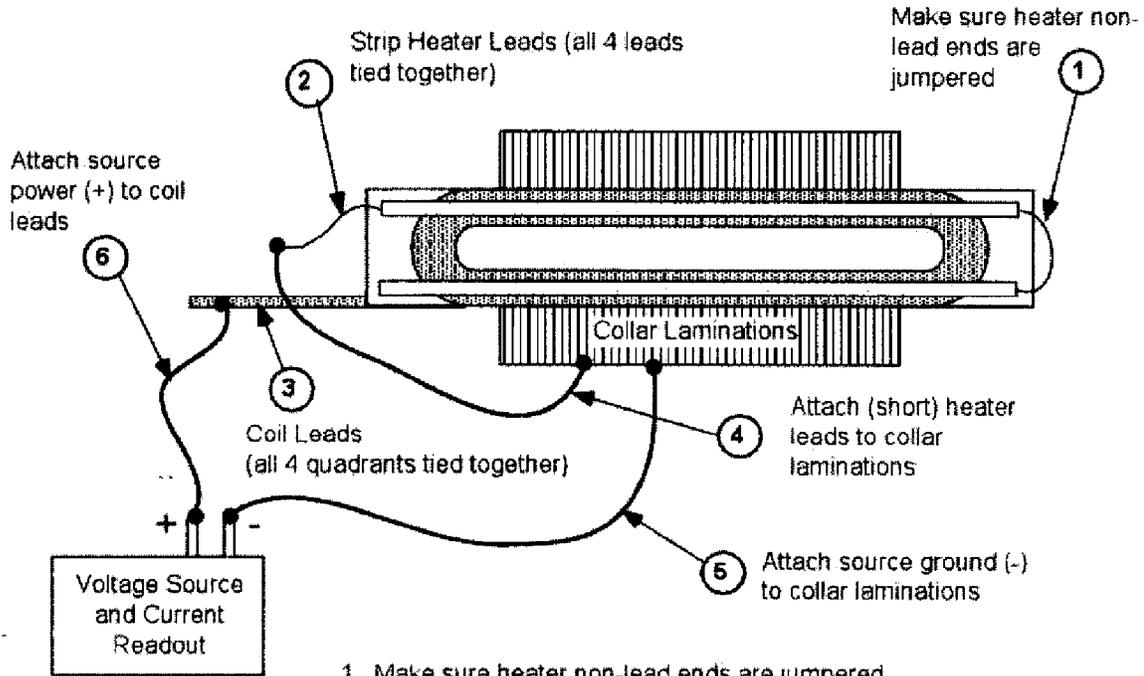
TRR#
 1293
 B-
 A-
 B+
 A+

Resistance Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2	9.10 to 9.50 Ω	19.476 Ω		
Heater Strips 2/3	9.10 to 9.50 Ω	19.398 Ω		
Heater Strips 3/4	9.10 to 9.50 Ω	19.476 Ω		
Heater Strips 4/1	9.10 to 9.50 Ω	19.398 Ω		

J. Howell
 Inspector

2/25/02
 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.

