Document ID:

905

Q2 LMQXB Cold Mass Module Assembly Traveler

333643 / Rev. A

Job No:	**248**
E + F Project/Task No.:	**300/1.1.1.6.2**
M + S Project/Task No.:	**300/1.1.1.6.2**

Place This Side Down For Scanning!!!

Magnet Travelers

LMQXB04-0

Document ID:

905

Job No.:

248

Project/Task No.

300/1.1.1.6.2

Series:

LQXB

Serial No:

LMQXB04

Rework ID:

0

Specification No.:

333643

Revision:

A

LMQXB04-0

Fermi National Accelerator Laboratory
Batavia, IL 60510

LARGE HADRON COLLIDER
Q2 - LMQXB
COLD MASS MODULE ASSEMBLY TRAVELER

Reference Drawing(s):
Q2 Cold Mass Welded Assembly (ME-390309)
Q2 Module Assembly (ME-369895)

Project/Task Number: *300/1.1.1.6.2*

Released By: *Bob Jensen* | **Magnet/Device Series:** *LQXB*

Date Issued: *11/5/03 2:32:45 PM* | **Scanned Pages:** 87

Prepared by: J. Szostak

Title	Signature	Date
TD / E&F Process Engineering	*Bob Jensen* Bob Jensen / Designee	*7/17/03*
TD / LHC Production Supervisor	*Jim Rife* Jim Rife / Designee	*7/17/03*
TD / LHC Production Engineer	*Rodger Bossert* Rodger Bossert / Designee	*7/17/03*
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TD / LHC Project Physicist	*Michael Lamm* Michael Lamm / Designee	*7/29/03*
TD / LHC Program Manager	*Jim Kerby* Jim Kerby / Designee	*7/17/03*

Revision Page

Revision	Step No.	Revision Description	TRR No.	Date
None	N/A	Initial Release	N/A	10/15/02
A	6.5	Modified Step. Changed MiniLevel Tolerance to +/- 0.05 mm/m per Tom Page.	1513	7/17/03
	6.10	Modified Step. Changed MiniLevel Tolerance to +/- 0.05 mm/m per Tom Page.		
	7.18	Modified Step. Changed to "Cut Q2b Quadrant 4 Lead at end of splice per Drawing (ME-369895)."		
	7.22	Modified Step. Added Picture to show all three Bus Leads. (13kA, 5kA 8kA)		
	7.29.2	Modified Step. Changed End of step to read "…Figure 7.29.2-A below." Corrected Picture to reflect accurate wiring diagram. Per **DR No. HGQ-0374**.		
	7.36	Modified Step. Changed MiniLevel Tolerance to +/- 0.05 mm/m per Tom Page.		
	8.1	Modified Step. Added Voltage Tap Serial Numbers to Tables.		
	11.11	Added Step. "Tack weld the corrector mounting hardware in place as per Q2 Coldmass Welded Assembly (ME-390309)."		
	11.13	Added Step. "Mount and adjust the Shipping restraint screws."		
	13.1	Modified Step. Added Voltage Tap Serial Numbers to Tables.		
	14.1	Modified Step. Added new wire information for installation of Hypertronics per Mike Lamm.		
	14.2	Modified Step. Added new wire information for installation of Hypertronics per Mike Lamm.		

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 All steps that require a sign-off shall include the Technician/Technician(s)s first initial and full last name.

1.2 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.

1.3 All Discrepancy Reports issued shall be recorded in the left margin next to the applicable step.

1.4 All personnel performing steps in this traveler must have documented training for this traveler and associated operating procedures.

1.5 Personnel shall perform all tasks in accordance with current applicable ES&H guidelines and those specified within the step.

1.6 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.

J. Szostak
Process Engineering/Designee

11/5/03
Date

3.0 Q2 Module Alignment

XXX 3.1 Record the serial number for each Magnetic Component Assembly.

Q2a Serial Number: MQXB010

Q2b Serial Number: MQXB012

MCBX Serial Number: HCMCBX-001-SI000006

Responsible Authority/Physicist — Date: 11-6-03

3.2 File the End Plate Welds, and Alignment Welds at the Non-Lead End of Coldmass Q2a to allow Center Body Tube (MC-390112) to fit properly.

Technician(s) — Date: 11-7-03

4.0 Q2a Magnet Placement (Module Assembly Tooling)

4.1 Configure tooling for Q2a/Q2b cold mass assembly per (ME-369768).

Technician(s) _____ Date 11-7-03

4.2 Configure tooling for Corrector Mounting per (ME-369780), 13.780 Diameter Corrector Magnet.

Technician(s) _____ Date 11-7-03

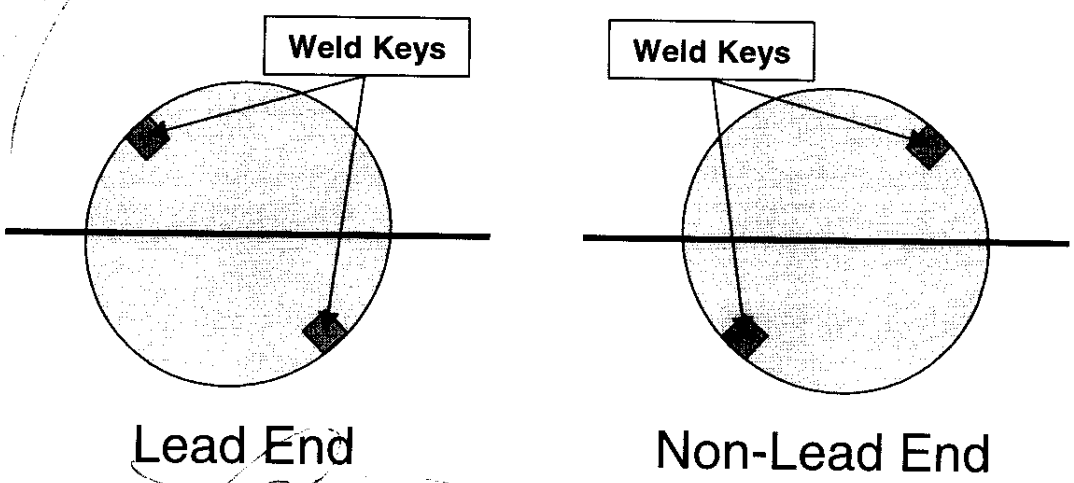
4.3 Configure tooling for End Dome Mounting per (ME-369765, View F-F) (Insert Item 22).

Technician(s) _____ Date 11-7-03

4.4 Move the Q2a Cold Mass to the Cold Mass Module Assembly Tooling, placing it nearest the East End of TCB, with the Lead End of the Magnet facing East as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 11-7-03

4.5 Rotate the Q2a Cold Mass, such that the Weld Keys are approximately at a 45° diagonal.



Technician(s) _____ Date 11-7-03

4.6 Slide the Center Body Tube (MC-390112) over Return End of Q2a Coldmass as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 11-7-03

5.0 Q2b Magnet Placement (Module Assembly Tooling)

5.1 Move the Q2b Cold Mass to the Cold Mass Module Assembly Tooling, placing it nearest the West End of ICB, with the Lead End of the Magnet Facing West as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) Date 11-7-03

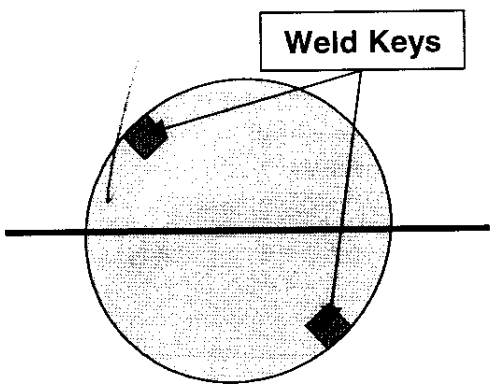
5.2 Position the Cold Masses so that the distance from the magnetic center of Q2a Cold Mass to the magnetic center of Q2b Cold Mass as denoted by the markings on the OD of the Cold Mass is 6524mm +/- 2 mm

Note(s):

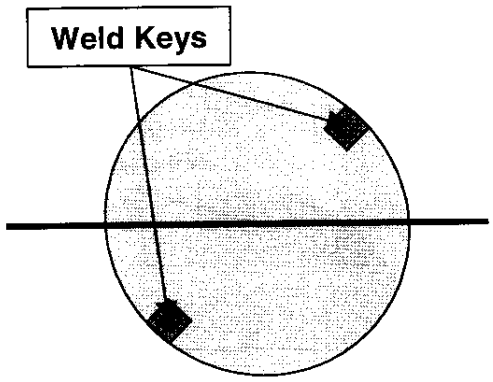
Needs to be the warm magnetic offset 6519.6 mm, plus 3/16" (4.4mm) allowance for weld shrinkage.

Technician(s) Date 11-7-03

5.3 Rotate the Q2b Cold Mass such that the Weld Keys are approximately at a 45° diagonal.



Lead End



Non-Lead End

Technician(s) Date 11-7-03

6.0 Q2a / Q2b Module Alignment

Q2a

XXX 6.1 Determine and record the location at which the level gauge should be mounted to the Cold Mass.

Distance from Lead End Plate: 200 inches.

T. Page
Responsible Authority/Physicist

11/13/03
Date

6.2 Mount the Twist Measuring Fixture to the Q2a Cold Mass at the assigned position.

Technician(s)

11-7-03
Date

6.3 Mount the Precision V Block to the top of the Twist Measuring Fixture.

Technician(s)

11/7/03
Date

6.4 Place the Mini Level on the top surface of the V Block.

Technician(s)

11/7/03
Date

6.5 Rotate the Q2a Cold Mass until the Mini Level reads Horizontal 0.00 mm/m (+/- 0.05 mm/m).

Note(s):

Mini Level should be "zeroed" at reference stand location before this operation.

Technician(s)

11-7-03
Date

Q2b

XXX 6.6 Determine and record the location at which the level gauge should be mounted to the Q2b Cold Mass.

Distance from Lead End Plate: 9C inches.

T. Page — 11/13/03

Responsible Authority/Physicist — Date

6.7 Mount the Twist Measuring Fixture to the Q2b Cold Mass at the assigned position.

11-7-03

Technician(s) — Date

6.8 Mount the Precision V Block to the top of the Twist Measuring Fixture.

11/7/03

Technician(s) — Date

6.9 Place the Mini Level on the top surface of the V Block.

11/7/03

Technician(s) — Date

6.10 Rotate the Q2b Cold Mass until the Mini Level reads Horizontal 0.00mm/m (+/- 0.05 mm/m).

Note(s):

Mini Level should be "zeroed" at reference stand location before this operation.

11-7-03

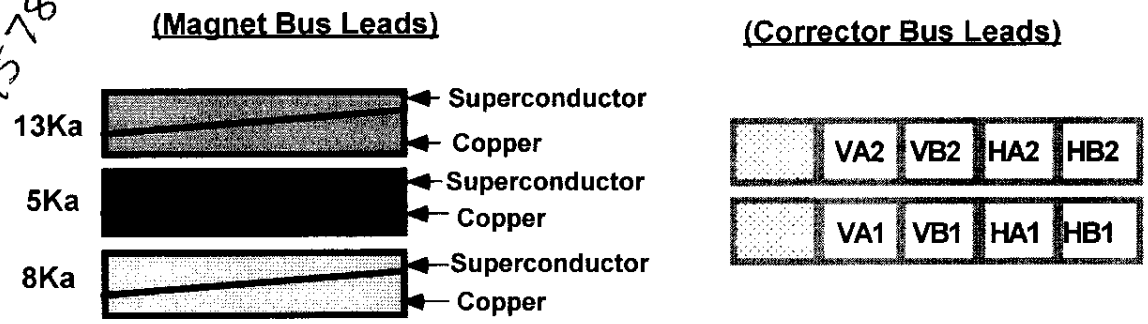
Technician(s) — Date

MOVE STEPS 7.0 - 7.5 TO 7.0 BUS ASSY TRR #1578

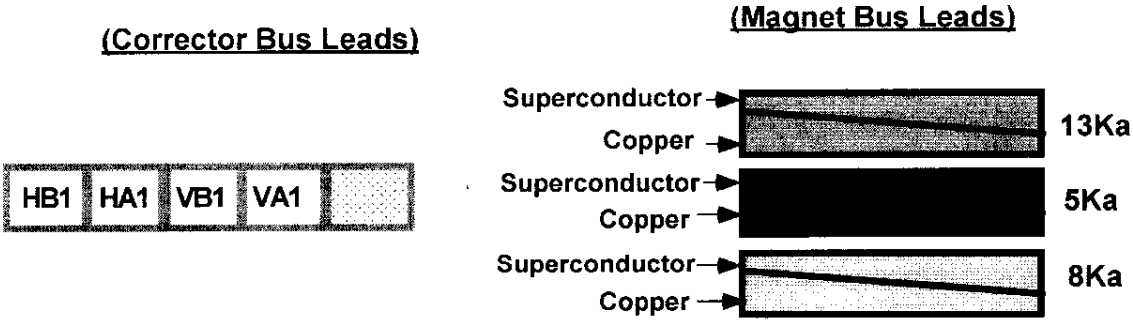
7.0 Bus & Instrumentation Connection and Assembly

Note(s):

Figure "7.0-A" shows the configuration of magnet and corrector bus leads in a Q2 Magnet.



(View Looking into Lead End of Q2b)



(View Looking into Lead End of Q2a)

Figure 7.0-A

7.1 Obtain Lead Bus (ME-369825). Inspect Bus for damaged or broken areas. Clean Bus using lint free Heavy Duty Wipers (Fermi stock 1660-0150) and Isopropyl Alcohol (Fermi stock 1920-0300)

L. Ruiz — Technician(s) — Date 11/7/03

7.2 Obtain parts for Bus Assembly (ME-369826) and assemble per Q2 Module Assembly Insulated Bus Assembly (ME-369826).

L. Ruiz — Technician(s) — Date 11/7/03

X 7.3 Verify Bus Assembly (ME-369826) is assembled correctly per Q2 Module Assembly Insulated Bus Assembly (ME-369826).

Crew Chief — Date 11/13/03

TRR#1578

XXX 7.4 Hipot the 5kA Lead Bus to the 8kA and 13 kA Lead Busses on table before inserting into magnets. Power the 15kA bus to 5000V and ground the 13kA Lead Bus and the 8kA Lead Bus. (Max. Leakage < 0.5μA).

5KA (NOT 15KA)

Note(s):

Ensure that the Bus is isolated from the Assembly Table during Hipotting.

Power Lead Assembly Hipot	Leakage or Failure Voltage
5kA lead bus	.539μA

Check with Mike Lamm, but I think this should be 2μA (RB)

Technician(s) — Date 11/13/03

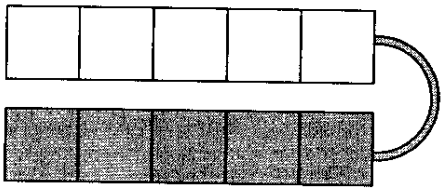
Responsible Authority/Physicist — Date 11/13/03

XXX 7.5 Hipot the Corrector Magnet (MD-390312) Busses at 5kV before inserting into magnet in both the parallel and checkerboard configurations as shown below. Corrector Wires not shaded should be at high potential, while those shaded should be connected to each other and grounded. **(Max. Leakage < 0.5μA)** Check with Mike Lamm but I think this should be 2μA RB

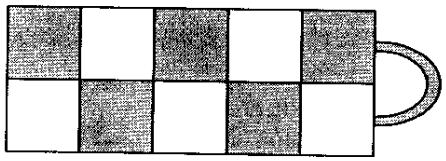
TRR# 1578

Note(s):

Ensure that the Bus is isolated from the Assembly Table during Hipotting.



