DFLX-26

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:January 6, 2003 Page 1 of 1 Author: Sandor Feher
	0. Cover Sheet for Check Out Form	

Power leads being tested: 7500 A DFLX 25 7500 A DFLX 26

Task #	Responsible	Task	Received Date,time		Performed Date,time	
1	Inspection	Unpack the leads			3/27	
2	Inspection	IB4 mech. & Tolerances				
3	Mechanical	Move the leads to MTF			7/22	1500
4	Electrical	Initial electrical check out			4/1	
5	Mechanical	Installation of the current leads			7/29-7/30	
5a	Mechanical	Preliminary leak check Procedure			7/28	
6	Mechanical	Pressure test			7/30	
7	Mechanical	Leak check			8/4	
7a	Mechanical	Top plate insertion into the dewar			8/4	
8	M. Tartaglia	Configuration of the DAQ system				
9&9.1	Electrical	Room temp. electrical test	8/4	10:00	8/4	16:00
10	Mechanical	Installation of the top plate			8/4	
12	Mechanical	Cool down			8/5	
13	Electrical	Electrical & instrumentation test	8/5	9:00	8/5	9:30
14	Mechanical	Connect the leads to the Power Supply & configure			8/5	1030
15	Electrical	Electrical & instrumentation test			8/5	
16	M. Thompson	Cold test of the power lead			8/5	1115
17	Mechanical	Perform a Thermal cycle			8/5	1715
18	M. Thompson	Cold test of the power lead			8/6	
19	Mechanical	Warm up			8/6	
20	Electrical	Electrical & instrumentation test			8/7	
21	Mechanical	Remove the top plate			8/12	1400
22	Mechanical	Remove the leads from the top plate			8/13	
23	Mechanical	Pack and move the leads			8/14	

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:January 6, 2003 Page 1 of 1 Author: Sandor Feher
	1. Unpacking Check Out Form	

Performed by SUDHIR GHANTA (name typed) [signature] (signature)

Date & time 3/27/03 9 30 AM

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

1.1 Container Identification: 7500 A DFLX 25 7500 A DFLX 26
(Leads serial numbers are on one side of the container)

1.2 Note condition of shipping container
No damage ☑ Slight damage ☐ Massive damage ☐

1.3 Examine condition of g-load indicators
a. Each side of the box are Shock Watch-s are installed
Not tripped ☑ Tripped (red) ☐ Remark: ____
Not tripped ☑ Tripped (red) ☐ Remark: ____

b. Each leads have a Shock Watch installed onto their body
Not tripped ☑ Tripped (red) ☐ Remark: ____
Not tripped ☑ Tripped (red) ☐ Remark: ____

c. Each leads have another "10G DROP" devices installed on the flag of the leads
Not tripped ☐ Tripped (Black) ☑ Remark: 25 INS. SLEEVE (-A) LOOSE
Not tripped ☑ Tripped (Black) ☐ Remark: 26 INS. SLEEVE (-A-) LOOSE

1.4 Container content:
a. Power leads: 7500 A DFLX 25 ; 7500 A DFLX 26
b. Travel document for each lead in an envelope ☑
c. In a plastic box:
1. One clamp: Item No. C105-12-401; Description NW16/10 Clamping ring ST/STEEL PK1 ☑
2. One valve made by "precision Cryogenic System" ☑
3. One O-ring seal with brass insert ☑
+ 2 HEATERS + 2 CONNECTORS.
(4) ONE MORE BOX CONTAINING THE ABOVE PLUS 2 HEATERS. AND 2 CONNECTORS.
(5) ONE BOX CONTAINING 8 HEATERS

PART NAME : 7.5 KA CURRENT LEAD ASSY (LBNL01)
REV NUMBER :
SER NUMBER :
STATS COUNT : 1

* INSULATOR SLEEVE (-A-) LOOSE

7500 A DFLX 26

MM	DIM CYL -A-DIA= LOCATION OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	99.000	0.200	0.200	99.070	0.070	0.000

MM	DIM -A-= ROUNDNESS OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.200	0.000	0.081	0.081	0.000

MM	DIM -B-= FLATNESS OF PLANE PLN -B-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.050	0.000	0.003	0.003	0.000

MM	DIM PERP1= PERPEND OF PLANE PLN -B- TO CYLINDER CYL -A- EXTEND=0.00(					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.400	0.000	0.225	0.225	0.000

MM	DIM PERP2= PERPEND OF PLANE LRG FLANGE TO CYLINDER CYL -A- EXTEND=5(					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.400	0.000	0.452	0.452	0.052

MM	DIM -C- DIA= LOCATION OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	80.000	0.200	0.200	80.016	0.016	0.000

MM	DIM CONCEN2=CONCENTRICITY FROM CYLINDER -C- TO CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	1.000	0.000	1.488	1.488	0.488

MM	DIM RND2= ROUNDNESS OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.200	0.000	0.081	0.081	0.000

MM	DIM DIST1= 2D DISTANCE FROM PLANE PLN -B- TO PLANE LRG FLANGE PAR T(					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	561.000	1.000	1.000	561.579	0.579	0.000

MM	DIM LOC5= TRUE POSITION OF CIRCLE CIR2						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	0.000				0.000	0.000	
Z	123.571				123.637	0.066	
DF	18.000	0.200	0.200	0.180	17.980	-0.020	0.000
TP	MMC	0.130		0.180		0.132	0.000

PART NUMBER=7.5 KA CURRENT LEAD ASSY (LBNL01) DATE=3/28/2003 TIME=2:47:16 PM

MM	DIM LOC10= TRUE POSITION OF CIRCLE CIR3							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
X	-78.890				-78.930	-0.041		
Z	95.047				95.059	0.012		
DF	18.000	0.200	0.200	0.177	17.977	-0.023	0.000	
TP	MMC	0.130		0.177		0.085	0.000	

MM	DIM LOC11= TRUE POSITION OF CIRCLE CIR4							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
X	78.890				78.969	0.078		
Z	95.047				95.191	0.144		
DF	18.000	0.200	0.200	0.175	17.975	-0.025	0.000	
TP	MMC	0.130		0.175		0.328	0.022	

MM	DIM LOC12= TRUE POSITION OF CIRCLE CIR5							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
X	78.890				79.142	0.252		
Z	-95.047				-94.908	0.139		
DF	18.000	0.200	0.200	0.176	17.976	-0.024	0.000	
TP	MMC	0.130		0.176		0.575	0.269	

MM	DIM 16.00 DIA HOLE #5= TRUE POSITION OF CIRCLE CIR6							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
X	-78.918				-78.760	0.158		
Z	-95.047				-95.039	0.008		
DF	18.000	0.200	0.200	0.135	17.935	-0.065	0.000	
TP	MMC	0.130		0.135		0.317	0.052	

MM	DIM 8.433 DIA HOLE #1= TRUE POSITION OF CIRCLE SH1							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.279	-0.271		
PA	-153.000				-152.971	0.029		
DF	8.433	0.200	0.000	0.117	8.550	0.117	0.000	
TP	MMC	0.080		0.117		0.549	0.352	

MM	DIM 8.407 DIA HOLE #2= TRUE POSITION OF CIRCLE SH2							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.352	-0.198		
PA	-171.000				-171.009	-0.009		
DF	8.433	0.200	0.000	0.115	8.548	0.115	0.000	
TP	MMC	0.080		0.115		0.397	0.202	

MM	DIM 8.433 DIA HOLE #3= TRUE POSITION OF CIRCLE SH3							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.296	-0.254		
PA	-135.000				-134.871	0.129		
DF	8.433	0.200	0.000	0.179	8.611	0.179	0.000	
TP	MMC	0.080		0.179		0.652	0.393	

PART NUMBER=7.5 KA CURRENT LEAD ASSY (LBNL01) DATE=3/28/2003 TIME=2:47:17 PM

MM | DIM 8.433 DIA HOLE #4= TRUE POSITION OF CIRCLE SH4

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.373	-0.177		
PA	171.000				170.975	-0.025		
DF	8.433	0.200	0.000	0.124	8.557	0.124	0.000	
TP	MMC	0.080		0.124		0.363	0.158	

MM | DIM 8.433 DIA HOLE #5= TRUE POSITION OF CIRCLE SH5

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.402	-0.148		
PA	153.000				152.901	-0.099		
DF	8.433	0.200	0.000	0.159	8.592	0.159	0.000	
TP	MMC	0.080		0.159		0.430	0.191	

MM | DIM 8.433 DIA HOLE #6= TRUE POSITION OF CIRCLE SH6

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.451	-0.099		
PA	135.000				134.924	-0.076		
DF	8.433	0.200	0.000	0.109	8.542	0.109	0.000	
TP	MMC	0.080		0.109		0.311	0.122	

MM | DIM 8.433 DIA HOLE #7= TRUE POSITION OF CIRCLE SH7

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.535	-0.015		
PA	117.000				116.918	-0.082		
DF	8.433	0.200	0.000	0.096	8.529	0.096	0.000	
TP	MMC	0.080		0.096		0.261	0.085	

MM | DIM 8.433 DIA HOLE #8= TRUE POSITION OF CIRCLE SH8

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.533	-0.017		
PA	99.000				98.894	-0.106		
DF	8.433	0.200	0.000	0.112	8.545	0.112	0.000	
TP	MMC	0.080		0.112		0.336	0.144	