Dr # HGA 0313

5 KV	Measurement(s)
Coils to Ground (Heaters Grounded)	<i>1.4 uA</i>

S. Gould
 Inspector

2/26/02
 Date

New Hipot Test

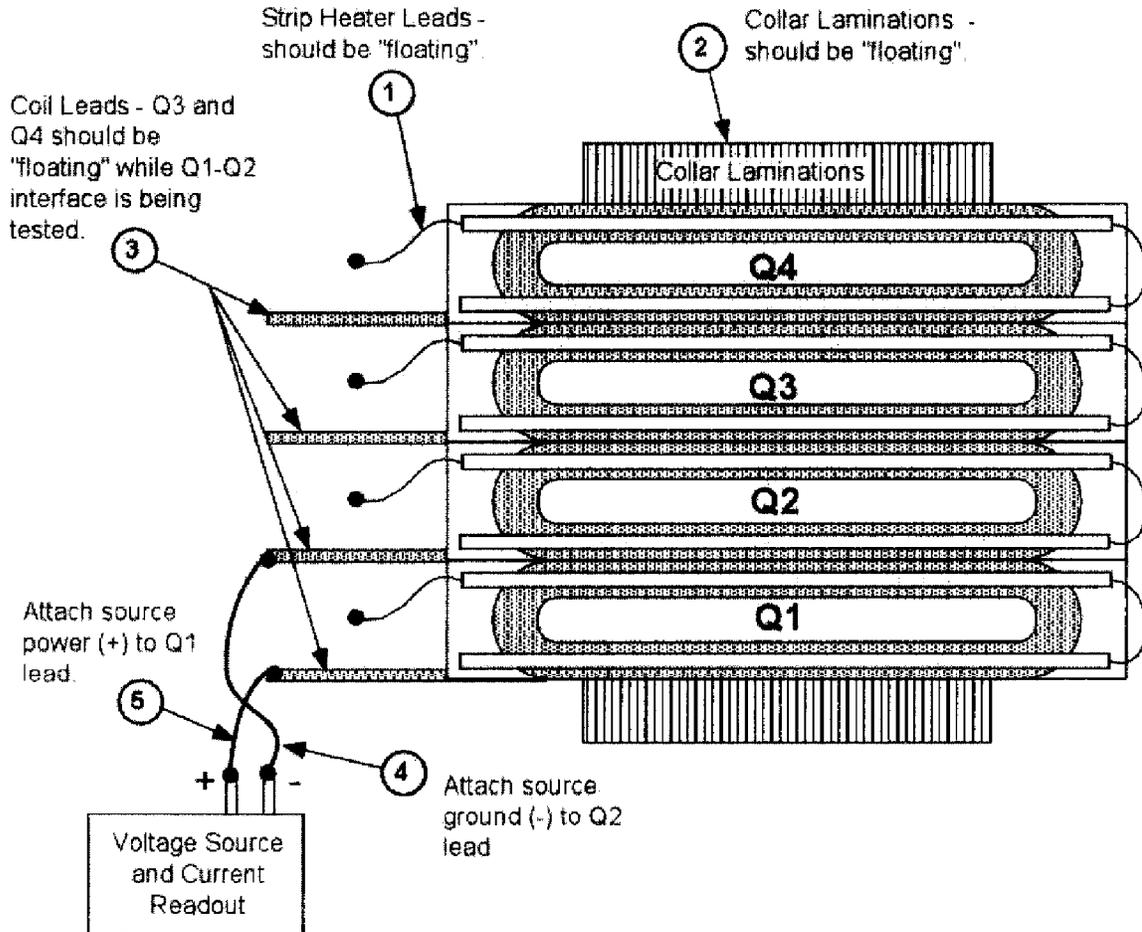
5KV	MEASUREMENT
COILS TO GROUND	<i>1.5 uA</i>

S. GOULD 2/26/02

5KV	MEASUREMENT
HEATERS TO GROUND (COILS GROUND)	<i>0.72 uA</i>

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.

N/A

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	

Inspector _____

Date _____



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

Michael / L
Responsible Authority/Physicist

2-26-02
Date

Perform Mole Measurement per (ES-344801).
AS
Technician(s)

03-06-02
Date

HGR Dr#
0316

9.4

TAR NEEDS HERE
ALSO!

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)

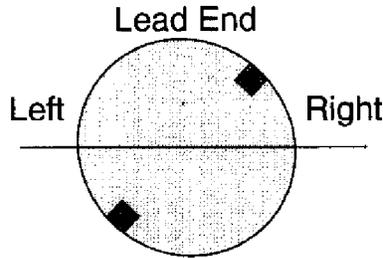
4/9/02
Date

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

J. Gould
Technician(s)

4/9/02
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	Ø	Ø
1'	0	Ø
2'	0	Ø
3'	.001	Ø
4'	.001	Ø
5'	.001	Ø
6'	.002	Ø
7'	.001	Ø
8'	0	.001
9'	0	.001
10'	0	.001
11'	0	.006
12'	0	.003
13'	0	.004
14'	.001	.004
15'	.001	.004
16'	.001	.004
17'	.002	.004
18'	Ø	.004
Return End Plate	Ø	Ø