Parallel Hipot



Checkerboard Hipot

Corrector Coil Assembly Hipot	Leakage or Failure Voltage
Parallel Hipot	.078μA
Checkerboard Hipot	.6μA

A Gould
Technician(s)

11/13/03
Date

Rodger Bossert
Responsible Authority/Physicist

11/13/03
Date

7.6 Slide Completed Bus Assembly (ME-369826) into Q2 as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 11.14.03

7.7 Connect the Bus Housing Lock (MB-369870) to the Bus Assembly (ME-369826) and Q2b Return End Plate as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 11/14/03

7.8 Connect the Bus Housing End Support (MB-369892) on the Q2a End per (ME-369895).

Technician(s) _____ Date 11/14/03

7.9 Connect the Bus Housing End Support (MB-369892) on the Q2b End per (ME-369895).

Technician(s) _____ Date 11/14/03

7.10 Set up the Power Leads for splicing. Create a ¾" space behind the Kevlar wrapped Leads to allow for Thermal Contraction differences between the bus and Cold Masses

Technician(s) _____ Date 11.14.03

7.11 Solder 13kA bus to Q2a Quadrant 4 lead as per Q2 Module Assembly (ME-369895) per LHC Cable Splice Joint Procedure (ES-369950).

Technician(s) _____ Date 11-15-03

7.12 Cut Q2a Quadrant 4 Lead at end of splice per Drawing (ME-369895).

Technician(s) _____ Date 11/15/03

7.13 Insulate splice area with ¾ overlap, .001 x 3/8 wide kapton.

Technician(s) _____ Date 11/15/03

7.14 Attach the Q2a Bus Housing Extension (MD-369872) to Q2a Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 11.17.03

7.15 Attach the Q2a Bus Housing Extension Base (MC-369873) to Q2a Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 11.17.03

7.16 Attach the Q2a Bus Housing Extension Cover (MD-369874) to Q2a Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 11/17/03

7.17 Solder 13kA bus to Q2b Quadrant 4 lead as per Q2 Module Assembly (ME-369895) as per LHC Cable Splice Joint Procedure (ES-369950).

Technician(s) _____ Date 11-15-03

7.18 Cut Q2b Quadrant 4 Lead at end of splice per Drawing (ME-369895).

Technician(s) _____ Date 11-15-03

7.19 Insulate splice area with ¾ overlap, .001 x 3/8 wide kapton.

Technician(s) _____ Date 11/15/03

7.20 Attach the Q2b Bus Housing Extension (MD-369867) to Q2b Lead as per Q2 Module Assembly (ME-369895).

Technician(s) _____ Date 11-17-03

7.21 Attach the Q2b Bus Housing Extension Cover (MD-369874) to Q2b Lead as per Q2 Module Assembly (ME-369895).

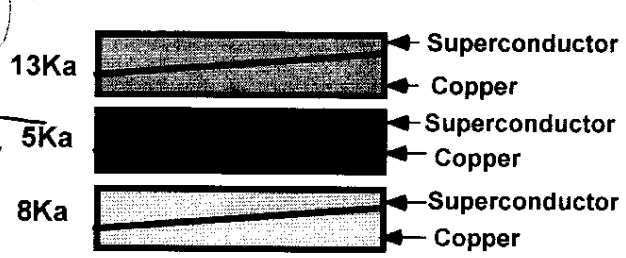
Technician(s) _____ Date 11/17/03

CHECK W/ KOBOCK DOES THIS STEP NEED TO BE REDONE COMPLETED

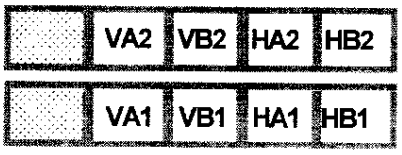
AS PER RB

XXX 7.22 Hipot the 5kA Lead Bus to all other components at 5 kV. Ensure that all Magnet components (*i.e. both Yokes, all Coils, Strip Heaters and 8kA Bus*) are grounded. **(Max. Leakage < 0.5μA)**

(Magnet Bus Leads)



(Corrector Bus Leads)



(View Looking into Q2b)

Power Lead Assembly Hipot	Leakage or Failure Voltage	Pass	Fail
5kA to all other components	.603	Y	

Technician(s) — Date: 11-17-03

Responsible Authority/Physicist — Date: 11-17-03

7.23 Prepare Q2a Lead End Instrumentation wire bundle. Wrap the Q2a Lead End instrumentation wires into Bus Cable as per (MB-369897). Wire Labels and descriptions are shown in Table 7.23 and per (MB-369897).

Q2a bundle MB-369897 (from lead end of Q2a)			
Wire Description	**Wire Label**	**Gauge**	
Lead tap from A lead (Q3 inner coil)	VTa1Q2a	26	Twist all three together
Lead tap from B lead (Q4 inner coil)	VTb1Q2a	26	
1/2 coil tap (Q1 outer - Q2 outer)	VTc1Q2a	26	
Lead tap from A lead (Q3 inner coil)	VTa2Q2a	26	Twist all three together
Lead tap from B lead (Q4 inner coil)	VTb2Q2a	26	
1/2 coil tap (Q1 outer - Q2 outer)	VTc2Q2a	26	
1/4 coil tap (Q1 inner - Q3 outer)	VTdQ2a	26	
1/4 coil tap (Q2 inner - Q4 outer)	VTeQ2a	26	
Warmup heater wire toward end plate	W1aQ2a	20	
Warmup heater wire away from end plate	W2aQ2a	20	
Strip heater wire circuit A+	H1aQ2a	20	Twist Together
Strip heater wire circuit A-	H2aQ2a	20	
Strip heater wire circuit B+	H1bQ2a	20	Twist Together
Strip heater wire circuit B-	H2bQ2a	20	

Table 7.23

TRR# 1578

TRC 12

11/17/03

7.24 Pull wire bundle from Q2a through entire Q2 Assembly and mark the Q2b Lead End Plate position on bundle. **(See Note below)** Leave sufficient slack in cable to allow for differential thermal contraction.

Note(s):

When Bus Assembly (ME-369896) is inserted into the Q2 in step 7.27, the mark from step 7.24 should be located 1 inch from the Q2b end of the aluminum channel.

Technician(s) _____ Date 11-17-03

XXX 7.25 Verify that there is sufficient slack in cable to allow for differential thermal contraction.

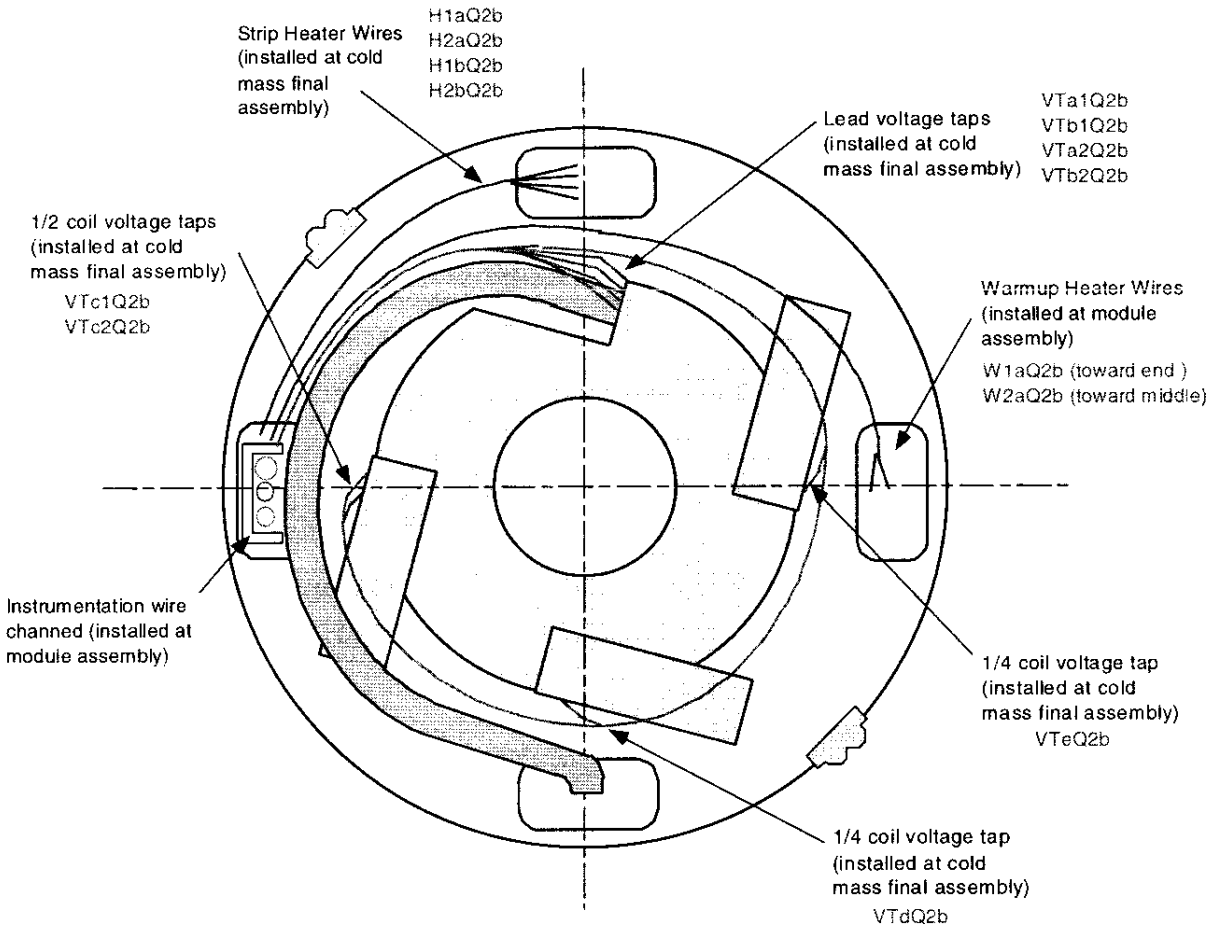
Responsible Authority/Physicist _____ Date 11-17-03

7.26 Remove Q2a bundle from Q2 Assembly.

Technician(s) _____ Date 11-17-03

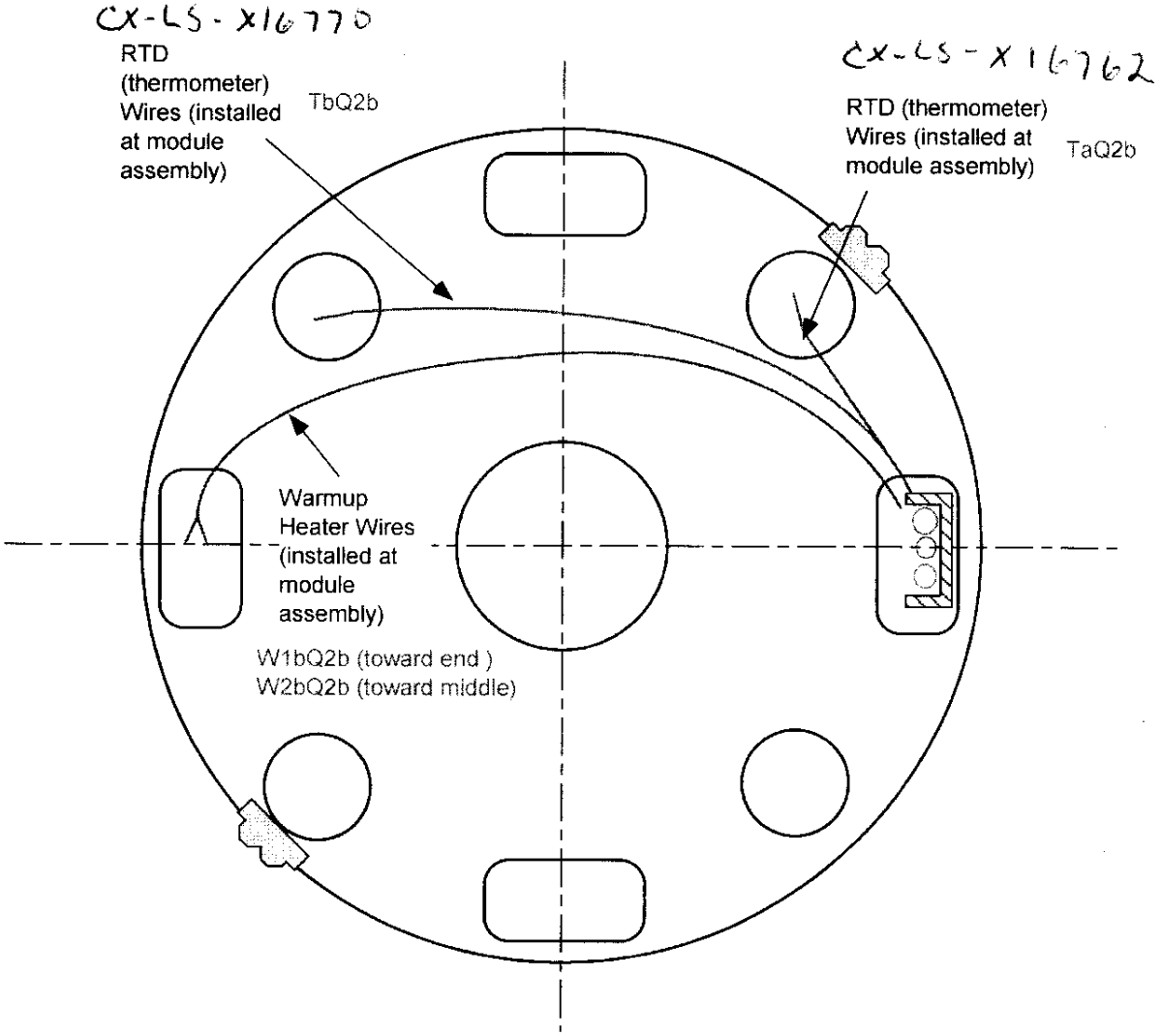
7.27 Slide Instrumentation Bus Assembly (ME-369896) into the proper Q2 Port as per Q2 Module Assembly (ME-369895). As instrumentation Bus Assembly is being inserted, feed Bus Cable (MA-369897) from Lead End of Q2a (4 strip heater wires, 8 voltage tap wires and 2 warm-up heater wires) into bus channel, wrapping entire channel intermittently with glass tape and Kevlar string as shown in drawing (ME-369896). Refer to Figures 7.27-A, 7.27-B, 7.27-C, 7.27-D and Drawing (ME-369895) to see the positions at which all wires are attached to the End Plates.