MM | DIM 8.433 DIA HOLE #9= TRUE POSITION OF CIRCLE SH9

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.667	0.117		
PA	81.000				80.944	-0.056		
DF	8.433	0.200	0.000	0.111	8.543	0.111	0.000	
TP	MMC	0.080		0.111		0.292	0.102	

MM | DIM 8.433 DIA HOLE #10= TRUE POSITION OF CIRCLE SH10

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.728	0.178		
PA	63.000				62.944	-0.056		
DF	8.433	0.200	0.000	0.102	8.535	0.102	0.000	
TP	MMC	0.080		0.102		0.397	0.215	

PART NUMBER=7.5 KA CURRENT LEAD ASSY (LBNL01) DATE=3/28/2003 TIME=2:49:30 PM

MM	DIM 8.433 DIA HOLE #11= TRUE POSITION OF CIRCLE SH11						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.785	0.235	
PA	45.000				44.998	-0.002	
DF	8.433	0.200	0.000	0.105	8.538	0.105	0.000
TP	MMC	0.080		0.105		0.471	0.286

MM	DIM 8.433 DIA HOLE #12= TRUE POSITION OF CIRCLE SH12						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.759	0.209	
PA	27.000				27.038	0.038	
DF	8.433	0.200	0.000	0.103	8.536	0.103	0.000
TP	MMC	0.080		0.103		0.434	0.251

MM	DIM 8.433 DIA HOLE #13= TRUE POSITION OF CIRCLE SH13						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.768	0.218	
PA	9.000				9.089	0.089	
DF	8.433	0.200	0.000	0.102	8.534	0.102	0.000
TP	MMC	0.080		0.102		0.518	0.336

MM	DIM 8.433 DIA HOLE #14= TRUE POSITION OF CIRCLE SH14						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.719	0.169	
PA	-9.000				-8.834	0.166	
DF	8.433	0.008	0.000	0.008	8.546	0.113	0.105
TP	MMC	0.003		0.008		0.625	0.614

MM	DIM 8.433 DIA HOLE #15= TRUE POSITION OF CIRCLE SH15						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.695	0.145	
PA	-27.000				-26.813	0.187	
DF	8.433	0.200	0.000	0.102	8.535	0.102	0.000
TP	MMC	0.080		0.102		0.658	0.477

MM	DIM 1450= 2D DISTANCE FROM LINE FRT END TO LINE LIN2 PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	1450.000	0.400	0.400	1452.997	2.997	2.597

MM	DIM 130.0DIA= LOCATION OF CIRCLE OD1					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	130.000	0.200	0.200	129.958	-0.042	0.000

MM	DIM 502 COOLING HOLE= 2D DISTANCE FROM CIRCLE ID15 TO PLANE LRC FLAN					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	502.000	0.400	0.400	501.744	-0.256	0.000

MM	DIM X LOC OF COOLING HOLE= LOCATION OF CIRCLE ID15					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.000	1.800	1.800	4.318	4.318	2.518

PART NUMBER=7.5 KA CURRENT LEAD ASSY (LBNL01) DATE=3/28/2003 TIME=2:47:18 PM

DEG	DIM WARM TERMINAL= 3D ANGLE (TRUE) FROM PLANE PLN2 TO ZAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
A	0.000	0.100	0.100	-0.270	-0.270	0.170

MM	DIM X LOC OF WARM TERM= LOCATION OF PLANE MID PLN					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.000	0.130	0.130	-1.733	-1.733	1.603

IN	DIM POLAR ANGLE OF COOLING HOLE= LOCATION OF CIRCLE ID15					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
PA	90.000	2.000	2.000	85.306	-4.694	2.694

MM	DIM 444.5= 2D DISTANCE FROM LINE FRT END TO PLANE PLN -B- PAR TO YAX					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	444.500	1.500	1.500	445.137	0.637	0.000

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	3. Form for moving power leads	

Power leads need to be moved from NW8 to MTF are:
7500 DFLX 25 & 7500 DFLX 26
Approved by__________SandorFeher__________________
(name typed) (signature)
Date & time ______________________________

The request should go through Marsha Schmidt who is responsible keeping track of whereabouts of the power leads.

Requested by ROGER RABEHL Roger Rabehl
(name typed) (signature)
Date & time JULY 22, 2003 13:30

Delivered by CLIFF BEECH [signature] 12698
(name typed) (signature)
Date & time 7/23/03

Received by ____________ [signature]
(name typed) (signature)
Date & time 7-22-03 1501

The next person ______________ responsible to perform Checkout form #5 (5. Installation of the current leads into the top plate) has been

Notified by ______________________________
(name typed) (signature)
Date & time ______________________________

This form should be copied and each copy should be placed into the folders of both of the power leads

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

Performed by DAN EDDY (name typed) Dan Eddy (signature)

Date & time 4/01/03 14:30

Power Lead 7500 A DFLX 26

When checkout is complete, make sure you place this document in the Traveler Binder

3.1 Voltage segment and drop measurement.

Apply 5 Amps between the copper flag and the LTS cable.

Record the applied current 5 A

Use HP3458 DVM, set it to 40 line cycle integration time.

Measure the voltages between the following pins:

Voltage tap Connector 1 (Primary) (Fisher DEE104A06)

Pin 1 - pin 2 **(80uv)** 80 V Pin 2 - pin 3 **(225uv)** 240 V
Pin 1 - pin 3 **(300uv)** 350 V Pin 3 - pin 4 **(240uv)** 250 V
Pin 1 - pin 4 **(530uv)** 590 V Pin 4 - pin 5 **(float)** FLOAT V
Pin 1 - pin 5 **(float)** FLOAT V Pin 5 - pin 6 **(float)** FLOAT V
Pin 1 - pin 6 **(float)** FLOAT V

Voltage tap Connector 2 (Redundant) (Fisher DEE104A06)

Pin 1 - pin 2 **(80uv)** 90 V Pin 2 - pin 3 **(225uv)** 240 V
Pin 1 - pin 3 **(300uv)** 350 V Pin 3 - pin 4 **(240`uv)** 240 V
Pin 1 - pin 4 **(530uv)** 580 V Pin 4 - pin 5 **(float)** FLOAT V
Pin 1 - pin 5 **(float)** FLOAT V Pin 5 - pin 6 **(float)** FLOAT V
Pin 1 - pin 6 **(float)** FLOAT V

3.2 Verify that between pin 5 and the coiled wire at the bottom of the lead has continuity:

Connector 1 (Primary) Pin 5 and end of the wire continuity is OK ☑ not OK ☐

Comments

Connector 2 (Redundant) Pin 5 and end of the wire continuity is OK ☑ not OK ☐

Comments

3.2.1 Using a small piece of fiberglass tape, mark the Primary and Redundant wires

3.3 Temperature sensor resistance measurements.

3.3.1 Two wire measurement on connector 3 (Fisher DEE104Z086):

Resistance between Pin 1 and pin 2 .63 Ω
Resistance between Pin 1 and pin 3 108.66 Ω
Resistance between Pin 1 and pin 4 108.64 Ω
Resistance between Pin 2 and pin 3 108.65 Ω

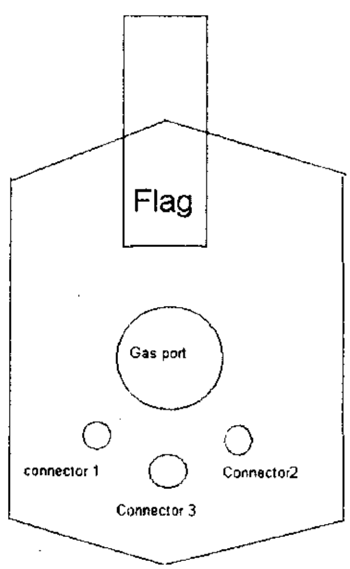
Resistance between Pin 2 and pin 4 __108.63__ Ω
Resistance between Pin 3 and pin 4 __.62__ Ω
Pins 1-4 resistance to lead __∞__ Ω Pins 1-4 resistance to flange __∞__ Ω

Resistance between Pin 5 and pin 6 __.64__ Ω
Resistance between Pin 5 and pin 7 __108.56__ Ω
Resistance between Pin 5 and pin 8 __108.55__ Ω
Resistance between Pin 6 and pin 7 __108.57__ Ω
Resistance between Pin 6 and pin 8 __108.57__ Ω
Resistance between Pin 7 and pin 8 __.63__ Ω
Pins 5-8 resistance to lead __∞__ Ω Pins 5-8 resistance to flange __∞__ Ω

Resistance between Pin 9 and pin 10 __.57__ Ω
Resistance between Pin 9 and pin 11 __108.54__ Ω
Resistance between Pin 9 and pin 12 __108.54__ Ω
Resistance between Pin 10 and pin 11 __108.54__ Ω
Resistance between Pin 10 and pin 12 __108.51__ Ω
Resistance between Pin 11 and pin 12 __.54__ Ω
Pins 9-12 resistance to lead __∞__ Ω Pins 9-12 resistance to flange __∞__ Ω

3.3.2 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:

Resistance of T1 __108.04__ Ω (I+ at pin 1, I- at pin 2, U+ at pin 3, U- at pin 4)
Resistance of T2 __107.95__ Ω (I+ at pin 5, I- at pin 6, U+ at pin 7, U- at pin 8)
Resistance of T3 __108.00__ Ω (I+ at pin 9, I- at pin 10, U+ at pin 11, U- at pin 12)



Looking from the top of the lead down where the LTS cable is located.
Connector 2= Redundant and Connector 1= Primary

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX:
5a. Preliminary Leak Check Procedure

Lead Number: DFLX-26

Signed C.E. Hess Jr.