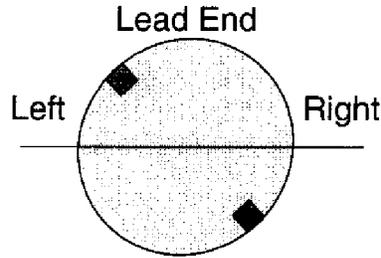
Technician(s)

J. B. Lee

Date

4-10-02

- 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	∅	∅
1'	∅	∅
2'	∅	∅
3'	∅	∅
4'	∅	∅
5'	∅	∅
6'	.001	∅
7'	∅	∅
8'	∅	∅
9'	∅	∅
10'	.001	∅
11'	.001	∅
12'	.002	∅
13'	.003	∅
14'	.002	∅
15'	.002	∅
16'	.001	∅
17'	∅	∅
18'	∅	∅
Return End Plate	∅	∅

J. B. Rice
Technician(s)

4-10-02
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. Hamed
Technician(s)

4/9/02
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 40"
T. Page Responsible Authority/Physicist 4/9/02 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.

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

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

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

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

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

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

X 11.6 Verify that the Cold Mass was properly rotated.

T. Page Lead Person 4-9-02 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) 113.076" 9/K 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:

Bob Jones
Process Engineering/Designee

8/28/02
Date

TD/ENGINEERING & FABRICATION

PARTS KIT REQUEST

ORIGINAL

IMPORTANT NOTES:

- 1) MAGNET NUMBER MUST BE FILLED IN.
- 2) ONLY ONE FORM PER MAGNET.
- 3) PARTS COORDINATOR OR DESIGNEE 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.

MAGNET NUMBER: MSXB02

RELEASED BY: _____ PRODUCTION SIGNATURE: T.J. Gardner

TODAY'S DATE: 12-Nov-01

NEED DATE: 14-Nov-01

DELIVER TO: _____ ICB

BUDGET CODE: LGB

ISSUE VERIFICATION: _____

MATERIAL CONTROL SIGNATURE: Muelh Schmidt

DATE ISSUED TO STOCKROOM: 11/12/01

THIS KIT LIST IS FOR:

ME-369578	A	FINAL COLD MASS ASSEMBLY
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PART NUMBER	REV	DESCRIPTION	REQUIRED QTY/ASS'Y	MATERIAL		CONTROL		PROD		SUPT.	
				QTY FILLED OUT BY STOCK ROOM	ROUTE FORM	DATE AVAIL	DATE AVAIL	VERIFY PART	VERIFY PART	VERIFY PART	VERIFY PART
344583	A	BULLET PUSHER SCREW	8 EA	8	74220	11/12/01					
344795	A	QUADRANT SPICE TOP SUPPORT BLOCK	3 EA	3	74293						
344908	A	COIL SPICE BLOCK #1	1 EA	1	69289						
344909	B	COIL SPICE BLOCK #2	1 EA	1	74538						
344910	B	COIL SPICE BLOCK #3	1 EA	1	69291						
344911	B	COIL SPICE BLOCK #4	1 EA	1	74524						
344919	A	INTERMEDIATE SPICE BLOCK #1	1 EA	1	74527						
344920	A	INTERMEDIATE SPICE BLOCK #2 & #3	2 EA	2	74526						
344921	A	INTERMEDIATE SPICE BLOCK #4 PART A	1 EA	1	69295						
344922	A	INTERMEDIATE SPICE BLOCK #4 PART B	1 EA	1	69296						
344923	A	SUPPORT BLOCK COVER	4 EA	4	74570						
344942	B	QUADRANT SPICE BOTTOM SUPPORT BLOCK	3 EA	3	74343						
369060	C	LE FULL PRELOAD PLATE	1 EA	1	74508						
369061	A	RE FULL PRELOAD PLATE	1 EA	1	72016						
369214	A	FILLER, G-11	3 EA	3	74560						
369215	A	COIL SUPPORT BLOCK	1 EA	1	74558						
369265	A	SHCS 3/4-10x4 ss	4 EA	4	69533						
369274	A	SOCKET HEAD CAP SCREW 10-32 X 1-1/4"	6 EA	6	73764						
369276	A	FLAT HEAD CAP SCREW #10-32 X 1-1/2"	28 EA	28	72770						
369277	A	SOCKET HEAD CAP SCREW 1/4-20 X 3/4"	6 EA	6	69837						
369278	A	SOCKET HEAD CAP SCREW #10-24 X 1-1/4"	8 EA	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] 11/12/01