Technician(s) _____ Date 11/17/03



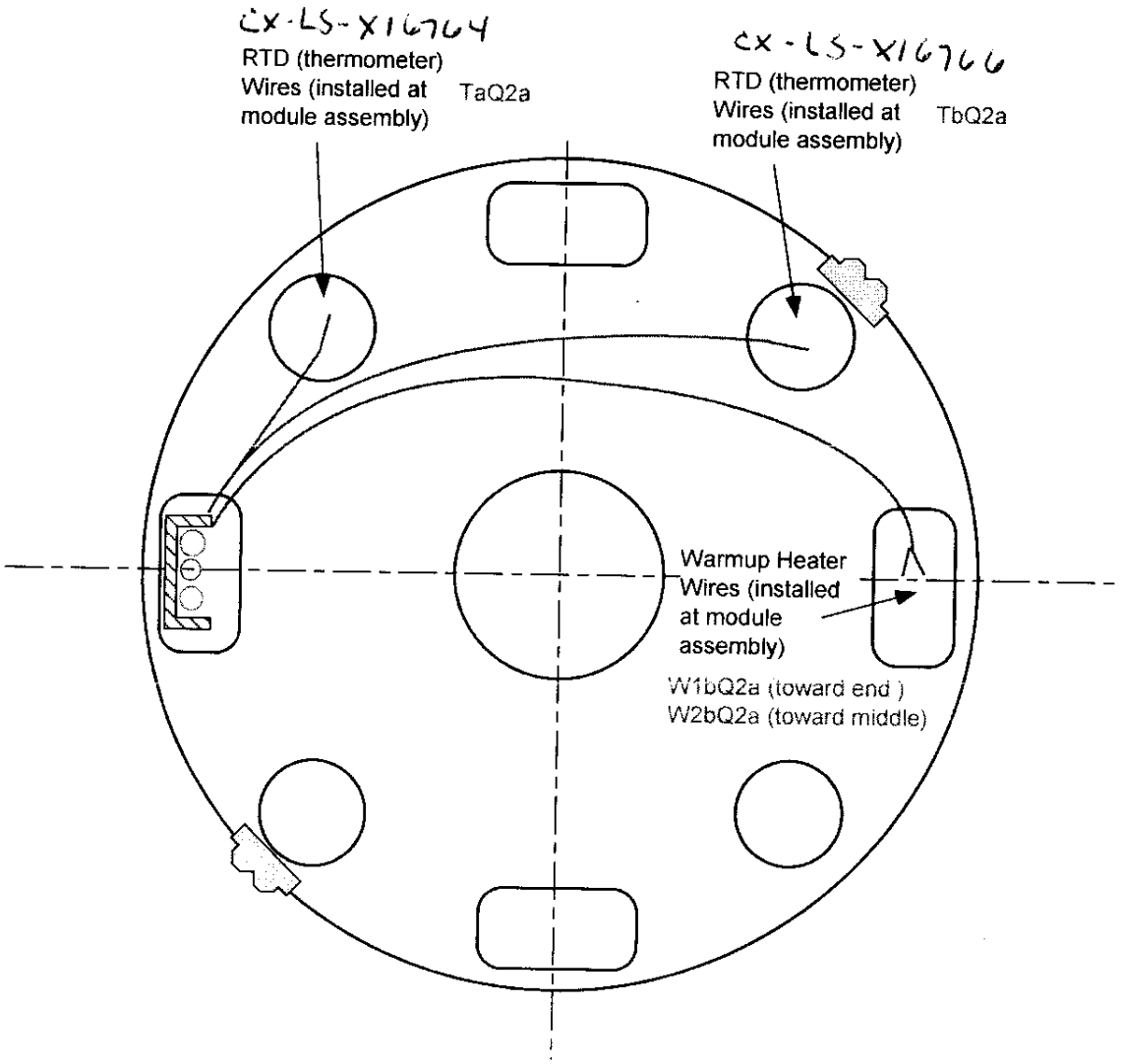
Looking at Lead End of Q2b

Figure 7.27-A



Looking at Non-lead End of Q2b

Figure 7.27-B



Looking at Non-lead End of Q2a

Figure 7.27-C

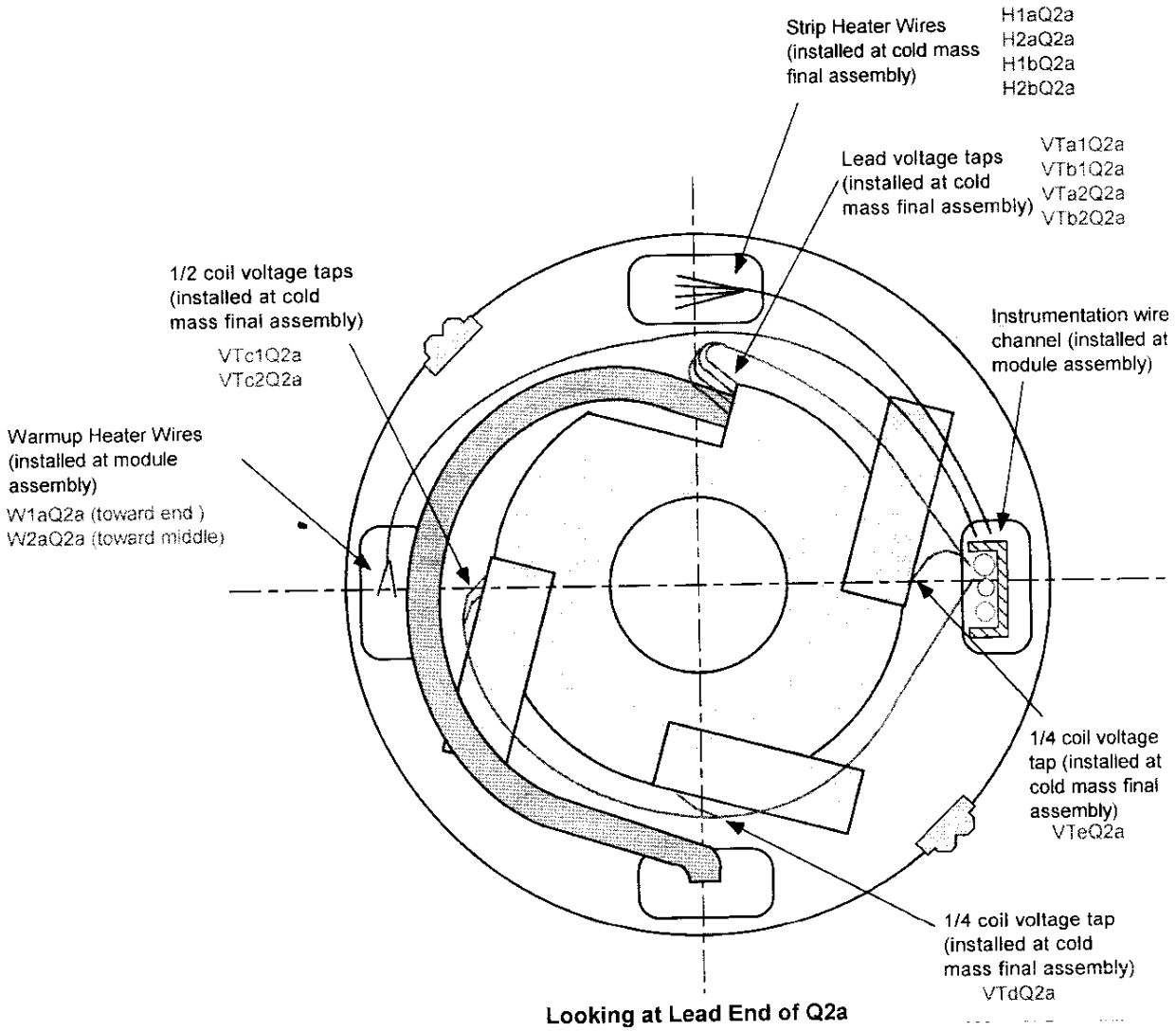

Strip Heater Wires (installed at cold mass final assembly)
H1aQ2a
H2aQ2a
H1bQ2a
H2bQ2a
Lead voltage taps (installed at cold mass final assembly)
VTa1Q2a
VTb1Q2a
VTa2Q2a
VTb2Q2a
1/2 coil voltage taps (installed at cold mass final assembly)
VTc1Q2a
VTc2Q2a
Instrumentation wire channel (installed at module assembly)
Warmup Heater Wires (installed at module assembly)
W1aQ2a (toward end)
W2aQ2a (toward middle)
1/4 coil voltage tap (installed at cold mass final assembly)
VTeQ2a
1/4 coil voltage tap (installed at cold mass final assembly)
VTdQ2a
Looking at Lead End of Q2a

Figure 7.27-D

7.28 Install Warm-up Heaters (ME-369834) to the Non-Lead Ends of Q2a and Q2b as per Q2 Module Assembly (ME-369895).

7.28.1 Install Warm-up Heaters (MA-369834) onto the Warm-up Heater Base Plate (MA-369829).

7.28.2 Solder wires (MA-369833) to the Warm-up Heaters as per (ME-369895).

7.28.3 Install Warm-up Heater Base Plates (MA-369829) by bolting into holes in End Plate. (Check each box as Heater is installed.)

Warm-up Heater #1 ☑

Warm-up Heater #2 ☑

Warm-up Heater #3 ☑

Warm-up Heater #4 ☑

Technician(s) 11-18-03 Date

7.29 Install RTD's as per Q2 Module Assembly (ME-369895). Record Serial Numbers of each RTD in the table below. Attach Data Sheet for each RTD to traveler.

7.29.1 Attach RTD's (MA-369835) (Qty. 2) to each Return End Plate as per Q2 Module Assembly (ME-369895).

7.29.2 Solder wires (MA-369836) to RTD's as per Q2 Module Assembly (ME-369895). Individual RTD wiring is shown in Figure 7.29.2-A below.

TRR NEEDED AFTER 7.29 TO INSTALL 369937 (INST. Bus lock) TRR# 1578

TOP VIEW

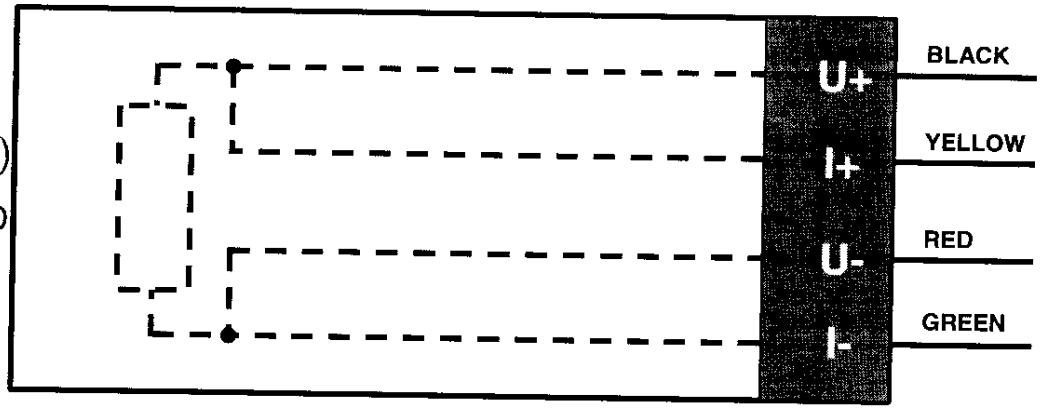


Figure 7.29.2-A

Technician(s) 11/18/03 Date

TRR# ~~1577~~ 1578

7.30 Perform a continuity check on all RTD's and Warm-Up Heaters. Record the Data below. ~~(1mA)~~

RTD'S			
Serial No.	**Location**	**Wire No.**	**Resistance ~~@ 1 mA~~**
CX-LS-X-16764	Q2a Inst. Bus Side	TaQ2a	65.944
CX-LS-X-16766	Q2a Non-Bus Side	TbQ2a	70.801
CX-LS-X-16762	Q2b Inst. Bus Side	TaQ2b	66.511
CX-LS-X-16770	Q2b Non-Bus Side	TbQ2b	65.427

Warm-up Heaters		
Location	**Wire No.**	**Resistance ~~@ 1 mA~~**
Q2a Lead End	W1aQ2a W2aQ2a	16.94
Q2a Non-Lead End	W1bQ2a W2bQ2a	16.53
Q2b Lead End	W1aQ2b W2aQ2b	16.54
Q2b Non-Lead End	W1bQ2b W2bQ2b	16.16

REMOVE (1 mA)

Technician(s) _____ Date 11/18/03

TRR NEEDED HERE (LIMITS NEEDED) TRR# 1579

RTD
.100 μA SCALE
100 V
NOTHING GRNDED
WARMUP HEATERS
.100 μA SCALE
300 V

7.31 Hipot Heaters (300 V) and RTD's (100 V)

RTD'S			
Serial No.	**Location**	**Wire No.**	**Hipot Leakage ~~@1 mA~~**
Replaced w/ CX-LS-X-16764	Q2a Inst. Bus Side	TaQ2a	.06 μa
Replaced w/ CX-LS-X-16766	Q2a Non-Bus Side	TbQ2a	.06 μa
CX-LS-X-16762	Q2b Inst. Bus Side	TaQ2b	.065 μa
CX-LS-X-16770	Q2b Non-Bus Side	TbQ2b	.07 μa

Warm-up Heaters		
Location	**Wire No.**	**Hipot Leakage ~~@1 mA~~**
Q2a Lead End	W1aQ2a W2aQ2a	.4 μa
Q2a Non-Lead End	W1bQ2a W2bQ2a	.6 μa
Q2b Lead End	W1aQ2b W2aQ2b	.6 μa
Q2b Non-Lead End	W1bQ2b W2bQ2b	.6 μa

remove (@1mA) TR#1538

E. Smith / [illegible] — Technician(s)

11-18-03 — Date

7.32 Install the mounts for the MCBX Corrector Magnet (MD-390312) on the Return End of Q2a as per Q2 Cold Mass Welded Assembly (ME-390309).

[illegible] — Technician(s)

11-18-03 — Date

7.33 Place the MCBX Corrector Magnet (MD-390312) in the Corrector Magnet Mounting Tooling, between Q2a and Q2b. The Flange end of the MCBX should face the Return End Plate of Q2a.

[illegible] — Technician(s)

11-19-03 — Date

DR (Corrector Q2A End Resting on Bus Assembly) 11Q-0437 (3875)

7.34 Attach the MCBX Corrector Magnet Alignment Tooling (ME-390390) to the MCBX Corrector Magnet (MD-390312). Align the Scribe Lines on the Corrector Magnet (MD-390312) with those on the tooling.

[illegible] — Technician(s)

11-19-03 — Date

TRR NEEDED HERE
COR. MAGNET MUST BE AGAINST MOUNT HARDWARE + BOLTS "SNUG" BEFORE LEVELING + ROTATING

7.35 Mount the Mini Level to the top of the MCBX Corrector Magnet Alignment Tooling.

Note(s):

Mini Level should be "zeroed" at reference stand location before this operation.