Date 07/28/03

1. **Preparation for Leak Checking**
   - **1.1** Put the power lead on the steel table, with the power lead lower flange resting in the end support clamp.
   - **1.2** Plug the 4-20 K inlet.
   - **1.3** Attach an adapter to the top of the power lead so that a leak detector can be connected.

2. **Leak Check-Lead Number** DFLX · 2G
   - **2.1** Pump out the power lead with the leak detector.
   - **2.2** Record the baseline reading from the leak detector.

64 Division X 5 scale   Baseline: 1.6×10^{-7} atm cc/s

   - **2.3** Spray all joints with He and watch for a signal from the leak detector
   - **2.4** Record the maximum leak detector reading.

64 Division X 5 scale   Maximum reading: 1.6×10^{-7} atm·cc/s

FERMILAB
Technical Division

Stand 3 LHC-HTS Lead Testing: 5. Installation of the Current Leads

Lead Pair

Negative Lead: DFLX-25

Positive Lead: DFLX-26

Signed (JEFF WITTENKELLER, CHUCK PRIBYL) Date 7/29/03 - 7/30/03

1. Mechanical Integration of Current Leads in Test Facility

1.1 Using wedges, tilt the insert by 10° so that the power leads will be vertical when installed.

1.2 Clean sealing surfaces inside the chimneys with acetone and/or alcohol wipe.

1.3 Position the upper insulator in each chimney according to Figure 1.3.

1.4 Position the PEEK seal in each chimney according to Figure 1.3.

1.5 Position the lower insulator in each chimney according to Figure 1.3.

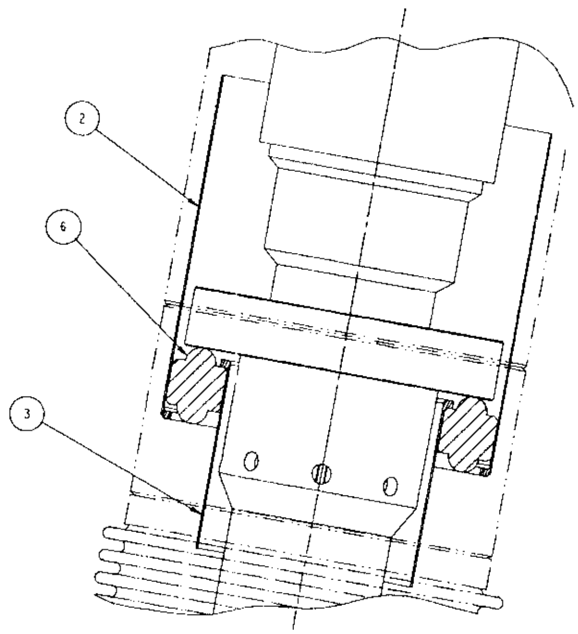


Figure 1.3 2 – Upper Insulator, 3 – Lower Insulator, 6 – PEEK Seal

1.6 Attach the lifting/insertion tool to the lead flag as shown in Figure 1.6 and remove the lead from the shipping container.

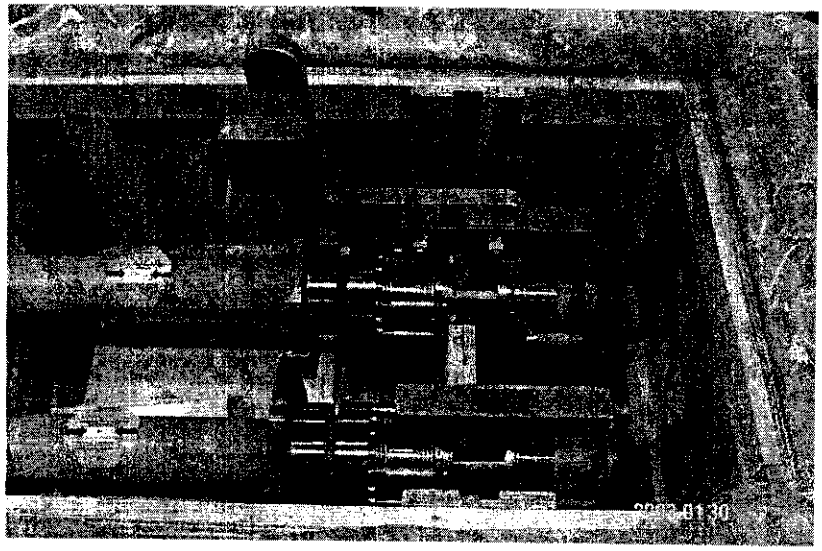


Figure 1.6 The lifting/insertion tool bolted to a power lead in preparation for removing it from the shipping container.

1.7 Remove the plastic plug from the 4-20 K gas inlet on the lead body.
1.8 Remove the protective covers from the lower and upper flanges.
1.9 With alcohol, clean the lower flange and the upper flange knife edge and sealing surface.
1.10 Prepare to install the power lead baffle by removing the short threaded rods to open the baffle.
1.11 Install the baffle on the lead with the pointed tips of the threaded rods pointing toward the bottom of the lead. An installed baffle is shown in Figure 1.11.

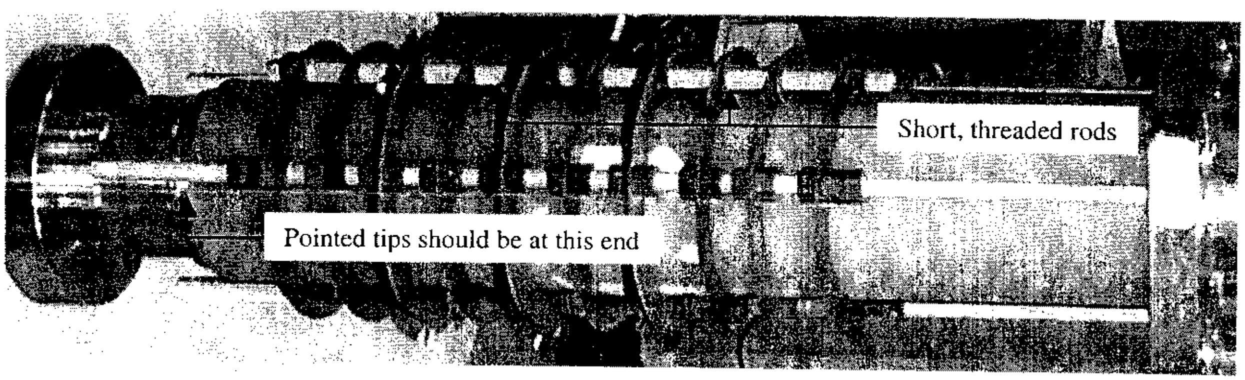


Figure 1.11 A baffle installed on a power lead.

1.12 Clamp the end support around the lower flange so that the handles will rest on the backs on the C-channels clamped to the steel table.
1.13 Set the lead in the C-channels on the steel table.
1.14 Clean the top plate Conflat flange knife edge and copper gasket. Install the gasket on the top plate Conflat flange.

Negative Lead DFLX 25 Positive Lead DFLX 26

1.15 Align the top plate rotatable Conflat flange to the orientation shown on Figure 1.15, where the leak check grooves on the flange align with the middle tensioning studs.

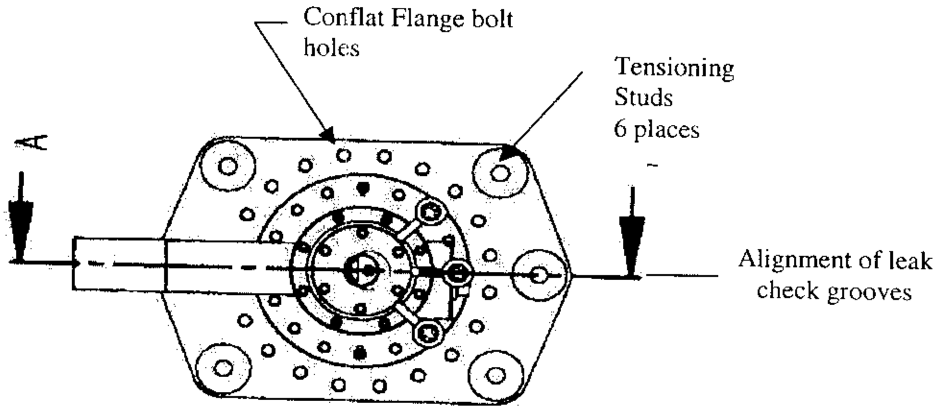


Figure 1.15 The 20-hole Conflat bolt pattern is bisected by center tensioning studs.

1.16 Back down the nuts on the tensioning studs.
1.17 Swing the lifting/insertion tool 180 degrees as shown in Figure 1.17 in preparation for lifting the power lead into the vertical position.