BADGE # 489

ORIGINAL

PARTS KIT REQUEST

TD/ENGINEERING & FABRICATION

IMPORTANT NOTES:

- 1) MAGNET NUMBER MUST BE FILLED IN.
- 2) ONLY ONE FORM PER MAGNET.
- 3) PARTS COORDINATOR OR DESIGNEE 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 1B-3

BUDGET CODE: IGB

MAGNET NUMBER: MQXB02

RELEASED BY: _____ PRODUCTION SIGNATURE: T J Gardner

TODAYS DATE: 12-Nov-01

NEED DATE: 14-Nov-01

ISSUE VERIFICATION

MATERIAL CONTROL SIGNATURE: [Signature]

DATE ISSUED TO STOCKROOM: 11/12/01

THIS KIT LIST IS FOR: FINAL COLD MASS ASSEMBLY

PART NUMBER	REV	DESCRIPTION	REQUIRED QTY/ASSY	MATERIAL		CONTROL		PROD VERIFY PART	SUPT. VERIFY PART
				QTY ISSUED	ROUTE FORM	DATE AVAIL	DATE AVAIL		
369293	A	BULLET ASSEMBLY	ICB HAS	8					
369314	A	SLOTTED FLAT HEAD SCREW #4-40 X 1/4 LG	8 EA	8	72777	11/12/01			
369413	A	SOCKET HEAD CAP SCREW 1/4-20 X 1-1/2	4 EA	4	72765				
369630	A	SOCKET HEAD CAP SCREW #8-32 X 3/4 LG	8 EA	8	72769				
369631	A	SOCKET HEAD CAP SCREW #8-32 X 1/2 LG	8 EA	8	72767				
369732	NR	BUSS ASSEMBLY	ICB HAS						
369737	A	SOCKET HAD CAP SCREW 3/4-10 X 3-1/2 LG	4 EA	4	73958	11/12/01			
369749	A	LEAD END PLATE	1 EA	1	75616				
369750	A	NON-LEAD END PLATE	1 EA	1	75617				

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

STOCKROOM SIGNATURE AND DATE

[Signature] 11/13/01

TRAVELER NO. TR-373

TR-373 KIT IS COMPLETE (PARTS COORDINATOR SIGNATURE): [Signature]

Page 2 BRIDGE #509

DATE: 15 NOV 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 Szostak

Revision Incorporated By

3/20/2002

Date

Process Engineering Final Review:

Bob Jensen

Process Engineering/Designee

3/20/2002

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:

Specification Number: Current Revision:

Traveler or Document Title

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.

Originator

Responsible Authority

Date

Revision Incorporated into the Traveler:

Revision Incorporated By

Date

Process Engineering Final Review:

Process Engineering/Designee

Date

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- 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: 1439

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

Traveler or Document Title LHC Final Cold Mass Assembly Traveler

Step #/Description of Revision:

- 3.3 Modified Step. Changed Step to read: "Insert the Heater Strips into notch and cover with .005 kapton. Place Green Putty (MA-103930) over the .005 kapton cover. Add .005 kapton to the back of the Pre-load Plate." DR No. HGQ-0337.
- 3.4 Modified Step. Changed Technician signoff to Crew Chief.
- 5.7 Modified Step. Moved Step to new Step 6.8.
- 5.8 Modified Step. Moved Step to new Step 6.9.
- 5.9 Modified Step. Moved Step to new Step 6.10.
- 6.4 Added Step. "Torque the Bullets as per Specification No. XXXXXX" Moved Note from 6.3 to 6.4.
- 6.6 Added Step. "Perform a Hipot on the Collared Coil Assembly. (Maximum Leakage 3mA)" DR No. HGQ-0329.
- 6.7 Added Step. "Un-torque the Bullets as per Specification No. XXXXXX".
- 7.1 Modified Step. Removed Inner and Outer Columns from tables.
- 9.1 Modified Step. Removed Inner and Outer Columns from tables.
- 8.8 Added Step. Solder the Leads.
- 8.11 Added Step. "Attach (2) Voltage Taps to each Quadrant Splice and (2) Voltage Taps to each Power Lead." (Included Table)

John Szostak

Originator

Jim Rife

Responsible Authority

3/28/2002

Date

Revision Incorporated into the Traveler:

Revision Incorporated By

Date

Process Engineering Final Review:

Process Engineering/Designee

Date

Instructions for the completion of the Revision Request Form

Note(s):

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Process Engineering Office Instructions:

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- 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.

Traveler Title:

LHC Final Cold Mass Assembly Traveler

Specification No:

5520-TR-333498

Revision:

A

DR No:

HGQ-0307

Step No:

8.2

Drawing No:

369655

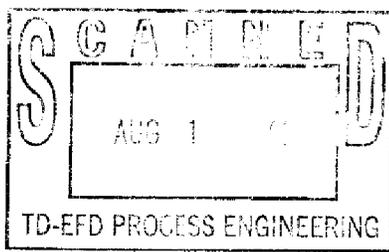
Routing Form No:

Serial No:

MQXB02

Discrepancy Description:

One hole for the MB-369875 was not counter bored deep enough for a cap screw.



Originator:

Steve Gould

Date:

2/20/02

Cause of Nonconformance:

Drawing has incorrect depth on hole.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Disposition:

Drill out Counterbore and continue.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Corrective Action to Prevent Recurrence:

Revise Drawing MB-369875 Rev. B. (Received by Process Engineering on 4/18/02 - John Szostak)

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Corrective Action/Disposition Verified By:

John Szostak

Date:

8/2/02

Will Configuration be affected?: YES NO

Identified problem area:

Material Manpower Method Machine Measurement

Reviewed By:

Bob Jensen

Date:

8/12/02

Traveler Title:

LHC Final Cold Mass Assembly Traveler

Specification No:

5520-TR-333498

Revision:

A

DR No:

HGQ-0308

Step No:

8.2

Drawing No:

369655

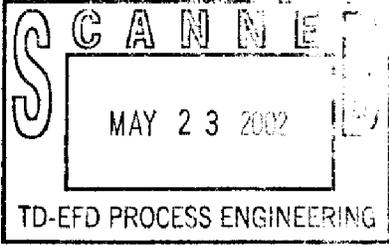
Routing Form No:

Serial No:

MQXB02

Discrepancy Description:

The three support block bases are not cut out enough so the soldered leads fit into the slot provided.



Originator:

Steve Gould

Date:

2/20/02

Cause of Nonconformance:

Width of soldered leads was not anticipated correctly. Parts were therefore made with a smaller than adequate slot width.

Responsible Authority:

Rodger Bossert

Date:

4/11/02

Disposition:

File out slots by hand and use blocks.

Responsible Authority:

Rodger Bossert

Date:

4/11/02

Corrective Action to Prevent Recurrence:

Drawing 344942 and 369875 will be modified to the correct slot dimensions. This has been completed.