Technician(s) 11-19-03 Date

7.36 Rotate the MCBX Corrector Magnet (MD-390312) such that the Mini Level is Horizontal 0.00 mm/m (+/- 0.05 mm/m).

Technician(s) 11-19-03 Date

7.37 Move the MCBX Corrector Magnet (MD-390312) up against the Mounting Hardware to the Q2a Magnet, and bolt the MCBX Corrector Magnet (MD-390312) to the Q2a Cold Mass as per Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) 11-19-03 Date

SHIM + TORQUE HERE WHILE MONITORING LEVELS

XXX 7.38 Verify Alignment of MCBX Corrector Magnet (MD-390312) as per Q2 Cold Mass Welded Assembly (ME-390309).

T. P. M. 11/19/03

Responsible Authority/Physicist Date

7.39 Connect the MCBX Corrector Magnet (MD-390312) Bus wires from Bus Assembly (ME-369826) to the MCBX Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895).

Technician(s) 11-19-03 Date

7.40 Solder MCBX Corrector Magnet Voltage Tap Wires (MA-369832) as per Q2 Module Assembly (ME-369895).

Technician(s) 11-20-03 Date

TRR#1602 NEED STEP HERE FOR ATTACHING VOLT TAP WIRES TO CORRECTOR MAGNET. CONFIGURATION A+-V A+-H

STEP HERE FOR WRAPPING CORRECTOR BUSES IN 3 mil KAPTON

9.0 Dome Setup

9.1 Attach IP End Dome (MD-390197) (Q2a) to the End Dome Positioning Fixture (MD-369776).

Technician(s) _____ Date 11-22-03

9.2 Align IP End Dome (MD-390197) as shown in Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 11-22-03

9.3 Level the IP End Dome (MD-390197) using the Ball Socket (MD-369777) and the Mini Level.

Technician(s) _____ Date 11-22-03

9.4 Feed the Electrical wires/Bus through the proper ports as the Dome is brought into position against the End Plate. Ensure that no damage to wires has occurred during insertion.

Technician(s) _____ Date 11/22/03

9.5 Mark the IP End Dome (MD-390197) and the End Plate with a Horizontal Witness Line. This Step will be used in Step 11.0 to reposition the Domes prior to Welding.

Technician(s) _____ Date 11/22/03

9.6 Remove the IP End Dome (MD-390197) from the Tooling.

Technician(s) _____ Date 11/22/03

9.7 Attach Non-IP End Dome (MD-390253) (Q2b) to the End Dome Positioning Fixture (MD-369776).

Technician(s) _____ Date 11-22-03

9.8 **Align** Non-IP End Dome (MD-390253) as shown in Q2 Cold Mass Welded Assembly (ME-390309).

Technician(s) _____ Date 11-22-03

9.9 Level the Non-IP End Dome (MD-390253) using the Ball Socket (MD-369777) and the Mini Level.

Technician(s) _____ Date 11-22-03

9.10 Feed the Electrical wires/bus through the proper ports as the Non-IP End Dome (MD-390253) is brought into position against the End Plate.

Technician(s) _____ Date 11-22-03

9.11 Mark the Non-IP End Dome (MD-390253) and the End Plate with a Horizontal Witness Line. This Step will be used in Step 11.0 to reposition the Domes prior to Welding.

Technician(s) _____ Date 11-22-03

9.12 Remove the Non-IP End Dome (MD-390253) from the Tooling.

Technician(s) _____ Date 11-22-03

10.0 Beam Tube Insertion

10.1 Inspect the Beam Tube (MD-369802) for damage. Clean Beam Tube using lint free Heavy Duty Wipers (Fermi stock 1660-0150) and Isopropyl Alcohol (Fermi stock 1920-0300) as per Insulated Beam Tube Assembly for Q2a/Q2b (MD-369802).

Technician(s) _____ Date 11-24-03

XXX 10.2 Verify Alignment of Q2a, Q2b and Corrector Magnet (MD-390312) as per Q2 Cold Mass Welded Assembly (ME-390309).

Responsible Authority/Physicist _____ Date 11/24/03

10.3 Using Insertion Tooling, insert the Beam Tube (MD-369802) into the Magnet Assembly as per Beam Tube Insertion Tooling (MD-369789).

Technician(s) _____ Date 11-24-03

10.4 Center the Beam Tube (MD-369802) between the Coldmasses by leaving equal amounts of insulated Beam Tube protruding from the End Plates. Measure from the face of the End Plate to the End of the Kapton Wrap on the Beam Tube.

Technician(s) _____ Date 11-24-03

10.5 Measure the Beam Tube length and record this measurement below.

10.5.1 Beam Tube Length: 14012

10.5.2 Subtract 12,610 mm (± 2mm) from the Beam Tube Length, and record here: 1402

10.5.3 Divide the Number recorded in step 10.5.2 by 2 and record here: 701

The measurement recorded in step 10.5.3 is the amount to be cut off from each end.

Technician(s) _____ Date 11-24-03

SERIAL NUMBER 1

10.6 Measure from one end of the Beam Tube and place a mark at the distance from step 10.5.3.

Technician(s) — Date: 11-24-03

10.7 Verify the placement of the Mark, measured in Step 10.6 is correct.

Crew Chief — Date: 11-24-03

10.8 Using the Wachs Cutter, cut the Beam Tube at the Mark from Step 10.6.

Technician(s) — Date: 11/24/03

10.9 Measure from one end of the Beam Tube and place a mark at the distance from step 10.5.3.

Technician(s) — Date: 11/24/03

10.10 Verify the placement of the Mark, measured in Step 10.9 is correct. Measuring from the End Plate, this mark should be equal to the 'End Plate to Beam Tube' distance at the other end.

Crew Chief — Date: 11-24-03

10.11 Using the Wachs Cutter, cut the Beam Tube at the Mark from Step 10.9.

Technician(s) — Date: 11/24/03

XXX 10.12 Hipot the Beam Tube to coil, heaters and ground. (Max. Leakage < 0.5μA)

TR# 1602

[redacted] 5200 V
w/ Doggie

Hipot	Leakage or Failure Voltage	Pass	Fail
Beam Tube to coil, heaters and ground	.05 μA	✓	

Technician(s) — Date: 11-24-03

Rodger Rt
Responsible Authority/Physicist — Date: 11/24/03

11.0 Dome Installation

11.1 Reposition the IP End Dome as shown in Q2 Cold Mass Welded Assembly (ME-390309) using the Horizontal Witness Line from step 9.5.

Technician(s) _____ Date 11-24-03

11.2 Feed the Electrical wires/Bus through the proper ports as the IP End Dome (MD-390197) is brought into position against the End Plate.

Technician(s) _____ Date 11.24.03

11.3 Install Spider Assemblies (MC-369885) to protect wires/bus, if necessary.

Spider Assemblies Installed ☐

Spider Assemblies **NOT** Installed ☑ (No Signature Necessary)

Technician(s) N/A Date _____

11.4 Tack weld the IP End Dome in place at approximately 6-8 places around the Dome per (ME-390309).

Weldor(s) _____ Date 11/26

11.5 Weld the IP End Dome, skip weld around to minimize distortion per (ME-390309).

Weldor(s) _____ Date 11/26

11.6 Reposition the Non-IP End Dome as shown in Q2 Cold Mass Welded Assembly (ME-390309) using the Horizontal Witness Line from step 9.11.

Technician(s) _____ Date 11-24-03

11.7 Feed the Electrical wires/Bus through the proper ports as the Non-IP End Dome is brought into position against the End Plate.

Technician(s) C. Fuangan Date 11.24.03

11.8 Install Spider Assemblies (MC-369885) to protect wires/bus, if necessary.

Spider Assemblies Installed ☐

Spider Assemblies **NOT** Installed ☑ (No signature necessary)

Technician(s) N/A Date

11.9 Tack weld the Non-IP End Dome in place at approximately 6-8 places around the Dome as per (ME-390309).

Weldor(s) Date 11/26

11.10 Weld the Non-IP End Dome, skip weld around to minimize distortion as per (ME-390309).

Weldor(s) Date 11/26

X 11.11 Tack weld the corrector mounting hardware in place as per Q2 Coldmass welded assembly (ME-390309).

Weldor(s) Date 11/26

11.12 If needed, perform a stretched wire measurement of the system, noting the relative position and roll of the three magnetic elements to each other.

Performed Stretch Wire Measurement?

Yes ☐ No ☑ (No Signature necessary, if 'No' box is checked)

N/A
Technician(s) Date

11.13 Mount and adjust the Shipping restraint screws.

Note(s):
Weld to corrector if necessary.

O. Friman
Technician(s) Date 11/26/03

11.14 Weld the Center Body Tube (MC-390112) as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) Date 12/4/03

UNDO CLAMPS FRR# 1602 → STRETCH WIRE TEST

12.0 Cold Bore

12.1 Flare both ends of the Beam Tube using Flaring Tool (MC-390416) per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 12/4/03

12.2 Position Cold Bore Flange (MC-390300) over the Beam Tube and onto IP End Dome (Q2a) per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 12/4/03

12.3 Weld the Beam Tube to the Flange at IP End as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) _____ Date 12/4/03

12.4 Add Spacer between Beam Tube Flange and End Dome, if necessary.

Spacer Added? Yes ☒ No ☐

Technician(s) _____ Date 12/4/03

12.5 Position the Cold Bore Flange (MC-390300) over the Beam Tube and onto the Non-IP End Dome (Q2b) per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 12/4/03

12.6 Weld Beam Tube to Flange at NON-IP End as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) _____ Date 12/4/03

12.7 Align Beam Tube and the Flange at IP End per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 12/4/03

12.8 Weld the Flange to the IP End Dome as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) _____ Date 12/4/03

12.9 Align Beam Tube and Flange at NON-IP End per Q2 Cold Mass Welded Assembly (MB-390309).

Technician(s) _____ Date 12/4/03

12.10 Weld the Flange to the Non-IP End Dome as per Q2 Cold Mass Welded Assembly (ME-390309).

Weldor(s) _____ Date 12/4/03

13.0 Electrical Inspection

TRR# 1578 New page's issued

13.1 Perform an electrical inspection on each of the individual Quadrants and the Cold Masses. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

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	_____	2V
Amp selector knob	_____	1A
Temperature compensator	_____	On
Test current	_____	On (testing)

Hp 4284:

Function	_____	"Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla _____

HP 4284 _____

Q2a

See Additional Pages

(Q2a) Resistance			Total
Serial Numbers	Nominal		560 to 585 mΩ
VTC2Q2A / **VTDQ2A**	**Quadrant 1**		mΩ
VTC2Q2A / **VTEQ2A**	**Quadrant 2**		mΩ
VTDQ2A / **VTA2Q2A**	**Quadrant 3**		mΩ
VTB1Q2A / **VTEQ2A**	**Quadrant 4**		mΩ
Total Cold Mass	**Nominal**	2.305 Ω	Ω

(Q2a) Inductance			Total
Connections	Nominal		2.880 to 2.935 mH
VTC2Q2A / VTDQ2A	Quadrant 1		.5686 mH
VTC2Q2A / VTEQ2A	Quadrant 2		.5686 mH
VTDQ2A / VTA2Q2A	Quadrant 3		.5685 mH
VTB1Q2A / VTEQ2A	Quadrant 4		.5685 mH
Total Cold Mass	Nominal	13.3376 mH	2.276 mH

(Q2a) Q-Factor			Total
Connections	Nominal		4.5 to 5.2
VTC2Q2A / VTDQ2A	Quadrant 1		
VTC2Q2A / VTEQ2A	Quadrant 2		
VTDQ2A / VTA2Q2A	Quadrant 3		
VTB1Q2A / VTEQ2A	Quadrant 4		
Total Cold Mass	Nominal	5.036	

Technician(s) 12/13/03 Date

VT1112 ~~8312~~

(Q2a) Resistance Test	Limit	Actual Measurement
(Q2a) Heater Circuit A	18.20 to 21 Ω	~~18.04~~ 18.91 Ω
(Q2a) Heater Circuit B	18.20 to 21 Ω	~~17.69~~ 19.04 Ω

~~8322~~ VT1122

Technician(s) 12-13-03 Date

Q2b

(Q2b) Resistance			Total
CONNECTIONS	Nominal		560 to 585 mΩ
VTDQ2B VTC2Q2B	Quadrant 1		.5675 mΩ
VTC2Q2B VTEQ2B	Quadrant 2		.5678 mΩ
VTA1Q2B VTDQ2B	Quadrant 3		.5679 mΩ
VTB1Q2B VTEQ2B	Quadrant 4		.5674 mΩ
Total Cold Mass	Nominal	2.305 Ω	2.272 Ω

(Q2b) Inductance			Total
CONNECTIONS	Nominal		2.880 to 2.935 mH
VTDQ2B VTC2Q2B	Quadrant 1		mH
VTC2Q2B VTEQ2B	Quadrant 2		mH
VTA1Q2B VTDQ2B	Quadrant 3		mH
VTB1Q2B VTEQ2B	Quadrant 4		mH
Total Cold Mass	Nominal	13.3376 mH	

SEE ATTACHED SHEET!

(Q2b) Q-Factor			Total
CONNECTIONS	Nominal		4.5 to 5.2
VTDQ2B VTC2Q2B	Quadrant 1		
VTC2Q2B VTEQ2B	Quadrant 2		
VTA1Q2B VTDQ2B	Quadrant 3		
VTB1Q2B VTEQ2B	Quadrant 4		
Total Cold Mass	Nominal	5.036	

Technician(s)

Date 12/13/03

Heater Resistance		
(Q2b) Resistance Test	Limit	Actual Measurement
~~8332~~ YT1132 (Q2b) Heater Circuit A	18.20 to 21 Ω	~~17.27~~ 18.14 Ω
~~8342~~ YT1142 (Q2b) Heater Circuit B	18.20 to 21 Ω	~~17.60~~ 18.20 Ω

Technician(s) 12-13-03 Date

Instrumentation Q2a		
Component	Wire Labels	Resistance
~~¼ Coil Tap~~	VTdQ2a	
~~¼ Coil Tap~~	~~VTeQ2a~~	
½ Coil Tap	VTc1Q2a	
½ Coil Tap	1222 VTc2Q2a	.5713
~~Lead Tap~~	~~VTa1Q2a~~	
~~Lead Tap~~	~~VTb1Q2a~~	
Lead Tap	1122 VTa2Q2a	.5708
Lead Tap	1322 VTb2Q2a	.5709
RTD (Non-LE)	YT8312 TaQ2a	142.410
RTD (Non-LE)	YT8322 TbQ2a	93.819
8312 Warm-up Heater (LE)	W1aQ2a (toward end) W2aQ2a (toward middle)	~~17.27~~ 18.04
8322 Warm-up Heater (Non-LE)	W1bQ2a (toward end) W2bQ2a (toward middle)	~~17.60~~ 17.69

Technician(s) 12/13/03 Date

Instrumentation Q2b		
Component	**Wire Labels**	**Resistance**
¼ Coil Tap	VTdQ2b	
¼ Coil Tap	VTeQ2b	
½ Coil Tap	VTc1Q2b	
½ Coil Tap	1522 VTc2Q2b	.5698
Lead Tap	VTa1Q2b	
Lead Tap	VTb1Q2b	
Lead Tap	1422 VTa2Q2b	.5701
Lead Tap	1622 VTb2Q2b	.5696
RTD	~~+~~8332 TaQ2b	66.892
RTD	~~+~~8342 TbQ2b	66.297
Warm-up Heaters (LE)	W1aQ2b (toward end) W2aQ2b (toward middle)	17.27
Warm-up Heaters (Non-LE)	W1bQ2b (toward end) W2bQ2b (toward middle)	17.60

8332

8342

TRR# 1598

Technician(s) 12/13/03 Date

MCBX Corrector Coil Taps		
Component	**Wire Labels**	**Resistance**
Tap 1	8122	~~1.6~~ ~~1.16~~ 22.73 1.53
Tap 2	8112	1.6 1906

8122

8112

Technician(s) 12/13/03 Date

XXX 13.2 Hipot according to table below. Hipot to 5kV. Maximum leakage is 3μA.