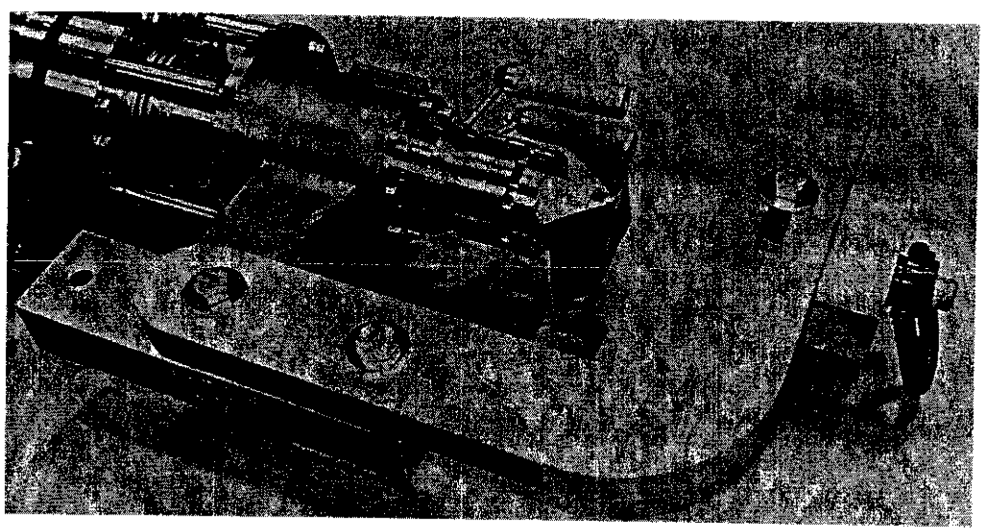


Figure 1.17 The lifting/insertion tool in position to lift the power lead into a vertical position.

1.18 Strapping the overhead crane to the lifting/insertion tool and manually guiding the lower end support, lift the lead and position it vertically while not allowing any loading on the bottom end of the lead.

Negative Lead DFLX 25 Positive Lead DFLX 26

1.19 Remove the lower end support.

1.20 Tie a weighted string to the LTS bus to help guide it through the chimney during installation.

1.21 Install the lead in the chimney per Figure 1.21a until the lower sealing flange bottoms out. The flag should be toward the bayonet connections on the insert. The negative lead is installed on the left hand side, and the positive lead is installed on the right hand side as shown in Figure 1.21b.

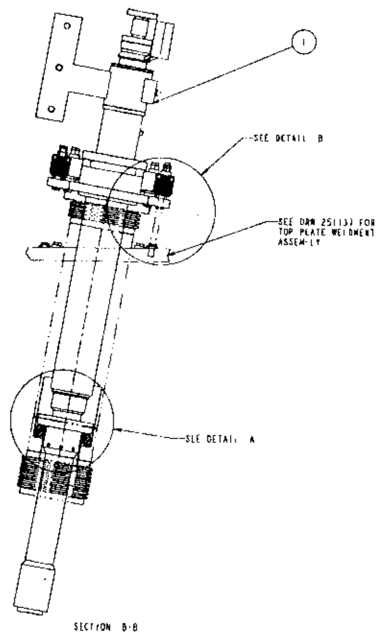


Figure 1.21a HTS Lead in Test Chimney. Note: CERN chimneys do not have bellows.

Negative Lead DFLX ___25___ Positive Lead DFLX ___26___

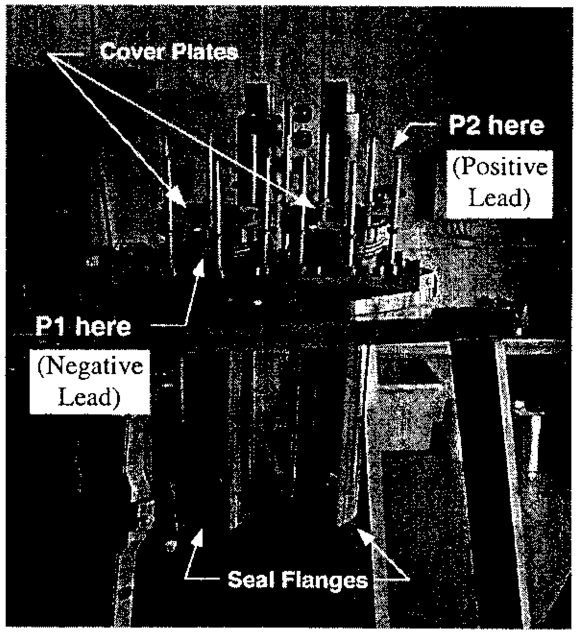


Figure 1.21b Locations of the negative and positive leads.

1.22 Raise the nuts on the tensioning studs to hold the lead in place, as shown in Figure 1.22.

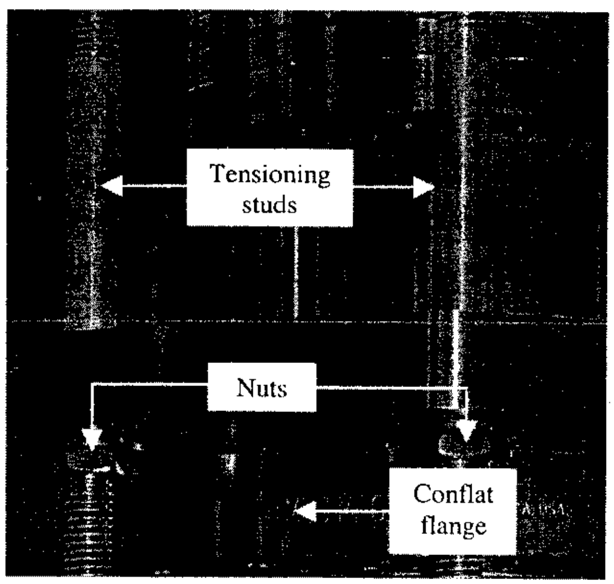


Figure 1.22 The positions of the tensioning studs, nuts, and top plate Conflat flange as the 20 Conflat bolts are tightened.

Negative Lead DFLX 25 Positive Lead DFLX 26

1.23 Center the lower end of the lead in the chimney using the centering shim blocks. The Teflon inner centering shim blocks are labeled with an 'I' and go between the power lead and the lower insulator. The Teflon outer centering shim blocks are labeled with an 'O' and go between the lower insulator and the chimney. The installed Teflon centering shim blocks are shown in Figure 1.23.

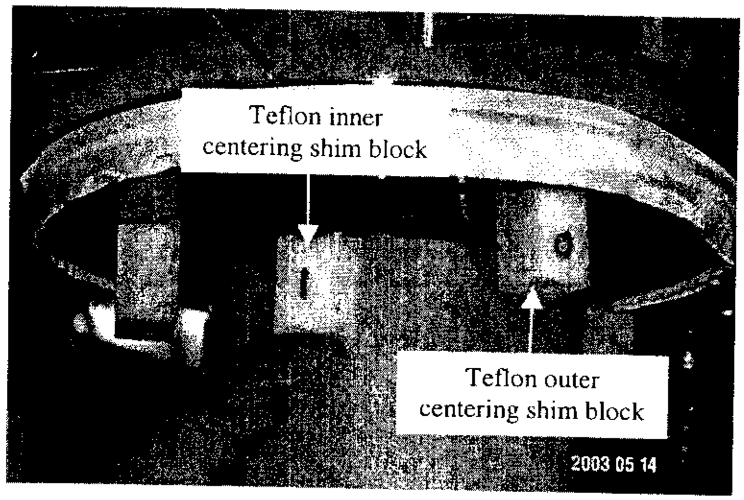


Figure 1.23 The installed Teflon centering shim blocks.

1.24 On the power lead flange, number the Conflat bolt holes 1 through 20 as indicated by Figure 1.25.

1.25 If there is a gap between the top plate Conflat flange and the Pirelli flange, pull the bellows up to close the gap using bolts 1 through 4.

1.26 Use a 5/16 12-point socket to tighten the 20 Conflat bolts. The tightening must be made gradually in ¼ turn increments to a final torque of 15 ft-lbf (180 in-lbf). The tightening sequence is given by Fig. 1.26.

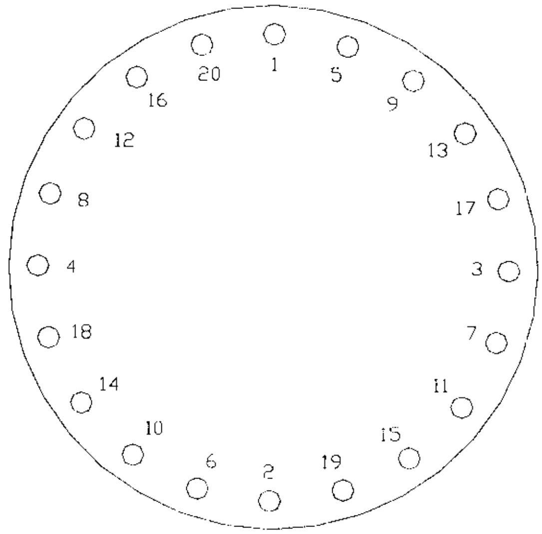


Figure 1.26 Tightening sequence for the 20 Conflat bolts.

