Fermi National Accelerator Laboratory
Batavia, IL 60510

LARGE HADRON COLLIDER COLLARING & KEYING TRAVELER

Reference Drawing(s)
Collared Coil Assembly
ME-369581

Budget Code: LPT	**Project Code:** LHC
Released by:	**Date:** 20 JUL 01
Prepared by: M. Cullen, J. Larson	

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

Revision Page

Revision	Step No.	Revision Description	TRR No.	Date
None	N/A	Initial Release	N/A	10/16/00
A	3.0	Modified the Lamination Packs and added Kapton.	1183	6/13/01
	4.0	Removed Strain Gauges		
	5.0	Added Electrical Limits		

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 as applicable.

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 List for the LHC Collared Coil Keying Traveler to this traveler. Ensure that the serial number on the Parts Kit List matches the serial number of this traveler. Verify that the Parts Kit received is complete.

INCL W/ORIG

Process Engineering/Designee

20 JUL 01

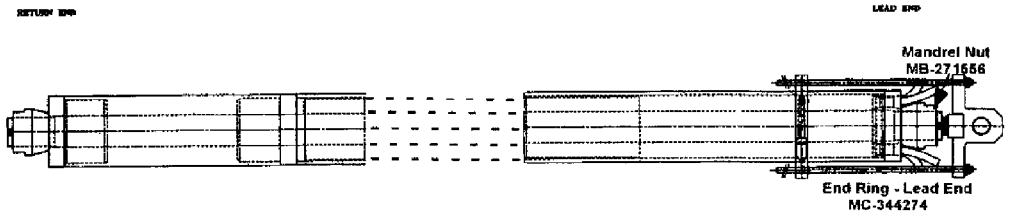
Date

3.0 Collaring

3.1 Clean all Mandrel hardware with Isopropyl Alcohol (Fermi stock 1920-0300) and Heavy Disposable Wipes (Fermi stock 1660-2600) or equivalent.

Technician(s) Date

3.2 Install the Nuts and the Lifting Eye onto the Lead End of the Mandrel.



Technician(s) Date

3.3 Lift vertically with the crane and transport the Collared Coil Assembly to the Keying Press and insert the Collared Coil Assembly into the Keying Press.

Technician(s) 7/20/01 Date

3.4 Machine the End Collar Lamination Packs (8) in accordance with the End Pack Modification Drawings (MX-XXXXXX).

Technician(s) 7/20/01 Date

3.5 Install the Return End Collar Lamination Packs with 5 mil self adhesive kapton on the Pole Piece side in accordance with the Collared Coil W/O Ends Assembly (ME-369581).

Note(s):

Remove shrink-wrap Mylar in 3" sections to prevent the ground wrap from loosening during collaring.

Technician(s) 7/20/01 Date

3.6 Install the Collar Lamination Packs in accordance with the Collared Coil W/O Ends Assembly (ME-369581).

Note(s):

Remove shrink-wrap Mylar in 3" sections to prevent the ground wrap from loosening during collaring.

Technician(s) 7.20.01 Date

3.7 Install the Modified Lead End Collar Lamination Packs with 5 mil self adhesive kapton on the Pole Piece side in accordance with the Collared Coil W/O Ends Assembly (ME-369581).

Technician(s) Date 7-20-01

3.8 Verify the Lamination Packs are tight and in accordance with the Collared Coil W/O Ends Assembly (ME-369581).

Crew Chief Date 7/20/01

4.0 Keying Procedure

Note(s):

Operate the Press in accordance with the Operating Procedure (OP-333503)
Monitor resistance of the magnet during the entire Collaring Procedure.
Resistance change of no more than 3 mOhms is allowed.

4.1 Massage the Collared Coil Assembly at 900-pump psi. from Lead End to Return End.

A Gould — Technician(s) — 7/20/01 — Date

4.2 Massage the Collared Coil Assembly at 1800 pump psi from Return End to Lead End.

A Gould — Technician(s) — 7/20/01 — Date

4.3 Partially insert Keys from the Lead End to Return End. Use 3000 pump psi main pusher pressure and 700-pump psi Key pusher pressure for this step.