Hipot Heaters to Coil and Ground.

AS PER M. LAMM

High Potential	Grounded	~~Floating~~ GROUNDED	Leakage
All Strip Heaters	Coils, Yoke, Q1 Instrumentation Bus, Lead and Corrector Coil Busses.	RTD's and Warm-up Heaters	.005mA

Hipot Coil to Heaters and Ground.

High Potential	Grounded	~~Floating~~ GROUNDED	Leakage
All Coils	Strip Heaters, Yoke, Q1 Instrumentation Bus, 8kA and 5kA Lead Busses and Corrector Coil Busses.	RTD's and Warm-up Heaters	.018mA

Technician(s) — Date: 12/13/03

XXX 13.3 Verify that the results in Step 13.0 are acceptable.
Approved for next Assembly Procedure.

Responsible Authority/Physicist — Date: 12/13/03

14.0 Installation of Hypertronics

14.1 Install Hypertronics Connectors at **Q2a** end as per Q2 Module Assembly (ME-369895) and Hypertronics Connector Assembly Procedure ES-XXXXXX.
Pin Numbers for connectors are shown in Table 14.1 below

Table 14.1

CERN Label	Wire Label	Module	Pin No.	Description
EE111Q1	VTa1Q1	M2	1	Q1 Lead Voltage Tap "a", primary
EE112Q1	VTa2Q1	M2	2	Q1 Lead Voltage Tap "a", redundant
EE131Q1	VTc1Q1	M2	3	Q1 Center Voltage Tap "c", primary
EE132Q1	VTc2Q1	M2	4	Q1 Center Voltage Tap "c", redundant
EE151Q1	VTb1Q1	M2	5	Q1 Lead Voltage Tap "b", primary
EE152Q1	VTb2Q1	M9	5	Q1 Lead Voltage Tap "b", redundant
EE811H1	VTH1	M5	1	Corrector Q1 – H1 Voltage Tap
EE811V1	VTV1	M5	2	Corrector Q1 – V1 Voltage Tap
EH111Q1	W1aQ1	M7	1	Q1 Warm-up heater Lead "1", lead end heater
EH151Q1	W2aQ1	M7	2	Q1 Warm-up heater, Lead "2", lead end heater
EH112Q1	W1bQ1	M7	3	Q1 Warm-up heater, Lead "1", non-lead end heater
EH152Q1	W2bQ1	M7	4	Q1 Warm-up heater, Lead "2", non-lead end heater
YT111Q1	H1aQ1	M9	1	Q1 Protection heater, Lead "1", 1-2 & 3-4 circuit heater (ckt. "a")
YT151Q1	H2aQ1	M9	3	Q1 Protection heater, Lead "2", 1-2 & 3-4 circuit heater (ckt. "a")
YT112Q1	H1bQ1	M9	5	Q1 Protection heater, Lead "1", 1-4 & 2-3 circuit heater (ckt. "b
YT152Q1	H2bQ1	M10	4	Q1 Protection heater, Lead "2", 1-4 & 2-3 circuit heater (ckt. "b
TT111Q1	TaQ1_I+	M12	1	Q1 RTD, primary
TT121Q1	TaQ1_I-	M12	2	
TT131Q1	TaQ1_V+	M12	3	
TT141Q1	TaQ1_V-	M12	4	
TT112Q1	TbQ1_I+	M12	5	Q1 RTD, redundant
TT122Q1	TbQ1_I-	M12	6	
TT142Q1	TbQ1_V-	M12	10	
TT132Q1	TbQ1_V+	M12	11	

Technician(s) / Dan Walton

Date 12/12/03

14.2 Install Hypertronics Connectors at **Q2b** end as per Q2 Module Assembly (ME-369895) and Hypertronics Connector Assembly Procedure ES-XXXXXX.
Pin Numbers for connectors are shown in Table 14.2 below.

Table 14.2

CERN Label	Wire Label	Module	Pin No.	Description
	VTa1Q1	M2	1	Q1 Lead Voltage Tap "a", primary
	VTa2Q1	M2	2	Q1 Lead Voltage Tap "a", redundant
	VTc1Q1	M2	3	Q1 Center Voltage Tap "c", primary
	VTc2Q1	M2	4	Q1 Center Voltage Tap "c", redundant
	VTb1Q1	M2	5	Q1 Lead Voltage Tap "b", primary
EE131Q2a	VTc1Q2a	M3	1	Q2a Center Voltage Tap "c", primary
EE121Q2a	VTdQ2a	M3	2	Q2a Quarter Coil Voltage Tap "d" (1-3 Interface)
EE112Q2a	VTa2Q2a	M3	3	Q2a Lead Voltage Tap "a", redundant
EE111Q2a	VTa1Q2a	M3	4	Q2a Lead Voltage Tap "a", primary
	VTbQ21	M3	5	Q1 Lead Voltage Tap "b", redundant
EE132Q2a	VTc2Q2a	M4	1	Q2a Center Voltage Tap "c", redundant
EE141Q2a	VTeQ2a	M4	2	Q2a Quarter Coil Voltage Tap "e" (2-4 Interface)
EE151Q2a	VTb1Q2a	M4	3	Q2a Lead Voltage Tap "b", primary
EE162Q2a	VTb2Q2a	M4	4	Q2a Lead Voltage Tap "b", redundant
	VTb1Q2b	M4	5	Q2b Lead Voltage Tap "b", primary
	VTdQ2b	M5	1	Q2b Quarter Coil Voltage Tap "d" (1-3 Interface)
	VTc2Q2b	M5	2	Q2b Center Voltage Tap "c", redundant
	VTc1Q2b	M5	3	Q2b Center Voltage Tap "c", primary
	VTeQ2b	M5	4	Q2b Quarter Coil Voltage Tap "e" (2-4 interface)
	VTb2Q2b	M5	5	Q2b Lead Voltage Tap "b", redundant
	VTa1Q2b	M6	1	Q2b Lead Voltage Tap "a", primary
	Vta2Q2b	M6	2	Q2b Lead Voltage Tap "a", redundant
	VTH1	M8	1	Corrector Q1 – H1 Voltage Tap
	VTV1	M8	2	Corrector Q1 – V1 Voltage Tap
EE811H2	VTH2	M8	3	Corrector Q2 – H2 Voltage Tap
EE811V2	VTV2	M8	4	Corrector Q2 – V2 Voltage Tap
	W1aQ1	M10	1	Q1 Warm-up Heater Lead "1", lead end heater
	W2aQ1	M10	2	Q1 Warm-up Heater Lead "2", lead end heater
	W1bQ1	M10	3	Q1 Warm-up Heater Lead "1", non-lead end heater
	W2bQ1	M10	4	Q1 Warm-up Heater Lead "2", non-lead end heater
EH111Q2a	W1aQ2a	M11	1	Q2A Warm-up Heater, Lead "1", lead end heater
EH151Q2a	W2aQ2a	M11	2	Q2A Warm-up Heater, Lead "2", lead end heater
EH112Q2a	W1bQ2a	M11	3	Q2A Warm-up Heater, Lead "1", non-lead end heater
EH152Q2a	W2bQ2a	M11	4	Q2A Warm-up Heater, Lead "2", non-lead end heater
	W1aQ2b	M12	1	Q2B Warm-up Heater, Lead "1", lead end heater
	W2aQ2b	M12	2	Q2B Warm-up Heater, Lead "1", lead end heater
EH112Q2b	W1bQ2b	M12	3	Q2B Warm-up Heater, Lead "1", non-lead end heater
EH152Q2b	W2bQ2b	M12	4	Q2B Warm-up Heater, Lead "2", non-lead end heater

Table 14.2 (Continued)

CERN Label	Wire Label	Module	Pin No.	Description
	H1aQ1	M14	1	Q1 Heater Lead "1", 1-2 & 3-4 circuit heater
	H2aQ1	M14	3	Q1 Heater Lead "2", 1-2 & 3-4 circuit heater
	H1bQ1	M14	5	Q1 Heater Lead "1", 1-4 & 2-3 circuit heater
YT111Q2a	H2aQ2a	M15	2	Q2a Protection Heater, Lead "2", 1-2 & 3-4 circuit heater (ckt. "a")
	H2bQ1	M15	4	Q1 Heater Lead "2", 1-4 & 2-3 circuit heater (ckt. "b")
YT151Q2a	H1aQ2a	M16	1	Q2a Protection Heater, Lead "1", 1-2 & 3-4 circuit heater (ckt. "a")
YT112Q2a	H1bQ2a	M16	3	Q2a Protection Heater, Lead "1", 1-4 & 2-3 circuit heater (ckt. "b")
YT152Q2a	H2bQ2a	M16	5	Q2a Protection Heater, Lead "2", 1-4 & 2-3 circuit heater (ckt. "b")
	H2aQ2b	M17	2	Q2b Heater Lead "2", 1-2 & 3-4 circuit heater (ckt. "a")
	H1aQ2b	M17	4	Q2b Heater Lead "1", 1-2 & 3-4 circuit heater (ckt. "a")
	H1bQ2b	M18	1	Q2b Heater, Lead "1", 1-4 & 2-3 circuit heater (ckt. "b")
	H2bQ2b	M18	3	Q2b Heater, Lead "1", 1-4 & 2-3 circuit heater (ckt. "b")
	TaQ1_I+	M20	1	Q1 RTD, primary
	TaQ1_I-	M20	2	
	TaQ1_V+	M20	3	
	TaQ1_V-	M20	4	
	TbQ1_I+	M20	5	Q1 RTD, redundant
	TbQ1_I-	M20	6	
TT131Q2a	TaQ2a_V+	M20	7	
TT121Q2a	TaQ2a_I-	M20	8	
TT111Q2a	TaQ2a_I+	M20	9	Q2a RTD, primary
	TbQ1_V-	M20	10	
	TbQ1_V+	M20	11	
TT141Q2a	TaQ2a_V-	M20	12	
TT112Q2a	TbQ2a_I+	M20	13	Q2a RTD, redundant
TT122Q2a	TbQ2a_I-	M20	14	
TT132Q2a	TbQ2a_V+	M20	15	
TT142Q2a	TbQ2a_V-	M20	16	
TT111Q2b	TaQ2b_I+	M21	1	Q2b RTD, primary
TT121Q2b	TaQ2b_I-	M21	2	
TT131Q2b	TaQ2b_V+	M21	3	
TT141Q2b	TaQ2b_V-	M21	4	
TT112Q2b	TbQ2b_I+	M21	5	Q2b RTD, redundant
TT122Q2b	TbQ2b_I-	M21	6	
TT142Q2b	TbQ2b_V-	M21	10	
TT132Q2b	TbQ2b_V+	M21	11	

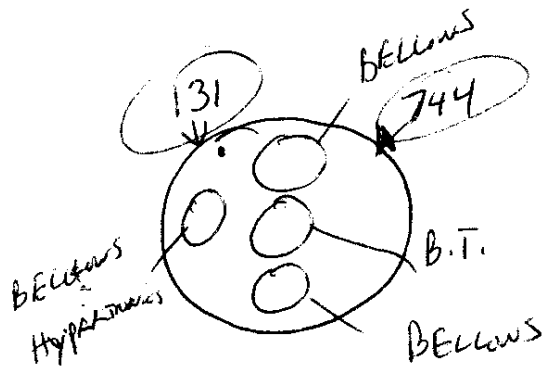
Technician(s) _____ Date 12/12/03

XXX 14.3 Check installation of Hypertronics. Ensure Hypertronics were installed as per Q2 Module Assembly (ME-369895) and Hypertronics Connector Assembly Procedure ES-XXXXXX.

Technician(s) _____ Date 12/15/03

Responsible Authority/Physicist _____ Date 12/15/03

NOTE: 2 NEW RTD'S WERE INSTALLED ON CORRECTOR COILS SKIN. FACING THE IP END FROM THE NON-IP END, RTD # CX_LS_X16131 IS ON THE LEFT AND RTD # CX_LS_X16744 IS ON THE RIGHT.



S. GOULD
12/17/03

N/A

DR # HGQ-0439 (3834)

15.0 Final Electrical Inspection

15.1 Perform an electrical inspection on each of the individual Quadrants and the Cold Masses. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

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	_____	2V
Amp selector knob	_____	1A
Temperature compensator	_____	On
Test current	_____	On (testing)

Hp 4284:

Function	_____	"Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla _____

HP 4284 _____

Q2a

(Q2a) Resistance			Total
Serial Numbers	Nominal		560 to 585 mΩ
VTC2Q2A / **VTDQ2A**	**Quadrant 1**		mΩ
VTC2Q2A / **VTEQ2A**	**Quadrant 2**		mΩ
VTDQ2A / **VTA2Q2A**	**Quadrant 3**		mΩ
VTB1Q2A / **VTEQ2A**	**Quadrant 4**		mΩ
Total Cold Mass	**Nominal**	2.305 Ω	Ω

(Q2a) Inductance			Total
Connections	Nominal		2.880 to 2.935 mH
VTC2Q2A VTDQ2A	Quadrant 1		mH
VTC2Q2A VTEQ2A	Quadrant 2		mH
VTDQ2A VTA2Q2A	Quadrant 3		mH
VTB1Q2A VTEQ2A	Quadrant 4		mH
Total Cold Mass	Nominal	13.3376 mH	mH

N/A

(Q2a) Q-Factor			Total
Connections	Nominal		4.5 to 5.2
VTC2Q2A VTDQ2A	Quadrant 1		
VTC2Q2A VTEQ2A	Quadrant 2		
VTDQ2A VTA2Q2A	Quadrant 3		
VTB1Q2A VTEQ2A	Quadrant 4		
Total Cold Mass	Nominal	5.036	

Technician(s) _____ Date _____

(Q2a) Resistance Test	Limit	Actual Measurement
(Q2a) Heater Circuit A	18.20 to 21 Ω	Ω
(Q2a) Heater Circuit B	18.20 to 21 Ω	Ω

Technician(s) _____ Date _____

Q2b

N/A

(Q2b) Resistance			Total
CONNECTIONS	Nominal		560 to 585 mΩ
VTDQ2B VTC2Q2B	Quadrant 1		mΩ
VTC2Q2B VTEQ2B	Quadrant 2		mΩ
VTA1Q2B VTDQ2B	Quadrant 3		mΩ
VTB1Q2B VTEQ2B	Quadrant 4		mΩ
Total Cold Mass	Nominal	2.305 Ω	Ω