1.27 Unbolt the lifting/insertion tool from the installed power lead.

1.28 Install Belleville Washer Assemblies on each tensioning stud per Figures 1.28a and 1.28b. A spherical washer must be placed below the Belleville washer holder on each stud. In the figures: Items 11 (10 each) are Belleville Washers, arranged as shown; Items 6 (2 each) are flat washers; Items 4 and 5 are the Belleville Washer Holder; Item 10 are Spherical Washers for above and below the washer holder; Item 9 is a loading nut; and Item 8 is a jam nut.

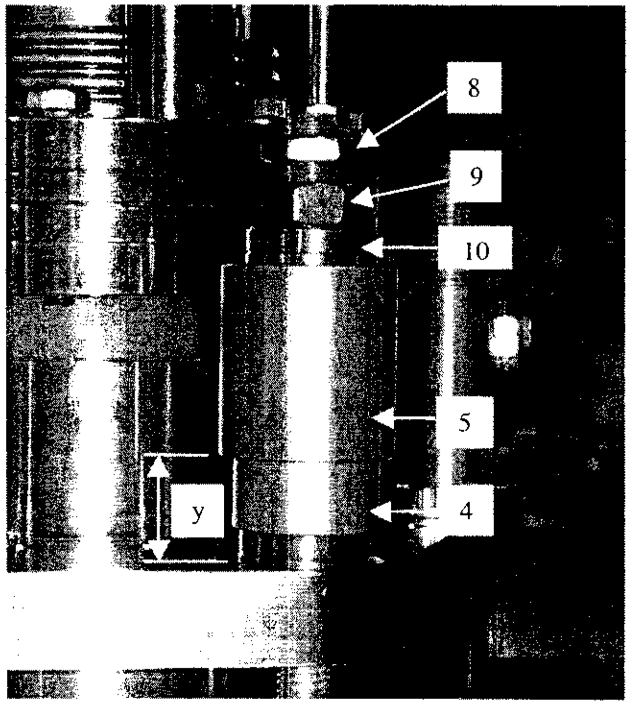


Figure 1.28a An installed Belleville Washer Assembly.

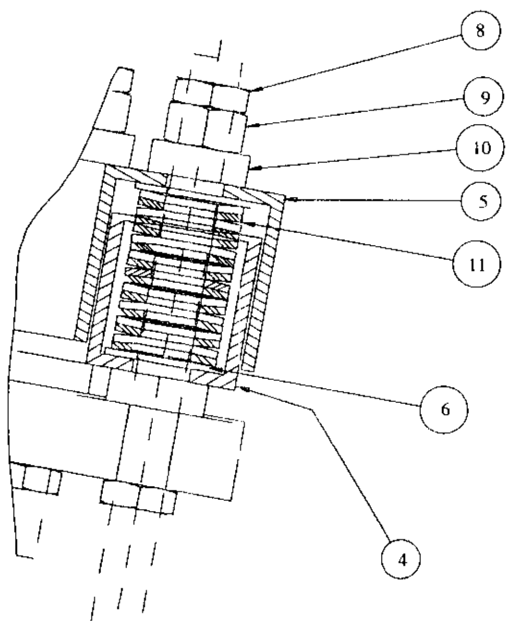


Figure 1.28b An installed Belleville Washer Assembly.

1.29 Tighten the 6 Belleville Washer Assemblies to apply load to the PEEK seal.
1.29.1 Washers for Lead **DFLX** 25

Negative Lead DFLX 25 Positive Lead DFLX 26

1.29.1.1 Ensure that the tensioning rod nuts used in 1.22 have a gap of about 5 mm below the lead flange.

1.29.1.2 Tighten the 6 loading nuts finger-tight. With adjustable parallels, measure and record the gap "y" indicated in Figure 1.28a between Item 5 and the current lead top flange at the 6 locations specified in Figure 1.29.1.5. Units are mm.

A 23.96 B 24.52 C 23.78 D 23.90 E 23.91 F 23.75

1.29.1.3 For each of the six studs: remove the adjustable parallel, adjust it for 1.8 mm of compression, and return the adjustable parallel into position under the Belleville washer holder. Record the adjusted heights of the adjustable parallels. Units are mm.

A 22.16 B 22.72 C 21.98 D 22.1 E 22.11 F 21.95

1.29.1.4 Using the sequence A through F in Figure 1.29.1.5, tighten the loading nuts ¼ turn until the total compression is 1.8 mm at each of the six locations. As each loading nut is tightened ¼ turn, check off the appropriate line.

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ______ B ______ C ______ D ______ E ______ F ______

Negative Lead DFLX 25 Positive Lead DFLX 26

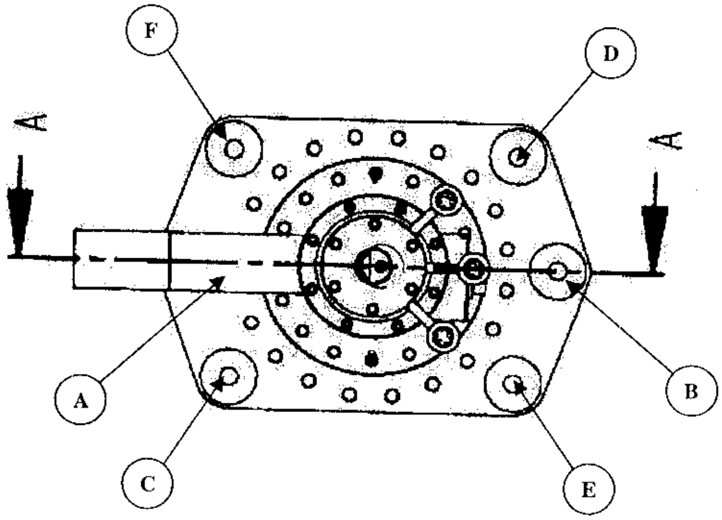


Figure 1.29.1.5 The specified sequence for tightening the Belleville Washer Assemblies.

1.29.1.5 Record the final measured gaps 'y' in Figure 1.28a. Units are mm.

A 22.13 B 22.55 C 21.90 D 21.96 E 21.52 F 21.82

1.29.1.6 Remove the Teflon centering shim blocks from the installed power lead.

1.29.2 Washers for Lead **DFLX** 26

1.29.2.1 Ensure that the nuts used in 1.22 have a gap of about 5 mm below the lead flange.

1.29.2.2 Tighten the 6 loading nuts finger-tight. With adjustable parallels, measure and record the gap "y" indicated in Figure 1.28a between Item 5 and the current lead top flange at the 6 locations specified in Figure 1.29.1.5. Units are mm.

A 24.16 B 23.34 C 23.72 D 23.76 E 24.47 F 23.15

1.29.2.3 For each of the six studs: remove the adjustable parallel, adjust it for 1.8 mm of compression, and return the adjustable parallel into position under the Belleville washer holder. Record the adjusted heights of the adjustable parallels. Units are mm.

A 22.36 B 21.54 C 21.92 D 21.96 E 22.67 F 21.35

1.29.2.4 Using the sequence A through F in Figure 1.29.1.5, tighten the loading nuts ¼ turn until the total compression is 1.8 mm at each of the six locations. As each of the loading nuts is turned ¼ turns, check off the appropriate line.

A 22.16 B 21.91 C 21.70 D 21.71 E 22.63 F 21.24
FINAL VALUES - SHOULD BE LISTED IN 1.29.2.5

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ______ B ______ C ______ D ______ E ______ F ______

1.29.2.5 Record the final measured gaps 'y' in Figure 1.28a. Units are mm.

[SEE 1.29.2.4]

A ______ B ______ C ______ D ______ E ______ F ______

1.29.2.6 Remove the Teflon centering shim blocks from the installed power lead.

1.30 On both power leads, tighten down the jam nuts to secure the loading nuts on the installed Belleville Washer Assemblies.

1.31 Tighten the nuts on the underside of the current lead top plate against the plate to provide stability during transportation.

2. Pressure Test

2.1 Follow the procedure specified in the document entitled, "7500 A HTS Power Leads for the LHC DFBX: 6. Pressure Test Procedure."

3. Leak Check

3.1 Follow the procedure specified in the document entitled, "7500 A HTS Power Leads for the LHC DFBX: 7. Leak Check Procedure."

4. Electrical Integration of Current Leads in Test Facility

4.1 Attach the G-10 clamshell clamp at the bottoms of the power leads, and install the clamp support.

4.2 Make connection to LTS pigtails. The joint is a mechanical connection with a stainless steel clamp (supplied by LBNL) and indium foil between the cables to ensure good electrical contact. Figure 4.1a shows a rendition of the installed power leads. Figure 4.1b shows the G-10 clamshell clamp, the clamp support, and the mechanical clamp.