Responsible Authority:

Rodger Bossert

Date:

4/11/02

Corrective Action/Disposition Verified By:

Rodger Bossert

Date:

4/11/02

Will Configuration be affected?: YES NO

Identified problem area:

Material Manpower Method Machine Measurement

Reviewed By:

Bob Jensen

Date:

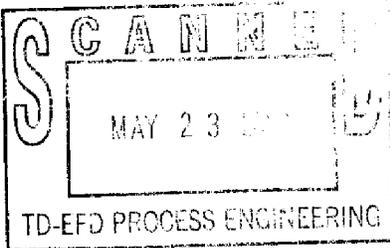
5/22/02

Traveler Title: LHC Final Cold Mass Assembly Traveler	Specification No: 5520-TR-333498	Revision: A	DR No: HGQ-0313
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Step No: 9.2	Drawing No: 369655	Routing Form No: 	Serial No: MQXB02
------------------------	------------------------------	-----------------------------	-----------------------------

Discrepancy Description:

During the standard 30 second wait at 5000 volts, the hipotter tripped out.



Originator:
Steve Gould

Date:
2/26/02

Cause of Nonconformance:

Unknown. Presumed malfunction in hipotter or wire external to magnet not properly shielded.

Responsible Authority:
Rodger Bossert

Date:
2/26/02

Disposition:

Re-hipot. Magnet Passed.

Responsible Authority:

Rodger Bossert

Date:

2/26/02

Corrective Action to Prevent Recurrence:

Ensure wires external to magnet are properly shielded. Beginning with magnet MQXB03, new programmable hipotting unit will be used. (Received by Process Engineering on 4/18/02 - John Szostak)

Responsible Authority:

Rodger Bossert

Date:

2/26/02

Corrective Action/Disposition Verified By:

Rodger Bossert

Date:

2/26/02

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-0315

Step No:

8.2

Drawing No:

369655

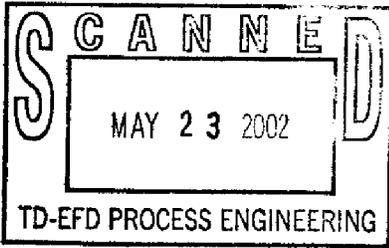
Routing Form No:

Serial No:

MQXB02

Discrepancy Description:

Support block 369215 is no longer used.



Originator:

Steve Gould

Date:

2/27/02

Cause of Nonconformance:

Parts kit not up to date.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Disposition:

Assemble magnet without Part No. 369215.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Corrective Action to Prevent Recurrence:

Remove Part No. 369215 from Parts Kit. (Received by Process Engineering on 4/18/02 - John Szostak)

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Corrective Action/Disposition Verified By:

John Szostak

Date:

4/22/02

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-0316

Step No:

9.4

Drawing No:

369655

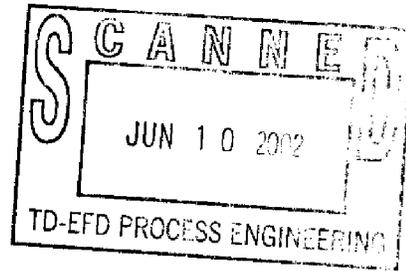
Routing Form No:

Serial No:

MQXB02

Discrepancy Description:

Welds on the skins had to be filed down to allow Part No. MC-390112B to fit properly. A step is needed in the traveler to allow this to be done every magnet. Thirty four inches from the non-lead end was filed so Part No. MC-390112B would fit properly.



Originator:

Steve Gould

Date:

2/28/02

Cause of Nonconformance:

Welds are slightly higher than skin surface. This is only a problem where transition sleeve needs to slide over magnet.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Disposition:

File welds to fit and continue.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Corrective Action to Prevent Recurrence:

Add step to traveler to incorporate this operation. (Received by Process Engineering on 4/18/02 - John Szostak)
Step Added to New Module Assembly Traveler 333643.

Responsible Authority:

Rodger Bossert

Date:

4/1/02

Corrective Action/Disposition Verified By:

John Szostak

Date:

6/10/01

Will Configuration be affected?: YES NO

Identified problem area:

Material Manpower Method Machine Measurement

Reviewed By:

Bob Jensen

Date:

6/10/02