(Q2b) Inductance			Total
CONNECTIONS	Nominal		2.880 to 2.935 mH
VTDQ2B VTC2Q2B	Quadrant 1		mH
VTC2Q2B VTEQ2B	Quadrant 2		mH
VTA1Q2B VTDQ2B	Quadrant 3		mH
VTB1Q2B VTEQ2B	Quadrant 4		mH
Total Cold Mass	Nominal	13.3376 mH	

(Q2b) Q-Factor			Total
CONNECTIONS	Nominal		4.5 to 5.2
VTDQ2B VTC2Q2B	Quadrant 1		
VTC2Q2B VTEQ2B	Quadrant 2		
VTA1Q2B VTDQ2B	Quadrant 3		
VTB1Q2B VTEQ2B	Quadrant 4		
Total Cold Mass	Nominal	5.036	

Technician(s) _____ Date _____

Heater Resistance		
(Q2b) Resistance Test	**Limit**	**Actual Measurement**
(Q2b) Heater Circuit A	18.20 to 21 Ω	Ω
(Q2b) Heater Circuit B	18.20 to 21 Ω	Ω

N/A

Technician(s) _____ Date _____

Instrumentation Q2a		
Component	**Wire Labels**	**Resistance**
¼ Coil Tap	VTdQ2a	
¼ Coil Tap	VTeQ2a	
½ Coil Tap	VTc1Q2a	
½ Coil Tap	VTc2Q2a	
Lead Tap	VTa1Q2a	
Lead Tap	VTb1Q2a	
Lead Tap	VTa2Q2a	
Lead Tap	VTb2Q2a	
RTD (Non-LE)	TaQ2a	
RTD (Non-LE)	TbQ2a	
Warm-up Heater (LE)	W1aQ2a (toward end) W2aQ2a (toward middle)	
Warm-up Heater (Non-LE)	W1bQ2a (toward end) W2bQ2a (toward middle)	

Technician(s) _____ Date _____

N/A

Instrumentation Q2b		
Component	**Wire Labels**	**Resistance**
¼ Coil Tap	VTdQ2b	
¼ Coil Tap	VTeQ2b	
½ Coil Tap	VTc1Q2b	
½ Coil Tap	VTc2Q2b	
Lead Tap	VTa1Q2b	
Lead Tap	VTb1Q2b	
Lead Tap	VTa2Q2b	
Lead Tap	VTb2Q2b	
RTD	TaQ2b	
RTD	TbQ2b	
Warm-up Heaters (LE)	W1aQ2b (toward end) W2aQ2b (toward middle)	
Warm-up Heaters (Non-LE)	W1bQ2b (toward end) W2bQ2b (toward middle)	

Technician(s) _____ Date _____

MCBX Corrector Coil Taps		
Component	**Wire Labels**	**Resistance**
Tap 1		
Tap 2		

Technician(s) _____ Date _____

XXX 15.2 Hipot according to table below. Hipot to 600V. Maximum leakage is 3μA. Hipot using pins in Hypertronics Connectors. Isolate the Hypertronics Connectors in gas Helium (He) at room temperature during Hipot.

Hipot Heaters to Coil and Ground

High Potential	Grounded	Floating	Leakage
All Strip Heaters	Coils, Yoke, Q1 Instrumentation Bus, Lead and Corrector Coil Busses.	RTD's and Warm-up Heaters	

N/A

Hipot Coil to Heaters and Ground

High Potential	Grounded	Floating	Leakage
All Coils	Strip Heaters, Yoke, Q1 Instrumentation Bus, 8kA and 5kA Lead Busses and Corrector Coil Busses.	RTD's and Warm-up Heaters	

_____ _____
Technician(s) Date

XXX 15.3 Verify that the results in Step 15.0 are acceptable. Approved for next Assembly Procedure.

N/A

_____ _____
Responsible Authority/Physicist Date

16.0 Production Complete

XXX 16.1 Process Engineering verify that the LHC Cold Mass Module Assembly Traveler (5520-TR-333643) 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:

_____
_____
_____
_____
_____
_____
_____

John J. Szostak
Process Engineering/Designee

SEP 21 2005
Date

ORIGINAL

TD/ENGINEERING & FABRICATION

PARTS KIT REQUEST

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_____ICB

BUDGET CODE: LCI

PROJECT NUMBER: 300
TASK NUMBER: 1.1.1.3.3

RELEASED BY

MAGNET NUMBER: LMQXB04

PRODUCTION SIGNATURE: J. Szostak x2003

TODAYS DATE: 10-Jun-03

NEED DATE: 20-Jun-03

ISSUE VERIFICATION

MATERIAL CONTROL SIGNATURE: [signature]

DATE ISSUED TO STOCKROOM: 6/12/03

THIS KIT LIST IS FOR

ME-390309		Q2 COLD MASS WELDED ASSEMBLY

PART NUMBER	REV	DESCRIPTION	REQUIRED QTY/ASS'Y		MATERIAL CONTROL: QTY FILLED OUT BY STOCK ROOM: ISSUED	ROUTE FORM	NOT AVAIL	FILLED OUT BY EXPEDITER: DATE AVAIL	COMMENTS TO PRODUCTION MANAGER	PROD VERIFY PART	SUPT. VERIFY PART
369655	C	COLD MASS ASSEMBLY	ICB HAS					—			
369417	-	INSULATING VARNISH & ADHESIVE	A / R					—			
369802	-	INSULATED BEAM TUBE	ICB HAS					—			
369826	C	BUSS ASSEMBLY	ICB HAS					—			
369835	A	RTD TEMPERATURE SENSOR	4	EA	4	79920		6/12/03	R2,S2,L5 - 70		
369893	B	RTD MOUNTING BLOCK	4	EA	4	79174		↓	IB4 Bin - 18		
369899	-	Q2 WIRE FEED-THRU CHANNEL	1	EA	1	78969			PIN - 6		
390112	B	CENTER BODY TUBE	1	EA	1	78283			IB4 - 6		
390197	B	IP END DOME WELDMENT	1	EA	1	N/A			PIN - 6		
390203	-	MCBX CORRECTOR MOUNTING SPACER	4	EA	4	77194			IB4 - Bin - 25		
390228	-	MCBX CORRECTOR MTG. FLAT WASHER	4	EA	4	77180			R1,S3,L2 - 32		
390230	A	TRANSPORTATION RESTRAINT ADJUSTING SCREW	4	EA	4	76224			IB4 Bin - 24		
390248	-	1/2 - 20 x 3.5" SILVER PLATED SCREW	4	EA	4	74628			IB4 Bin - 38		
390253	A	NON IP END DOME WELDMENT	1	EA					PIN - 6		
390294	-	MCBX TRANSPORTATION RESTRAINT NUT	4	EA	4	76266			IB4 Bin - 96		
390300	B	BEAM TUBE FLANGE	2	EA	2	77028		↓	R10,1,2 - 48		
390312	-	MCBX CORRECTOR MAGNET WELDMENT	ICB HAS					—			
390482	-	CORRECTOR SHIM, 0.002"	4	EA	4	79123		6/12/03	R2,S2,L4 - 149		
390483	-	CORRECTOR SHIM, 0.005"	4	EA	4	79124		↓	R2,S2,L4 - 152		
390484	-	CORRECTOR SHIM, 0.010"	4	EA	4	79125			R2,S2,L4 - 151		
390485	-	CORRECTOR SHIM, 0.015"	4	EA	4	79126		↓	R2,S2,L4 - 140		
393029	-	1/4 - 28 x 1" HEX SHCS, S.S.	16	EA	16	77857		6/12/03	IB4 Bin - 152		
393030	-	#10 - 32 x 0.188" CUP POINT SET SCREW, S.S.	8	EA	8	77839			IB4 Bin - 76		
393180	-	SHCS M4 x 10mm SS	8	EA	8	79631		↓	IB4 Bin - 3185		

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

[signature] 7/11/03 : STOCKROOM SIGNATURE AND DATE

TRAVELER NO. TR-333643

KIT IS COMPLETE (PARTS COORDINATOR SIGNATURE): [signature] BADGE # 02943C

DATE 7/11/03

ORIGINAL

13.0 Electrical Inspection

13.1 Perform an electrical inspection on each of the Individual Quadrants and the Cold Masses. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

Q2A

(Q2A) Resistance			Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers			Total
FermiLab	CERN	Quadrant	
VTc2Q2a	EE1222 1212	Quadrant 1	572.7 mΩ
VTdQ2a	EMPTY		
VTc2Q2a	EE1222 1212	Quadrant 2	572.7 mΩ
VTeQ2a	EMPTY		
VTdQ2a	EMPTY	Quadrant 3	572.6 mΩ
VTa2Q2a	EE1122 1112		
VTb1Q2a	EE1312	Quadrant 4	572.5 mΩ
VTeQ2a	EMPTY		

Total Cold Mass	Nominal ~ 2.305 Ω	2.288 Ω

same as

(Q2A) Inductance			Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers			Total
FermiLab	CERN	Quadrant	
VTc2Q2a	EE1222 1212	Quadrant 1	3.460 mH
VTdQ2a	EMPTY		
VTc2Q2a	EE1222	Quadrant 2	mH
VTeQ2a	EMPTY		
VTdQ2a	EMPTY	Quadrant 3	mH
VTa2Q2a	EE1122		
VTb1Q2a	EE1312	Quadrant 4	mH
VTeQ2a	EMPTY		

See original pages,

Total Cold Mass	Nominal ~ 13.3376 mH	mH

(Q2A) Q-Factor			Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers			Total
FermiLab	CERN	Quadrant	
~~VTc2Q2a~~	~~EE1222~~	~~Quadrant 1~~	3.58
~~VTeQ2a~~	~~EMPTY~~		
VTc2Q2a	EE1222	Quadrant 2	
VTeQ2a	EMPTY		
~~VTbQ2a~~	~~EMPTY~~	~~Quadrant 3~~	
~~VTeQ2a~~	~~EMPTY~~		
VTbQ2a	EE1312	Quadrant 4	
VTeQ2a	EMPTY		

Same as resistance

Total Cold Mass	Nominal ~ 5.036	

Technician(s) _____ Date _____

Strip Heater Resistance		
(Q2a) Resistance Test	Limit	Actual Measurement
(Q2a) Heater Circuit A	18.20 to 21 Ω	18.66 Ω
(Q2a) Heater Circuit B	18.20 to 21 Ω	18.78 Ω

YT 1112
YT1122

Technician(s) [signature] Date 12/6/03

Q2B

(Q2B) Resistance			Nominal ~ 560 to 585 mΩ
Voltage Tap Serial Numbers			Total
FermiLab	CERN	Quadrant	
VTbQ2b	EMPTY	Quadrant 1	572.3 mΩ
VTcQ2b	EE1522		
VTcZQ2b	EE1522	Quadrant 2	572.5 mΩ
VTeQ2b	EMPTY		
VTa1Q2b	EE1412	Quadrant 3	572.1 mΩ
VTdQ2b	EMPTY		
VTb1Q2b	EE1612	Quadrant 4	572.1 mΩ
VTeQ2b	EMPTY		

Total Cold Mass	Nominal ~ 2.305 Ω	2.286 Ω

(Q2B) Inductance			Nominal ~ 2.880 to 2.935 mH
Voltage Tap Serial Numbers			Total
FermiLab	CERN	Quadrant	
VTbQ2b	EMPTY	Quadrant 1	mH
VTcQ2b	EE1522		
VTc2Q2b	EE1522	Quadrant 2	mH
VTeQ2b	EMPTY		
VTa1Q2b	EE1412	Quadrant 3	mH
VTdQ2b	EMPTY		
VTb1Q2b	EE1612	Quadrant 4	mH
VTeQ2b	EMPTY		

Same as Resistance

Total Cold Mass	Nominal ~ 13.3376 mH	mH

(Q2B) Q-Factor			Nominal ~ 4.5 to 5.2
Voltage Tap Serial Numbers			Total
FermiLab	CERN	Quadrant	
[redacted]	[redacted]	[redacted]	
VTc2Q2b	EE1522	Quadrant 2	
VTeQ2b	EMPTY		
[redacted]	[redacted]	[redacted]	
VTb1Q2b	EE1612	Quadrant 4	
VTeQ2b	EMPTY		

Same as resistance

Total Cold Mass	Nominal ~ 5.036	

Technician(s) _____ Date _____

Strip Heater Resistance		
(Q2b) Resistance Test	Limit	Actual Measurement
(Q2b) Heater Circuit A	18.20 to 21 Ω	17.89 Ω
(Q2b) Heater Circuit B	18.20 to 21 Ω	17.95 Ω

YT 1132
YT 1142

Technician(s) [signature] Date 12/6/03

add to other tables see RB JL

Instrumentation Q2A			
Component	FermiLab Label	CERN Label	Resistance
¼ Coil Tap	VTa~~1~~2Q2a	~~EE1112~~ 1122	Ω
	VTdQ2a	EMPTY	Ω
¼ Coil Tap	VTa1Q2a	EE1112	Ω
	VTeQ2a	EMPTY	Ω
½ Coil Tap	VTa1Q2a	EE1112	Ω
	VTc1Q2a	EE1212	Ω
½ Coil Tap	VTa1Q2a	EE1112	Ω
	VTc2Q2a	EE1222	572.4 Ω
Lead Tap	VTa1Q2a	EE1112	Ω
	VTa1Q2a	EE1112	Ω
Lead Tap	VTa1Q2a	EE1112	Ω
	VTb1Q2a	EE1312	Ω
Lead Tap	VTa1Q2a	EE1112	Ω
	VTa2Q2a	EE1122	572.1 Ω
Lead Tap	VTa1Q2a	EE1112	Ω
	VTb2Q2a	EE1322	572.1 Ω
RTD (Non-LE)	~~VTa1Q2a~~	~~EE1112~~	Ω
	TaQ2a	TT8312	66.21 Ω
RTD (Non-LE)	~~VTa1Q2a~~	~~EE1112~~	Ω
	TbQ2a	TT8322	71.11 Ω
Cryogenic (warm-up) Heater (LE)	W1aQ2A	EH8312+	16.89 Ω
	W2aQ2A	EH8312-	Ω
Cryogenic (warm-up) Heater (Non-LE)	W1bQ2A	EH8322+	Ω
	W2bQ2A	EH8322-	16.53 Ω

Technician(s) _____ Date _____

LHC Serial No.: LMQXB04

Notes: New Steps added per TRR No. 1578

Instrumentation Q2B			
Component	**FermiLab Label**	**CERN Label**	**Resistance**
¼ Coil Tap	VTa1Q2b	EE1412	Ω
	VTdQ2b	EMPTY	Ω
¼ Coil Tap	VTa1Q2b	EE1412	Ω
	VTeQ2b	EMPTY	Ω
½ Coil Tap	VTa1Q2b	EE1412	Ω
	VTc1Q2b	EE1512	Ω
½ Coil Tap	VTa1Q2b	EE1412	Ω
	VTc2Q2b	EE1522	574.9 Ω
Lead Tap	VTa1Q2b	EE1412	Ω
	VTa1Q2b	EE1412	Ω
Lead Tap	VTa1Q2b	EE1412	Ω
	VTb1Q2b	EE1612	Ω
Lead Tap	VTa1Q2b	EE1412	Ω
	VTa2Q2b	EE1422	571.5 Ω
Lead Tap	VTa1Q2b	EE1412	Ω
	VTb2Q2b	EE1622	571 Ω
RTD	[redacted]	[redacted]12	Ω
	TaQ2b	TT8332	66.75 Ω
RTD	[redacted]	[redacted]12	Ω
	TbQ2b	TT8342	66.72 Ω
Cryogenic (warm-up) Heater (LE)	W1aQ2B	EH8332+	16.11 Ω
	W2aQ2B	EH8332-	Ω
Cryogenic (warm-up) Heater (Non-LE)	W1bQ2B	EH8342+	16.46 Ω
	W2bQ2B	EH8342-	Ω

Add to other tables
SC
RBJ
JR

Technician(s) _____ Date _____

LHC Cold Mass Module Assembly

LHC Serial No.: LMQXB04

Notes: New Steps added per TRR No. 1578

MCBX Corrector Coil Taps			
Component	**FermiLab Label**	**CERN Label**	**Resistance**
(TAP1) **Q2-H2**	**VTH2**	**EE8122**	914 m Ω
(TAP2) **Q2-V2**	**VTV2**	**EE8112**	940.8 m Ω

Technician(s) _____ Date 12-6-03

XXX 13.2 Hipot according to table below. Hipot to 5kV. Maximum leakage is 3μA.