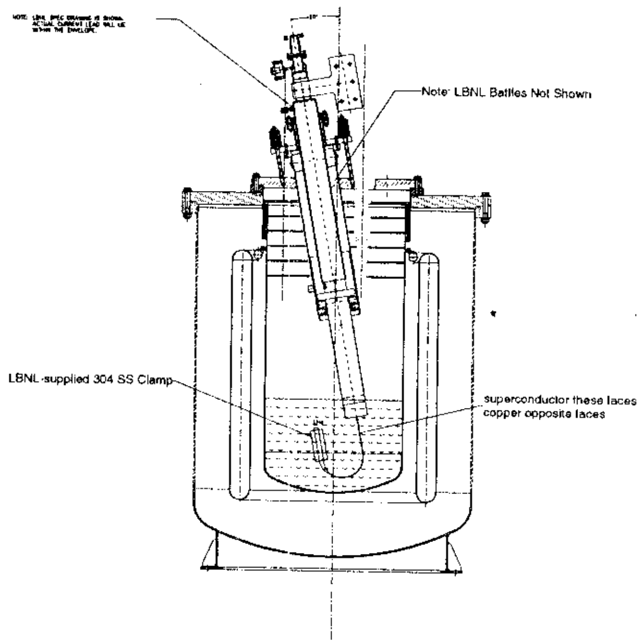
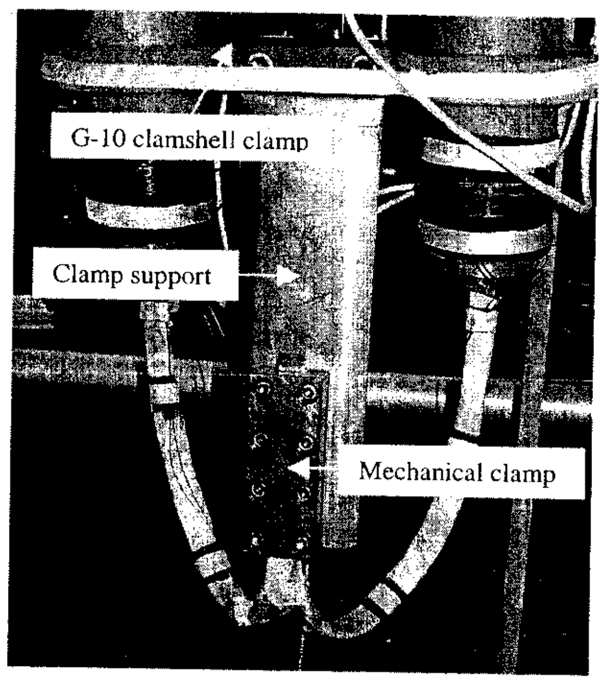


Figure 4.1a Side View of Lead in Cryostat with the LTS cables connected.



~~Figure~~ **4.1b** Electrical integration of the LTS sections.

4.3 Clamp a piece of bus wire and a little indium to the LTS cable. Solder the two V5 voltage tap wires to the bus wire. Wind excess voltage tap wire around the bottom of the lead, securing it with Kapton and glass tape.

4.4 Insulate the superconducting cable with Kapton and glass tape.

4.5 Install He space temperature sensors and LHe liquid level probes.

4.6 Install the bottom fill tube.

4.7 Bolt the heaters to each power lead. Use grease at the interface to improve the thermal contact between the heater and power lead.

4.8 Measure and record dimensions required for the insert map.

Negative Lead DFLX 25 Positive Lead DFLX 26

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX:
6. Pressure Test Procedure

Lead Pair
Negative Lead: DFLX25
Positive Lead: DFLX-26

Signed (JEFF WITTENKELLER, CHUCK PRIBYL) Date 7/30/03

1. **Preparation for Pressurization**
   1.1 Install the bayonet plug into the 4-20 K supply bayonet on the top plate. Tie it down.
   1.2 On the 4-20 K female bayonet vacuum jacket, cap off one of the 1/4 inch compression fittings. Connect the test gauge and associated tubing to the second 1/4 inch compression fitting.
   1.3 Install Conflat blankoffs on the vents of the installed power leads.
   1.4 Put the cover cans over each lead vent and tie them down.
   1.5 Connect a nitrogen bottle to the pressure test tubing.

2. **Pressurization**
   2.1 Pressurize the 4-20 K circuit to 65 psia (50 psig) and record the initial pressure from the test gauge.
   Initial pressure: 65.5 PSIA 3.13 PM

   2.2 Wait five minutes and record the final pressure from the test gauge.

   Final pressure: 65.5

3. **Release of Pressure**

3.1 Isolate the nitrogen bottle.
3.2 Release the pressure by opening the hand valve on the pressure test tubing.
3.3 Disconnect the pressure test tubing from the top plate/insert.

Negative Lead DFLX ____________ Positive Lead DFLX ____________

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX: 7. Leak Check Procedure

Lead Pair

Negative Lead: DFLX-25

Positive Lead: DFLX-26

Signed C. E. Hess Jr.

Date 08/01/03

1. **Preparation for Leak Checking**
   - **1.1** Cap/plug the two 1/4 inch compression fittings on the 4-20 K female bayonet vacuum jacket.
   - **1.2** Remove the Conflat blankoff from one of the lead vents and install the modified Conflat with a vacuum pumpout.
   - **1.3** Attach a leak detector to the vacuum pumpout installed on the top of one of the power leads.

2. **Leak Check**
   - **2.1** Pump out the 4-20 K circuit with the leak detector.
   - **2.2** Record the baseline reading from the leak detector.

54∂ X 100s Baseline: 54 2.7×10^{-6} atm·cc/s

   - **2.3** Spray all joints with He and watch for a signal from the leak detector
   - **2.4** Record the maximum leak detector reading.

54∂ X 100s Maximum reading: 2.7×10^{-6} atm·cc/s

20∂ X 5s = 5.03 e^{-8} atm cc sec

Negative Lead DFLX 25 Positive Lead DFLX 29

9. Room Temperature Electrical Checkout

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

.

Performed by Dan W (Name typed) Dan W (Signature)

Date & time 8/4/03

Pos. Power Lead 7500 A DFLX 26 and Neg. Power Lead 7500 A DFLX 25

When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binder.

1.0 Before beginning checkout, be sure that the following is done:

Make sure all of the 4-pin circular Hypertronic connectors inside dewar have been connected and taped up with fiberglass tape.
Install positive and negative lead heaters. Be sure to apply thermal compound on the back of heaters before attaching to leads.
Attach primary and redundant labels to the fisher connector assembly on each lead

2.0 Voltage drop measurement.

2.1 Connect Kepco power supply cable to the LHC power leads. This is the gray two-conductor cable (black to negative lead and clear to positive lead).
2.2 Configure the Kepco distribution box on the Stand 4 platform to power the LHC power leads (jumper should be in the Checkout power/Stand-3 Power leads position).
2.3 Turn on Kepco power supply and set the output for 10 amps. (5v on HP meter=10 amps)
2.4 Connect stand 3 trim current cable to shunt current monitor above the Kepco power supply.
2.5 Check the Cryo computer monitor numerical display to verify 10A through leads (left monitor near Stand-3).
2.6 Record the applied current 10 A
2.7 Connect both primary and redundant Vtap cables to positive and negative leads.
2.8 Remove the four primary and redundant Vtap cables from the back of the Vtap distribution box (these cables are located on the right side).
2.9 Using the dual 8-pin breakout box, connect the cables as per the following instructions:
Use HP3458 DVM, set it to 40-line cycle integration time.

DFLX 26 DFLX 25

9. Room Temperature Electrical Checkout

Positive Lead (single cable test)

Voltage tap Connector 1 (**Primary**)

Pin 1 - pin 2 **(160uv)** 143.8u V Pin 2 - pin 3 **(450uv)** 452.6u V
Pin 1 - pin 3 **(610uv)** 599.6u V Pin 3 - pin 4 **(480uv)** 460.2u V
Pin 1 - pin 4 **(1.1mv)** 1.063m V Pin 4 - pin 5 **(3.5mv)** 3.235m V
Pin 1 - pin 5 **(4.7mv)** 4.300m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

Voltage tap Connector 2 (**Redundant**)

Pin 1 - pin 2 **(160uv)** 144.2u V Pin 2 - pin 3 **(450uv)** 451.0u V
Pin 1 - pin 3 **(610uv)** 598.1u V Pin 3 - pin 4 **(480uv)** 456.5u V
Pin 1 - pin 4 **(1.1mv)** 1.059m V Pin 4 - pin 5 **(3.5mv)** 3.238m V
Pin 1 - pin 5 **(4.7mv)** 4.301m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

Negative Lead (single cable test)

Voltage tap Connector 1 (**Primary**)

Pin 1 - pin 2 **(-160uv)** -149.4u V Pin 2 - pin 3 **(-450uv)** -460.6u V
Pin 1 - pin 3 **(-600uv)** -606.8u V Pin 3 - pin 4 **(-480uv)** -461.1u V
Pin 1 - pin 4 **(-1.1mv)** -1.014m V Pin 4 - pin 5 **(-3.5mv)** -3.215m V
Pin 1 - pin 5 **(-4.7mv)** -4.276m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

Voltage tap Connector 2 (**Redundant**)

Pin 1 - pin 2 **(-160uv)** -148.8u V Pin 2 - pin 3 **(-450uv)** -461.8u V
Pin 1 - pin 3 **(-600uv)** -602.4u V Pin 3 - pin 4 **(-480uv)** -462.1u V
Pin 1 - pin 4 **(-1.1mv)** -1.004m V Pin 4 - pin 5 **(-3.5mv)** -3.216m V
Pin 1 - pin 5 **(-4.7mv)** -4.277m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