Note(s):

As needed modify the length of the keys 6" above the End of the Assembly to Ensure the final key is > 4" in length.
Verify the Mandrel Nut is hand tight every 4 ft (four times) of Keying.
Engage the Main Pushers, and then the Key Pushers, release the Main Pushers, and then the Key Pushers.

A Gould — Technician(s) — 7/20/01 — Date

4.4 Fully insert Keys from the Lead End to Return End. Use 4400 pump psi main pusher pressure and 2700-pump psi Key pusher pressure.

Note(s):

Verify the Mandrel Nut is hand tight every 4 ft (four times) of Keying.
Engage the Main Pushers, and then the Key Pushers, release the Main Pushers, and then the Key Pushers.

A Gould — Technician(s) — 7/20/01 — Date

X 4.5 While Lowering and Raising the Coil Assembly, visually inspect Keys to verify they are fully inserted.

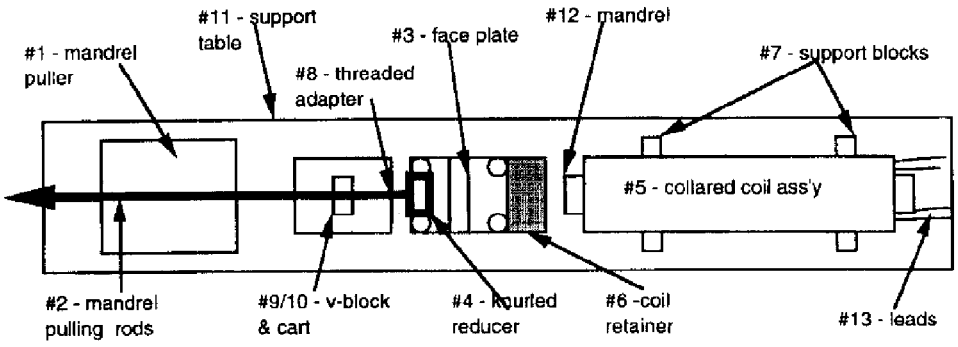
A Gould — Inspector — 7/20/01 — Date

4.6 Bring the Collared Coil Assembly horizontal using Approved and Appropriate procedures

A Gould — Technician(s) — 7/20/01 — Date

5.0 Pulling the Mandrel

5.1 Mandrel Pulling Procedure



TOP VIEW

Note(s):

Mandrel should be pulled out from return end of Collared Coil Assembly. Ensure that the Mandrel is kept in the correct radial position with respect to coils during extraction by inserting Mandrel into holding tooling (MC-344284) and Collar Laminations into Cradles (MD-344281)

5.1.1 The Mandrel pulling rods (2) are to be picked up by the crane and pushed into the Mandrel Puller (1) until they click into the groove. The rods should be about 6" from the face plate (3). To displace the weight of the rods, a cart (9) with a V block (10) shall be used to support the pulling rods.

5.1.2 The Collared Coil Assembly (5) shall then be picked up with the crane using two slings so it remains level. It is then placed on the support blocks (7) so the coil retainer (6) is flush against the face plate (3).

5.1.3 The knurled reducer (4) is then screwed into the Mandrel (12) so the threaded adapter (8) can be screwed from the rods (2) to the reducer (4).

5.1.4 The Mandrel Puller (1) shall be warmed up about 20-30 minutes before pulling the Mandrel (12). The crane shall also be left on the slings with the Collared Coil Assembly during the pulling process.

5.1.5 Leads (13) shall be secured (cable tied) so they are out of the way during the process.

N/A — Re-assembled assembly not using assembly mandrel. J. Rye 7/20/01

Technician(s) Date

X 5.2 Perform an electrical inspection on each of the individual Inner and Outer Coils, Quadrants and Heaters. Refer to the Valhalla and Leader Free Standing Coil Measurement Procedure (ES-292306).

Note(s):

Coils in the free state during an electrical inspection shall be at least 150 mm (6") away from any conductive material (i.e., surface of the Coil preparation / storage table).

Electrical connections to the Coil leads shall be 305 mm ± 13 mm (12" ± .5") away from the end of the Coil to be tested.