Hipot Heaters to Coil and Ground.

High Potential	Grounded	Floating	Leakage
All Strip Heaters	Coils, Yoke, Q1 Instrumentation Bus, Lead and Corrector Coil Busses.	RTD's and Warm-up Heaters	~~5.66uA~~ .447 μA

Hipot Coil to Heaters and Ground.

High Potential	Grounded	Floating	Leakage
All Coils	Strip Heaters, Yoke, Q1 Instrumentation Bus, 8kA and 5kA Lead Busses and Corrector Coil Busses.	RTD's and Warm-up Heaters	.079 μA

Technician(s) _____ Date 12-9-03

Responsible Authority/Physicist _____ Date 12-9-03

XXX 13.3 Verify that the results in Step 13.0 are acceptable.
Approved for next Assembly Procedure.

Responsible Authority/Physicist _____ Date _____

Q1 Taps Continuity Check Sheet

M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a", primary	X
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a",redundant	X
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary	X
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant	X
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary	X
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b",redundant	X
M5	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)	X
M5	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)	X
M7	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)	X
M7	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)	X
M7	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)	X
M7	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)	X
M9	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)	X
M9	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)	X
M9	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)	X
M10	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)	X
M12	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow	X
M12	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green	X
M12	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black	X
M12	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red	X
M12	5	TbQ1_I+	TT8321 I+		Q1 RTD, primary Wire color: Yellow	X
M12	6	TbQ1_I-	TT8321 I-		Q1 RTD, primary Wire color: Green	X
M12	11	TbQ1_V+	TT8321 U+		Q1 RTD, primary Wire color: Black	X
M12	10	TbQ1_V-	TT8321 U-		Q1 RTD, primary Wire color: Red	X

Technician(s) [illegible] **Date** 12/6/03

LMQ+B 04

"NEW" Hp LCR (read through both coldmasses)

Q2A	Ls	Q
Q1 (forward)	4.245	4.2
Q2 (forward)	3.513	3.9
Q3 (forward)	5.420	4.6
Q4 (forward)	3.405	3.8
Total (forward)	13.611	3.8

Q2b	Ls	Q
Q1 (forward)	3.4127	3.7
Q2 (forward)	3.422	3.8
Q3 (forward)	3.363	3.8
Q4 (forward)	3.395	3.8
Total (forward)	13.594	3.8

"NEW" Hp LCR (read through individual coldmasses)

Q2A	Ls	Q
Q1 (forward)	3.394	3.9
Q2 (forward)	3.388	3.8
Q3 (forward)	3.355	3.8
Q4 (forward)	3.364	3.8
Total (forward)	13.495	3.8

Q2b	Ls	Q
Q1 (forward)	3.376	3.8
Q2 (forward)	3.3934	3.8
Q3 (forward)	~~2.8743~~ 3.3532	3.9
Q4 (forward)	3.356	3.8
Total (forward)	12.991	3.8

12-13-03
LMQX3-04
PSace / 5 Jewell

LMQXB04
12/15/03

"NEW" Hp LCR (read through individual coldmasses)

Q2b	Ls	Q
Q1 (forward)	4.562	3.7
Q2 (forward)	4.571	3.7
Q3 (forward)	3.3405	3.8
Q4 (forward)	3.350	3.8
Total (forward)	13.467	3.8

Q1 Taps Continuity Check Sheet

M2	1	VTa1Q1	EE1111	a1	Q1 Lead Voltage Tap "a", primary	✓
M2	2	VTa2Q1	EE1121	a2	Q1 Lead Voltage Tap "a",redundant	✓
M2	3	VTc1Q1	EE1211	c1	Q1 Center Voltage Tap "c", primary	✓
M2	4	VTc2Q1	EE1221	c2	Q1 Center Voltage Tap "c", redundant	✓
M2	5	VTb1Q1	EE1311	b1	Q1 Lead Voltage Tap "b", primary	✓
M3	5	VTb2Q1	EE1321	b2	Q1 Lead Voltage Tap "b",redundant	✓
M5	1	VTH1	EE8121		Corrector voltage tap Q1-H1 (skew dipole) (on MCBX, MCBXH, A+ lead)	✓
M5	2	VTV1	EE8111		Corrector voltage tap Q1-V1 (normal dipole) (on MCBX, MCBXV A+ lead)	✓
M7	1	W1aQ1	EH8311+		Q1 Cryogenic Heater lead end - wire at top (CERN #1 I+)	✓
M7	2	W2aQ1	EH8311-		Q1 Cryogenic Heater lead end - wire at bottom (CERN #1 I-)	✓
M7	3	W1bQ1	EH8321+		Q1 Cryogenic Heater non-lead end - wire at top (CERN #2 I+)	✓
M7	4	W2bQ1	EH8321-		Q1 Cryogenic Heater non-lead end - wire at bottom (CERN #2 I-)	✓
M9	1	H1aQ1	YT1111+	HA1	Q1 Protection (Strip) Heater, ("a" circuit) (CERN lead #1+)	✓
M9	3	H2aQ1	YT1111-	HA2	Q1Protection (Strip) Heater, ("a" circuit) (CERN lead #1-)	✓
M9	5	H1bQ1	YT1121+	HB1	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2+)	✓
M10	4	H2bQ1	YT1121-	HB2	Q1 Protection (Strip) Heater, ("b" circuit) (CERN lead #2-)	✓
M12	1	TaQ1_I+	TT8311 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	2	TaQ1_I-	TT8311 I-		Q1 RTD, primary Wire color: Green	✓
M12	3	TaQ1_V+	TT8311 U+		Q1 RTD, primary Wire color: Black	✓
M12	4	TaQ1_V-	TT8311 U-		Q1 RTD, primary Wire color: Red	✓
M12	5	TbQ1_I+	TT8321 I+		Q1 RTD, primary Wire color: Yellow	✓
M12	6	TbQ1_I-	TT8321 I-		Q1 RTD, primary Wire color: Green	✓
M12	11	TbQ1_V+	TT8321 U+		Q1 RTD, primary Wire color: Black	✓
M12	10	TbQ1_V-	TT8321 U-		Q1 RTD, primary Wire color: Red	✓

Technician(s) [illegible] **Date** 12-13-03

CERN
CH-1211 Geneva 23
Switzerland

the **Large Hadron Collider** project

LHC ICP Document No.
LHC-MCBX-FR-0001 rev. **1.0**

EDMS Document No.

Certificate of Conformity

Part name:	MCBX Inner Triplet Dipole Corrector		
LHC Identification No.:	HCMCBX_001-SI000006	***Serial No.:***	HCMCBX_001-SI000006
Shipped To:	CERN	***Shipment No:***	***05***
		Shipment	***04/06/03***
Manufacturer:	SIGMAPHI	***Contract No.:***	F375/LHC/LHC
Related tech. Specification:	LHC-MCBX-CI-0001 and addenda		
Related drawings:	LHCMCBX_0012 (1525-CN-1001)		
Responsible person at CERN:	Mikko Karppinen	***Tel.***	+41 22 767 4305
		E-mail.	Mikko.Karppinen@cern.ch
Responsible person at SIGMAPHI:	Damien Neuvéglise	***Tel.***	+33 2 97 01 08 80
		E-mail.	dneuveglise@sigmaphi.fr
SIGMAPHI certifies that the delivered material conforms to the technical specification mentioned above:			
Date: 04/04/03	***Name: D.Neuvéglise***		***Signature: D.Neuvéglise***

Acceptance test results

		MCBXV (Inner)	***MCBXH (Outer)***	***Remarks:*** CERN:	
RT dc resistance (Ω):				MCBXV (INNER)	MCBXH (OUTER)
	SIGMAPHI:	***17.9***	***21.6***		
	CERN:	***17.9***	***21.8***	17.54 mΩ	21.37 Ω R
	CMA:				
Inductance @1 kHz/100 Hz (mH)	***SIGMAPHI:***	***56.07 / 112.90***	***68 / 160.89***	L= 62.9942 mH	58.4805 mH
	CERN	***63.13 /84.49***	***58.62 / 97.98***	Q= 4.45	2.45
	CMA:				
R.T. leakage current to ground @ 1.5 kV (μA):	***SIGMAPHI:***	***OK***	***OK***	OK	OK
	CERN:	***0.008***	***0.016***	1.02 μA	.977 μA
	CMA:				

	Cold Mass Assembler
Visual inspection	
Name / Signature	
Date	

A Gould 11/18/03

Accepted: ☒

Rejected: ☐

Comments (SigmaPhi):	***The connection plate is not perpendicular to the coil. The 2 alignment holes 8H7 have been re-machined to be in correct position.***

Comments (CERN):	***See NCR EDMS no. 398633***

Comments (CMA):	

Organisation Européenne pour la Recherche Nucléaire
European Organization for Nuclear Research

CH- 1211 - GENEVE 23 SUISSE
Telephone : +41 22 767 33 12
ou : 767 59 89
Telefax : +41 22 767 85 40

Expedition no: EM 1308118

LISTE DE COLISAGE DETAILLEE - DETAILED PACKING LIST

Nb de colis :	Emballage :	Poids brut : (Kgs)	Dimensions en cm : (longueur x largeur x hauteur)
1	CAISSE	477.0	94 x 63 x 70 cm
---		---	
1		477.0	

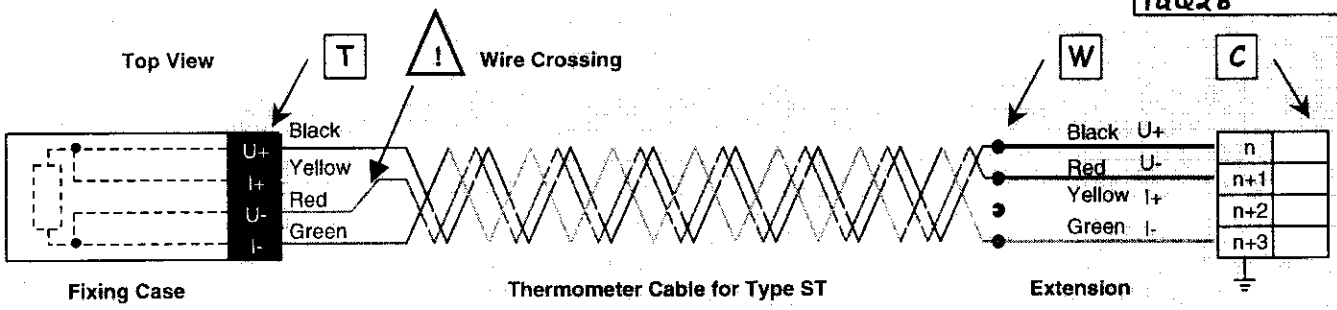
Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	Top Assembly Identification:	LMQXB04
Part Identification:	HCQITESCXT-CR012350		
Serial Number:	CX_LS_X16762	Manufactured By:	Fermilab

CABLING

Connector Tag Name: TaQ2b



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	04-Feb-2002	T	66.09	n.a	n.a	OVL	Ambient	IPN	Joly
Expedition	12-Mar-2003	T	64.753	0.1	0.1	OVL	293	CERN	Grivat
Reception	18 Nov 03	T W C	66.511				—	Fermi	Evans
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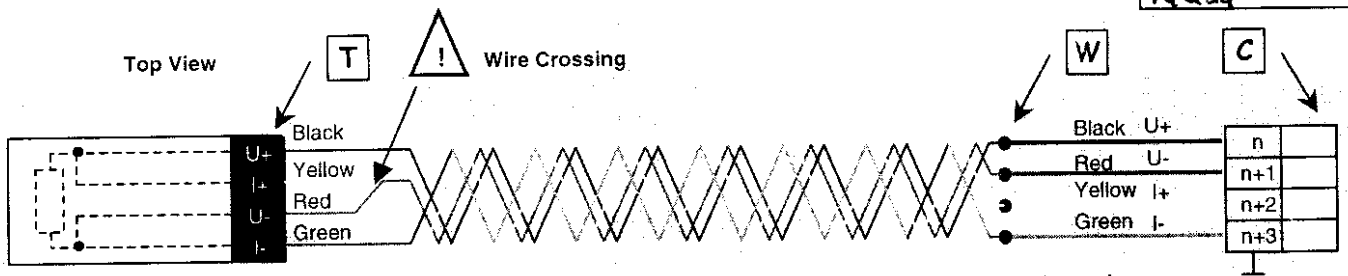
Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	Top Assembly Identification:	LMQXB04
Part Identification:	HCQITESCXT-CR012360		
Serial Number:	CX_LS_X16764	Manufactured By:	Fermilab

CABLING

Connector Tag Name: TqQ2q



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	21-Jan-2002	T	65.51	n.a	n.a	OVL	Ambient	IPN	Joly
Expedition	12-Mar-2003	T	64.104	0.1	0.1	OVL	293	CERN	Grivat
Reception	18 Nov 03	T W C	65.944				—	Fermi	Evans
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LMGXBOY

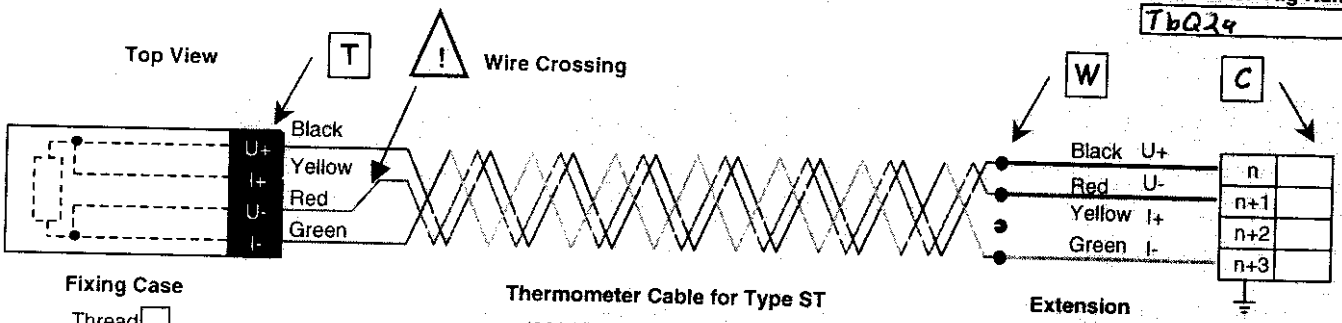
Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	Top Assembly Identification:	LMQXB04
Part Identification:	HCQITESCXT-CR012380	Manufactured By:	Fermilab
Serial Number:	CX_LS_X16766		