Connection 1 (**Primary**) (dual cable test)

Positive Lead Pin 1 - Negative Lead pin 5 **(3.7mv)** 3.118m V
Positive Lead Pin 1 - Negative Lead pin 4 **(7.3mv)** 6.329m V
Positive Lead Pin 1 - Negative Lead pin 3 **(7.7mv)** 6.787m V
Positive Lead Pin 1 - Negative Lead pin 2 **(8.2mv)** 7.245m V
Positive Lead Pin 1 - Negative Lead pin 1 **(8.3mv)** 7.390m V

Connection 2 (**Redundant**) (dual cable test)

Positive Lead Pin 1 - Negative Lead pin 5 **(3.7mv)** -3.124m V
Positive Lead Pin 1 - Negative Lead pin 4 **(7.3mv)** -6.336m V
Positive Lead Pin 1 - Negative Lead pin 3 **(7.7mv)** -6.783m V
Positive Lead Pin 1 - Negative Lead pin 2 **(8.2mv)** -7.250m V
Positive Lead Pin 1 - Negative Lead pin 1 **(8.3mv)** -7.395m V

DFLX ______ DFLX ______

2.10 When voltage measurements are complete, turn off kepco power supply and disconnect kepco power cable on positive and negative LHC power leads. Reconnect the Vtap cables on back of the Vtap Distribution box.

3.0 Temperature sensor resistance measurements.

3.1 Using the special test cable (cable should be located on cable rack near Fred's bench), use the standard blue breakout box, connect to connector 3 (LHC RTD's) of leads or connector between primary and redundant Vtap connector. The LHC lead RTD's are

3.2 511-3, 512-3, 509-3A, 509-3B, 510-3A, and 510-3B.

3.3 Using a hand-held meter, perform a two-wire measurement on connector #3 of Positive Lead

Resistance between Pin 1 and pin 2 **(.800)** .700 Ω
Resistance between Pin 1 and pin 3 **(109)** 109.8 Ω
Resistance between Pin 1 and pin 4 **(109)** 109.8 Ω
Resistance between Pin 2 and pin 3 **(109)** 109.8 Ω
Resistance between Pin 2 and pin 4 **(109)** 109.8 Ω
Resistance between Pin 3 and pin 4 **(.800)** .600 Ω

Pins 1-4 resistance to lead **(infinite)** ∞ Ω
Pins 1-4 resistance to ground **(infinite)** ∞ Ω

Resistance between Pin 5 and pin 6 **(.800)** .700 Ω
Resistance between Pin 5 and pin 7 **(109)** 109.7 Ω
Resistance between Pin 5 and pin 8 **(109)** 109.7 Ω
Resistance between Pin 6 and pin 7 **(109)** 109.7 Ω
Resistance between Pin 6 and pin 8 **(109)** 109.7 Ω
Resistance between Pin 7 and pin 8 **(.800)** .600 Ω

Pins 5-8 resistance to lead **(infinite)** ∞ Ω
Pins 5-8 resistance to ground **(infinite)** ∞ Ω

Resistance between Pin 9 and pin 10 **(.800)** .600 Ω
Resistance between Pin 9 and pin 11 **(109)** 109.7 Ω
Resistance between Pin 9 and pin 12 **(109)** 109.7 Ω
Resistance between Pin 10 and pin 11 **(109)** 109.7 Ω
Resistance between Pin 10 and pin 12 **(109)** 109.7 Ω
Resistance between Pin 11 and pin 12 **(.800)** .500 Ω

DFLX ______ DFLX ______

Pins 9-12 resistance to lead **(infinite)** ∞ Ω
Pins 9-12 resistance to ground **(infinite)** ∞ Ω

3.3.2 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:

Resistance of T1 109.207 Ω**(108.5)**(I+ at pin 1,U+ at pin 2,I- at pin 3,U- at pin 4)
Resistance of T2 109.121 Ω**(108.5)** (I+ at pin 5, U+ at pin 6, I- at pin 7, U- at pin 8)
Resistance of T3 109.195 Ω**(108.5)**(I+ at pin 9,U+ at pin 10,I- at pin 11,U- at pin 12)

3.3.3 Two wire measurement on connector 3 of Negative Lead (Fisher DEE104Z086):

Resistance between Pin 1 and pin 2 **(.800)** .700 Ω
Resistance between Pin 1 and pin 3 **(109)** 109.8 Ω
Resistance between Pin 1 and pin 4 **(109)** 109.8 Ω
Resistance between Pin 2 and pin 3 **(109)** 109.8 Ω
Resistance between Pin 2 and pin 4 **(109)** 109.8 Ω
Resistance between Pin 3 and pin 4 **(.800)** .600 Ω

Pins 1-4 resistance to lead **(infinite)** ∞ Ω
Pins 1-4 resistance to ground **(infinite)** ∞ Ω

Resistance between Pin 5 and pin 6 **(.800)** .700 Ω
Resistance between Pin 5 and pin 7 **(109)** 109.8 Ω
Resistance between Pin 5 and pin 8 **(109)** 109.9 Ω
Resistance between Pin 6 and pin 7 **(109)** 109.8 Ω
Resistance between Pin 6 and pin 8 **(109)** 109.8 Ω
Resistance between Pin 7 and pin 8 **(.800)** .700 Ω

Pins 5-8 resistance to lead **(infinite)** ∞ Ω
Pins 5-8 resistance to ground **(infinite)** ∞ Ω

Resistance between Pin 9 and pin 10 **(.800)** .600 Ω
Resistance between Pin 9 and pin 11 **(109)** 109.7 Ω
Resistance between Pin 9 and pin 12 **(109)** 109.7 Ω
Resistance between Pin 10 and pin 11 **(109)** 109.7 Ω
Resistance between Pin 10 and pin 12 **(109)** 109.7 Ω
Resistance between Pin 11 and pin 12 **(.800)** .600 Ω
Pins 9-12 resistance to lead **(infinite)** ∞ Ω
Pins 9-12 resistance to ground **(infinite)** ∞ Ω

3.3.4 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:

Resistance of T1 109.192 Ω(**108.5**)(I+ at pin 1,U+ at pin 2,I- at pin 3,U- at pin 4)
Resistance of T2 109.229 Ω (**108.5**)(I+ at pin 5, U+ at pin 6, I- at pin 7, U- at pin 8)
Resistance of T3 109.160 Ω(**108.5**)(I+ at pin 9,U+ at pin 10,I- at pin 11,U- at pin 12)

3.4 Check remaining RTDs
RTDs in the Dewar
530-3, 531-3, 532-3, 533-3, 534-3, 535-3
Top of leads
507-3A, 507-3B
Connect four-pin N2 shield
594-3
Connect four-pin outlet HE for each lead
513-3, 514-3
Connect cables for three 19-pin top plate connectors
dewar 0, dewar 1, dewar inlet HE te/ll

All of these can be read out on the cryo computer. This cannot be done until Mike T has rebooted the system. Once into the system, you need to switch to a computer on the main network. The command for this is "ssh" (for example, ssh mdtf34). To open the GUI and choose readout values type "numdisp –n mtfvx27&". The selected rtd's should read room temperature that is approximately 295 K. The cables for rtd's in the leads can be connected (511-3,512-3,509-3A, 509-3B, 510-3A, 510-3B) and can be read out on the mtfops computer and should also read approximately 295K. Any problems list in space provided below:

3.5 To check a RTD that is reading bad type the following in a new command window on the cryo computer.

```
rlogin mdtf34
alias disp
disp mtfpc26:0.0
ls
cd setups
cd stand3
ls –1 LHC
numdisp –n mtfvx27 –f LHC02_DVM_TeVoPvx.numdisp_setup&
( or type displayData –n mtfvx27)
```

3.6 Check to see if the resistance measurement of the RTD is just out of range. If so the RTD is OK.

DFLX _____ DFLX _____

9. Room Temperature Electrical Checkout

3.6 Check all three liquid levels probes (12", 30", and 36").
The 12" liquid level is connected to pins 9-12 of "dewar inlet HE te/ll" cable.
Connect 4-pin cable on top plate for 30" probe.

Disconnect J1 at the back of each liquid level meter and do a 4-wire resistance measurement on each probe. The resistance should read about 165 Ω (for 12") and 412 Ω (for 30"). Wires come out to pins 1(red), 7(black), 8(blue), and 6(yellow) on J1 connector. Using a breakout box, measure the resistance of each probe:

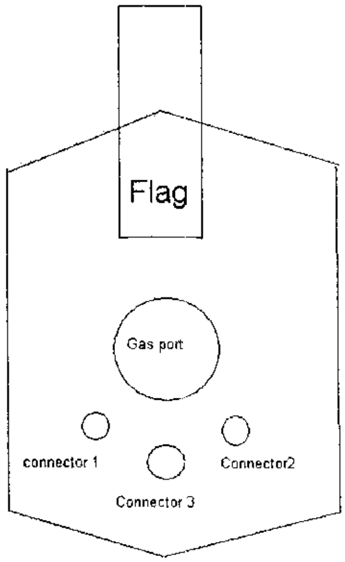
1.1(red) to 8(blue)	should be approx. 5 Ω
2. 8(blue) to 6(yellow)	should be approx. (13.75 X active length of probe) 165 Ω for 12" and 412.5 Ω for 30"
3. 6(yellow) to 7(black)	should be something less than 5 Ω
4. 1(red) to 7(black)	should approximately equal resistance from #2 + #1

4-Wire resistance measurement:
12" Dewar 163.98 30" Dewar 403.52 30" Phase sep. 404.31

	12" Dewar	30"Dewar	30" Phase sep
1.1(red) to 8(blue)	6.5	6.0	5.6
2. 8(blue) to 6(yellow)	166.1	404.1	404.8
3. 6(yellow) to 7(black)	2.6	.7	.6
4. 1(red) to 7(black)	170.7	404.2	410

DFLX ______ DFLX ______

9. Room Temperature Electrical Checkout



Looking from the top of the lead down where the LTS cable is located.
Connector 2= Redundant, Connector 1= Primary and Connector 3= RTD.