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

Caution:

Before applying power to the Valhalla 4300B, ensure that the test current is off.

During testing, ensure that the test current is off and the disconnect status safe light is lit while connecting and disconnecting test leads from the Coil Assembly. An unsafe signal indicates a test current is still being generated.

Valhalla 4300B settings:

Power must be on for 30 minutes before testing.

Test Current	_____	Off
Power	_____	On
Full Scale Voltage	_____	20mv
Amp Selector Knob	_____	.10 mA
Temperature Compensator	_____	On
Test Current	_____	On (testing)

Hp 4263B:

Function	_____	"Ls-Q" selected

Record the Serial Number of the test equipment used.

Valhalla _____

HP 4263b _____

Resistance Limits		Inner	Outer	Total	Pass	Fail
		240 mΩ to 265 mΩ	310 mΩ to 340 mΩ	550 mΩ to 605 mΩ		
Quadrant 1	Inner	.2599				
	Outer		.3227			
	Total			.5812	✓	
Quadrant 2	Inner	.2589				
	Outer		.3202			
	Total			.5780	✓	
Quadrant 3	Inner	.2591				
	Outer		.3216			
	Total			.5795	✓	
Quadrant 4	Inner	.2604				
	Outer		.3218			
	Total			.5798	✓	

TR# 0239

Inductance Limits		Inner	Outer	Total	Pass	Fail
		575-620 mH	1.120 to 1.17 H	2.890 to 2.920 H		
Quadrant 1	Inner	532.601				
	Outer		873.139			
	Total			2.3275		
Quadrant 2	Inner	530.085				
	Outer		869.627			
	Total			2,5236		
Quadrant 3	Inner	530.853				
	Outer		869.478			
	Total			2,321 56		
Quadrant 4	Inner	534.723				
	Outer		873.802			
	Total			2.32939		

(Q) Limits		Inner	Outer	Total	Pass	Fail
		3.3 to 3.7	4.8 to 5.3	4.5 to 5.2		
Quadrant 1	Inner	3.12				
	Outer		3.06			
	Total			5.36		
Quadrant 2	Inner	3.12				
	Outer		3.05			
	Total			5.33		
Quadrant 3	Inner	3.10				
	Outer		3.04			
	Total			5.32		
Quadrant 4	Inner	* 3.10				
	Outer		3.03			
	Total			5.31		

JHould
Inspector

7/23/01
Date

Electrical Test	Limit	Actual Measurement	Pass	Fail
Heater Strips 1/2 Resistance	9.20 to 9.60 Ω	9.370 Ω	✓	
Heater Strips 2/3 Resistance	9.20 to 9.60 Ω	9.460 Ω	✓	
Heater Strips 3/4 Resistance	9.20 to 9.60 Ω	9.477 Ω	✓	
Heater Strips 4/1 Resistance	9.20 to 9.60 Ω	9.412 Ω	✓	

X Gould — Inspector

7/23/01 — Date

X 5.3 Perform an Electrical inspection of the IORS Voltage Taps (Readings accurate ± 1mV).

Limit: No Opens

Inner	Valhalla Serial Number	Coil Serial Number	Reading
Quadrant 1		MQXBI-21	.2599 mV ↔
Quadrant 2		MQXBI-22	.2589 mV →
Quadrant 3		MQXBI-23	.2591 mV ↔
Quadrant 4		MQXBI-24	.2604 mV ↔

X Gould — Inspector

7/23/01 — Date

X 5.4 Perform a Hipot on the Collared Coil Assembly (**Maximum Leakage 5μA**)

5 KV	Measurement(s)
Heater #1/2 to Ground	.3 μA
Heater #2 to Ground	.2μA
Heater #3 to Ground	.3μA
Heater #4 to Ground	.2 μA
Heater #1/2 to Coils	.2 μA
Heater #2/3 to Coils	.2 μA
Heater #3/4 to Coils	.2 mA
Heater #4/1 to Coils	.2 μA
Magnet to Ground	.01 μA

Coil to Coil 3.0 KV	Measurement(s)
Quadrant 1 to Quadrant 2	.04
Quadrant 2 to Quadrant 3	.04
Quadrant 3 to Quadrant 4	.03
Quadrant 4 to Quadrant 1	.04