CABLING

Connector Tag Name: TbQ24



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	21-Jan-2002	T	70.41	n.a	n.a	OVL	Ambient	IPN	Joly
Expedition	12-Mar-2003	T	68.907	0.1	0.1	OVL	293	CERN	Grivat
Reception	18 Nov 03	T W C	70.801				—	Fermi	Evans
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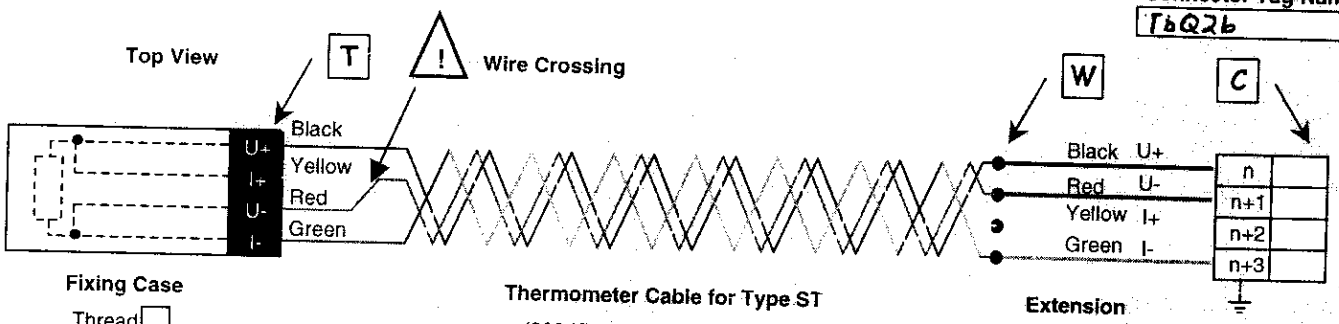
In Case of problem, do not hesitate to contact Responsible person at CERN. Tel:+41 22 767 4266

Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	Top Assembly Identification:	LMQXB04
Part Identification:	HCQITESCXT-CR012400	Manufactured By:	Fermilab
Serial Number:	CX_LS_X16770		

CABLING



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	21-Jan-2002	T	65.57	n.a	n.a	OVL	Ambient	IPN	Joly
Expedition	12-Mar-2003	T	64.062	0.1	0.1	OVL	293	CERN	Grivat
Reception	18 Nov 03	T W C	65,927				—	Fermi	Evans
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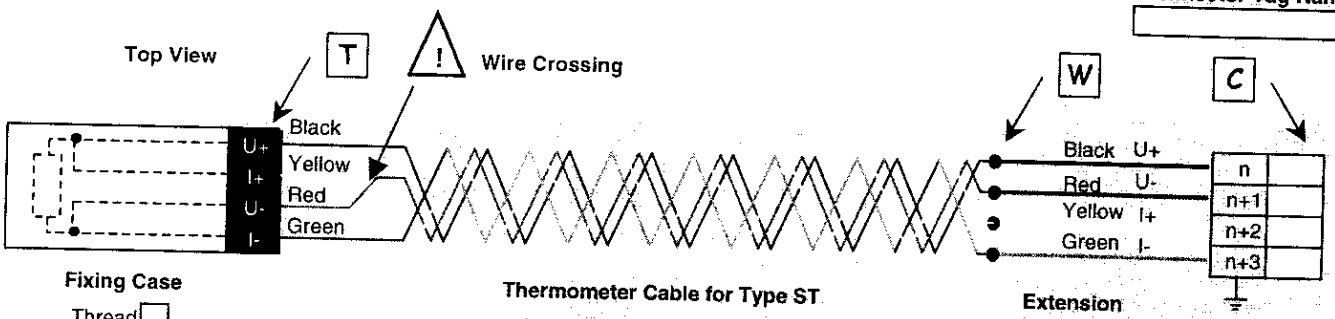
LMGXBOY

Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	**Top Assembly Identification:**	LMQXB04
Part Identification:	HCQITESCXT-CR012240	**Manufactured By:**	Fermilab
Serial Number:	CX_LS_X16744		

CABLING



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	21-Jan-2002	T	67.06	n.a	n.a	OVL	Ambient	IPN	Joly
Expedition	12-Mar-2003	T	65.616	0.1	0.1	OVL	293	CERN	Grivat
Reception		T W C	67.818					S.Gould	12/17/03
		T W C							
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		T W C							
		T W C							
		T W C							
		T W C	Added Later						
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In Case of problem, do not hesitate to contact Responsible person at CERN, Tel:+41 22 767 4266

67.818

68.689

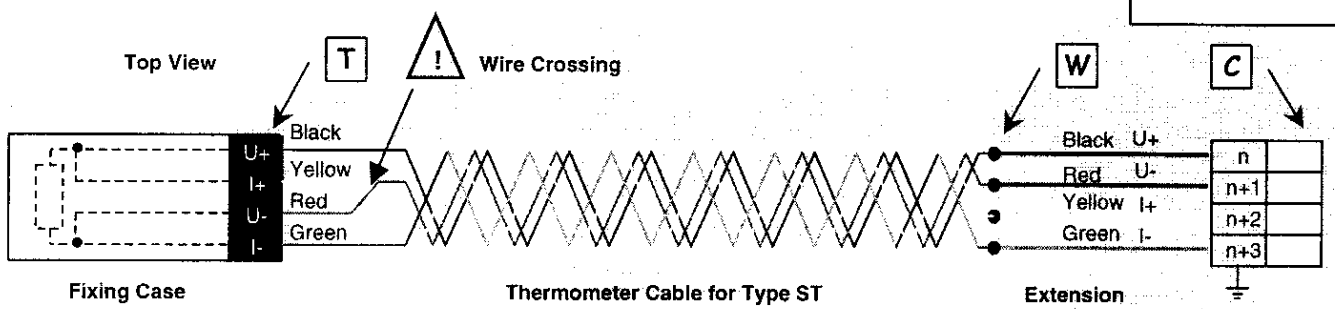
Cryogenic Thermometer Traveller

DESCRIPTION

Part description:	Cryogenic thermometer	**Top Assembly Identification:**	LMQXB04
Part Identification:	HCQITESCXT-CR010500		
Serial Number:	CX_LS_X16131	**Manufactured By:**	Fermilab

CABLING

Connector Tag Name



Fixing Case

Thread ☐
Hole ☐
Stud ☐

Thermometer Cable for Type ST

ρ (300 K) = 0.32 Ohm/m
Copper AWG 30
Length = ☐ m

Extension

ρ (300 K) = 0.07 Ohm/m
Copper AWG 24
Length: 0.8 m

CHECKS

Intervention	Date/ DD-MMM-YYYY	Check Point	R(U+,U-,I+,I-) [Ohm] 4W	R(U-,I-) [Ohm] 2W	R(U+,I+) [Ohm] 2W	R(U+,GND) [Ohm] 2W	Temperature [K]	Firm/Laboratory	Checked by
Calibration	*21-Jan-2002*	T	*68.38*	*n.a*	*n.a*	*OVL*	*Ambient*	*IPN*	*Joly*
Expedition	*12-Mar-2003*	T	*66.578*	*0.1*	*0.1*	*OVL*	*293*	*CERN*	*Grivat*
Reception		T W C	68.689					S. Gouco	12/17/03
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Added Later

LMGXB04

Revision Request Control Number: 1578

Specification Number: 5520 - TR - 333643 Current Revision: A

Traveler or Document Title Q2 LMQXB Cold Mass Module Assembly Traveler

Step #/Description of Revision:

6.11 Added Step. "Perform a Stretched Wire Verification Measurement."
7.1 Removed Step. "Obtain Lead Bus (ME-369825). Inspect Bus for damaged or broken areas. Clean Bus using lint free Heavy Duty Wipers (Fermi stock 1660-0150) and Isopropyl Alcohol (Fermi stock 1920-0300)." Moved to Q2 Insulated Bus Assembly Traveler (333721) per LMQXB04. Step 5.3
7.2 Removed Step. "Obtain parts for Bus Assembly (ME-369826) and assemble per Q2 Module Assembly Insulated Bus Assembly (ME-369826)." Moved to Q2 Insulated Bus Assembly Traveler (333721) per LMQXB04. Step 5.4
7.3 Removed Step. "Verify Bus Assembly (ME-369826) is assembled correctly per Q2 Module Assembly Insulated Bus Assembly (ME-369826)." Moved to Q2 Insulated Bus Assembly Traveler (333721) per LMQXB04. Step 5.5
7.4 Removed Step. "Hipot the 5kA Lead Bus to the 8kA and 13 kA Lead Busses on table before inserting into magnets. Power the 5kA bus to 5000V and ground the 13kA Lead Bus and the 8kA Lead Bus.(Max. Leakage < 0.5A)." Moved to Q2 Bus Assembly Traveler (333721) per LMQXB04. Step 5.6
7.5 Removed Step. "Hipot the Corrector Magnet (MD-390312) Busses at 5kV before inserting into magnet in both the parallel and checkerboard configurations as shown below. Corrector Wires not shaded should be at high potential, while those shaded should be connected to each other and grounded. (Max. Leakage < 0.5mA)" Moved to Q2 Bus Assembly Traveler (333721) per LMQXB04. Step 5.7
7.22 Modified Step. Added a "Floating" Column Header to Table 7.22 and "RTD's and Warm-up Heaters" in that column.
7.23 Modified Step. Added Note. "All wires in this table have been previously soldered to the Magnet except for the Cryogenic (warm-up) Heater Wires." Modified Table 7.23. Added CERN Labels per Rodger Bossert. Added Technician Signoff per LQXB04.
7.27 Modified Step. Added "Attach Instrumentation Bus Channel Lock(MB-369937) to Q2b Non Lead End as per Q2 Module Assembly(ME-369895, page 4 of 4)"
7.30 Modified Step. Changed resistance check of RTD's and Warm-up Heaters per Rodger Bossert. New Step 7.25.
7.31 Modified Step. Changed hipot of RTD's and Warm-up Heaters per Rodger Bossert. New Step 7.26.
8.0 Modified Step. Changed electrical procedure specifications per Rodger Bossert. Added new tables with CERN Labels and new pictures.
11.3 Modified Step. Changed to "Install Spider Assembly (MC-430044) to protect wires." Removed checkboxes and added Responsible Authority signoff.

John Szostak	Jim Rife	10/27/2003
Originator	Responsible Authority	Date
Revision Incorporated into the Traveler:	John Szostak	1/15/2004
	Revision Incorporated By	Date
Process Engineering Final Review:	Bob Jensen	1/15/2004
	Process Engineering/Designee	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 initialed 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: 1602

Specification Number: 5520 - TR - 333643 Current Revision: B

Traveler or Document Title Q2 LMQXB Cold Mass Module Assembly Traveler

Step #/Description of Revision:

1.4 Removed Step. "All personnel performing steps in this traveler must have documented training for this traveler and associated operating procedures."
7.26 Modified Step. Modified table. Removed row to record Temperature of Building (+/- 5°). Not necessary for hipots.
7.30 Added Step. "Ensure that the MCBX Corrector Magnet (MD-390312) is against the Mount Hardware and the bolts are "snug", before leveling and rotating."
7.36 Added Step "Attach Voltage Tap Wires to Corrector Magnet (MD-390312) as per Q2 Module Assembly (ME-369895)."
10.12 Modified Step. Changed to "Hipot the Beam Tube to coil, heaters and ground. (5kV) (Max. Leakage < 0.5mA)."
11.14 Added Step. "Undo Clamps."
11.15 Added Step. "Perform a stretched wire measurement of the system to align the Cold Mass within ± .2 mR"

John Szostak	Jim Rife	1/28/2004
Originator	Responsible Authority	Date
Revision Incorporated into the Traveler:	John Szostak	4/4/2004
	Revision Incorporated By	Date
Process Engineering Final Review:	Bob Jensen	4/7/2004
	Process Engineering/Designee	Date

Instructions for the completion of the Revision Request Form

Note(s):

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Originator Instructions:

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Traveler Title:	Specification No:	Revision:	DR No:
Q2 LMQXB Cold Mass Module Assembly Traveler	5520-TR-333643	A	HGQ-0437

Step No:	Drawing No:	Routing Form No:	Serial No:	Rework ID:
7.33	ME-369895		LMQXB04	0

Discrepancy Description:

Corrector magnet, when placed on mounting tooling, rests on 13k/5k/8k bus assembly.

Originator: Damon Bice

Date: 11/19/2003

Cause of Nonconformance:

Bus housing cover was slightly thicker than anticipated. Prototype part was mistakenly used.

Responsible Authority: Rodger Bossert

Date: 12/27/2004

Disposition:

Use part made to current specification.

Responsible Authority: Rodger Bossert

Date: 12/27/2004

Corrective Action to Prevent Recurrence:

None needed. Parts as currently designed will fit appropriately. No traveler change.

Responsible Authority: Rodger Bossert

Date: 12/27/2004

Corrective Action/Disposition Verified By: John Szostak

Date: 1/18/2005

Will Configuration be affected?: ☐ YES ☑ NO

Identified problem area:

☑ Material ☐ Manpower ☐ Method ☐ Machine ☐ Measurement

Reviewed By: Bob Jensen

Date: 1/20/2005

Traveler Title:	Specification No:	Revision:	DR No:
Q2 LMQXB Cold Mass Module Assembly Traveler	5520-TR-333643	A	HGQ-0439

Step No:	Drawing No:	Routing Form No:	Serial No:	Rework ID:
15.0	369895		LMQXB04	0

Discrepancy Description:

RTD #'s TT8312 and TT8322 readings are too high.

Originator: Steve Gould

Date: 12/15/2003

Cause of Nonconformance:

Electrical test caused failure.

Responsible Authority: Fred Nobrega

Date: 4/5/2004

Disposition:

Leave in place and add 2 more RTD's.

Responsible Authority: Fred Nobrega

Date: 4/5/2004

Corrective Action to Prevent Recurrence:

Changed inspection technique to prevent damage. Change Traveler. (TRR No. 1578)

Responsible Authority: Fred Nobrega

Date: 4/5/2004

Corrective Action/Disposition Verified By: John Szostak

Date: 12/6/2004

Will Configuration be affected?: ☐ YES ☑ NO

Identified problem area:

☐ Material ☐ Manpower ☐ Method ☐ Machine ☑ Measurement

Reviewed By: Bob Jensen

Date: 12/6/2004