A Howald
Inspector

7/20/01
Date

Pos #2

Ø" 7.282
3" 7.2735
6" 7.274

Pos. # 9

Ø" 6.796
3" 6.790
6" 6.789

Pos #7

Ø" 7.286
3" 7.276
6" 7.276

Pos# 10

Ø 6.797
3" 6.789
6" 6.790

pos# 4

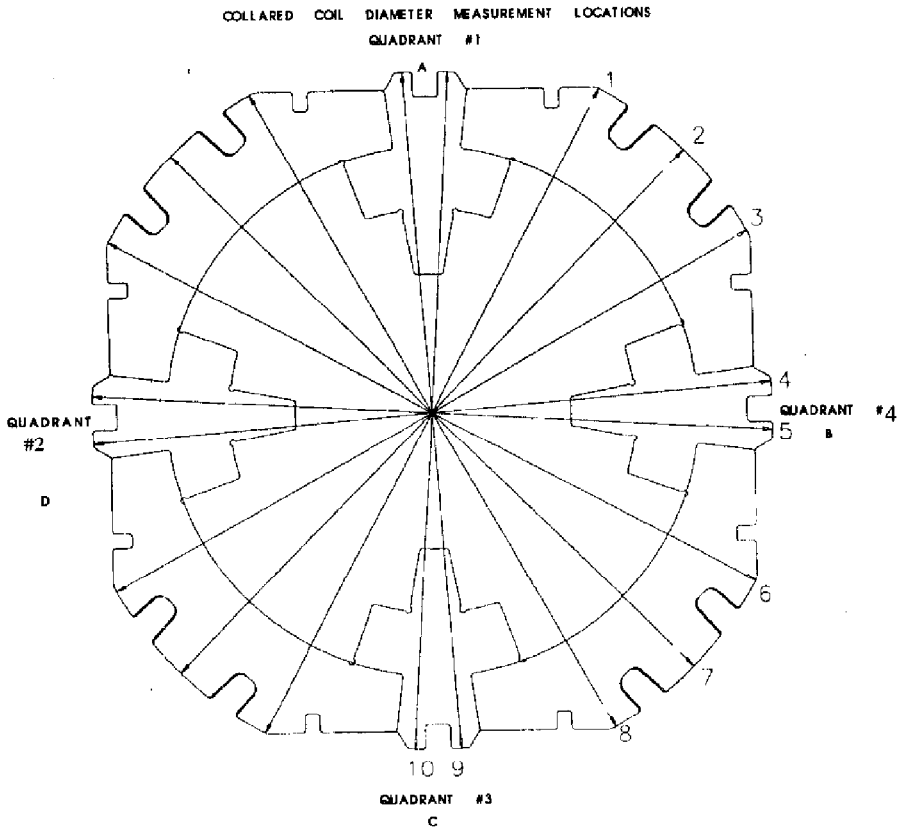
Ø" 6.793
3" 6.788
6" 6.786

pos #5

Ø" 6.795
3" 6.790
6" 6.790

Distance in inches is from lead end.

X 5.5 Diameter Measuring Procedure (ES-344697).



Looking from the Lead End

5.5.1 Using the Collared Coil Assembly Measuring Fixture, measure and record the dimension across the Collared Coil Assembly as shown at points 2, 4, 5, 7, 9 and 10.

5.5.2 Measurements are taken across the laminations.

5.5.3 Start at the Lead End of the Collared Coil Assembly.

5.5.4 Measurements along the length of the Collared Coil Assembly shall be taken at the Center of each lamination pack.

5.5.5 Insert computer printout of measurement at this page of the traveler.

5.5.6 Send an electronic copy of the computer-collected data to the Samsats II folder.

_____ 7/23/01

Inspector Date

STOP

5.6 Verify that the readings in Step 5.0 are acceptable.
Approved for next Major Assembly Procedure.

_____ 7-23-01

Responsible Authority/Physicist Date

6.0 Production Complete

6.1 Process Engineering verify that the LHC Collared/Keying Traveler (5520-TR-333495) 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:

Process Engineering/Designee

Date 7/27/01