NOTE: After checkout is complete, be sure to set up kepco with function generator for +/- 10 amps and then turn off. Cryo techs will turn on when they begin cool down.

Set up function generator for square wave.
You should see current go from +10A to −10A. Frequency should be set at .01 (approx. 100 seconds).

DFLX ______ DFLX ______

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX:
10. Installation of the Top Plate

Lead Pair
Negative Lead: DFLX25
Positive Lead: DFLX26

Signed (CHARLIE HESS + GEORGE KIRSCHBAUM) **Date** 8/4/03

✓ 1. Install all bolts to fasten the top plate to the dewar extension.

✓ 2. Loosen the tensioning rod nuts on the undersides of the lead plates at least 0.5 mm below the lead plate.

✓ 3. Install the transfer lines for maintaining the test dewar liquid level.

✓ 4. Install the transfer lines supplying the 4-20 K circuit.

✓ 5. Install the test dewar flexible vent line.

✓ 6. Install a power lead vent stack on each power lead, keeping in mind the orientation of the vent line.

✓ 7. Connect the vent lines (thermally insulated, non-conductive hoses) to the power lead vent stacks.

✓ 8. Connect the lines labeled "+ LD PDT L" and "- LD PDT L" to the positive and negative lead vent stacks, respectively. These lines connect to the low side of the differential pressure transducers.

✓ 9. Connect the lines labeled "+ LD PDT H" and "- LD PDT H" at the 4-20 K female bayonet vacuum jacket. These lines connect to the high side of the differential pressure transducers.

✓ 10. Connect the power leads' warm gas supply line to the 4-20 K transfer line.

✓ 11. Connect one end of the bypass line at the phase separator and the other end at the vent piping.

Negative Lead DFLX 25 Positive Lead DFLX 26

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX 10.1 Warm Temp Hi-pot In Gasous He Environment	Doc. No. Rev. No. Date: March 5,2003 Page 1 of 1 Author: Dan Eddy

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

.

Performed by Fred L
(Name typed) (Signature)

Date & time 8/4/03

Pos. Power Lead 7500 A DFLX 26 and Neg. Power Lead 7500 A DFLX 25

This hi-pot should be performed after dewar has been filled with gaseous helium. Notify the Cryo Operator before you disconnect cables. When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binders.

1.0 Short all of the temperature sensors together using the special RTD high pot cable. High pot each set of temperature sensor to 300v with respect to the Lead (ground).

Record breakdown voltage (if any) — V.
Record current .01 u A

1.2 Hi-pot the leads in a gaseous He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector to the flag of each lead. **Be sure to disconnect all voltage tap cables on both leads and the power connections from Kepco power supply.**

Record breakdown voltage (if any) — V.
Record current .02 u A.
Record approximate temp. 295 K.
Record approximate test dewar pressure 3 PSIG.

NOTE: After checkout is complete, be sure to set up kepco with function generator for +/- 10 amps and then turn off. Cryo techs will turn on when they begin cool down. Also reconnect Vtaps and RTDs when finished.

Set up function generator for square wave. You should see current go from +10A to –10A. Frequency should be set at .01 (approx. 100 seconds).

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX: 12. Cooldown Checklist

Lead Pair

Negative Lead: DFLX-25

Positive Lead: DFLX-26

Signed (GEORGE KIRSCHBAUM) Date 8/5/03

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date: March 5,2003 Page 1 of 1 Author: Dan Eddy
	13. Cold Temp Hi-pot In HE Environment	

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

.

Performed by Dan W (Name typed) [signature] (Signature)

Date & time 8/5/03

Pos. Power Lead 7500 A DFLX 26 and Neg. Power Lead 7500 A DFLX 25

This hi-pot should be performed after dewar has been filled with liquid helium. Notify the Cryo Operator before you disconnect cables. When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binders.

1.1 Short all of the temperature sensors together using the special RTD high pot cable. High pot each set of temperature sensor to 300v with respect to the Lead (ground).

Record breakdown voltage (if any) — V.
Record current .01 μ A
* NEG LEAD RTD FAILED

1.2 Hi-pot the leads in a cold (4.5K) He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector to the flag of each lead. **Be sure to disconnect the redundant voltage taps on both leads and the power connections from Kepco power supply.**

Record breakdown voltage (if any) — V.
Record current .3 μ A.
Record approximate temp. 4.2K K.
Record approximate test dewar pressure 3 PSIG.

NOTE: Reconnect Vtaps and RTDs when finished.

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX: 14. Connect the Leads to the Power Supply & Configure

Lead Pair

Negative Lead: DFLX25

Positive Lead: DFLX26

Signed Roger Rabehl Date 8/5/03

1. **Power Supply Changes**

✓ 1.1 On the FIX32 HMTF Power Interlock screen, switch the selector switch to the Stand 3 position.

✓ 1.2 Switch warning lights to the "Stand 3" position.

✓ 1.3 Adjust the power supply time constant by setting the resistance to 500 $\mu\Omega$.

✓ 1.4 Adjust the power supply time constant by setting the inductance to 0.5 mH.

✓ 1.5 Adjust the dump resistance to 30 mΩ.

2. **Bus Connection Changes – Stand 3 Side**

✓ 2.1 Perform MTF-ELEC-07 (VMTF/ST4/ST3) LOTO procedure for all handling of flexible bus work.

✓ 2.2 Mate the Stand 3 hard bus with the Stand 4 flexible bus on the Stand 4 platform. Verify the polarity is correct.

✓ 2.3 Disconnect trim current supply leads.

✓ 2.4 Connect the flex leads and chill blocks to the power lead flags. Apply Penetrox E conductive grease to the cooling block-lead flag joint.

✓ 2.5 Attach voltage taps VFF-A and VFF-B at the negative and positive flex lead flags, respectively, and voltage VLF-A and VLF-B at the negative and positive power lead flags, respectively. These taps will allow the voltage drop across the flex lead/chill block joint and chill block/power lead joint to be measured.

✓ 2.6 Using glass tape, attach the Kapton-wrapped platinum temperature sensors TE515-3 and TE516-3 to the positive and negative lead flags, respectively.

✓ 2.7 Wrap the power lead flags with rubber insulation for personnel safety.

✓ 2.8 Install the plexiglass enclosure around the power leads for personnel safety.

3. **Bus Connection Changes – VMTF End**

✓ 3.1 Remove the short VMTF flex leads from the 30 kA bus work.

✓ **3.2** Install flex leads from the Stand 4 bus to the 30 kA bus work.

✓ **3.3** Wrap all exposed bus with rubber insulation for personnel safety.

✓ **3.4** Place the VMTF ground switch in the "off" position.

✓ **3.5** Place the Stand 4 ground switch in the "on" position.

✓ **3.6** Place the Stand 3/VMTF ground switch on the ETS panel in the Stand 3 (up) position and press the Master Reset.

✓ **3.7** Remove the power control cable, which contains QLM, PLC, etc. signals, from the VMTF "j" plug and insert into the Stand 4 "j" plug.

Negative lead DFLX ______________ Positive lead DFLX ______________

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:April 2, 2003 Page 1 of 2 Author: Sandor Feher
	16. Cold test of the power leads	

Performed by ROGER RABEHL (name typed) Roger Rabehl (signature)

Date & time AUGUST 5, 2003 1115

Power Lead 7500 A DFLX ~~33~~ 25 & 7500 A DFLX ~~34~~ 26

16.0 Set the DAQ system ScribeLeads and ScribeFix32 Data Logging Intervals to capture data every ~~10~~ 5 seconds.

16.1. Establish cryogenic parameters for normal high current operating conditions.
Set the liquid level at 6in location using the 1 foot LL probe ✓
Set the copper section inlet cooling gas temperature to 15-20K range ✓
Set the LHe vapor cooling control loop in automatic mode to keep the upper HTS terminal temperature at 45 K for ½ hour ✓
Set the upper HTS temperature to 50 K and keep it there for ½ hour ✓

16.1.1 Set software quench detection thresholds by executing:

✓ /usr/vmtf/sh/lhc_setquenchthreshold_run.sh

16.2 Stair step profile test.
Turn on the Power Supply. Set HTS terminal temperature to 50K and apply current profile 1 ✓
Monitor voltages and make sure that the data is recorded.
Run data analysis tool on the obtained data file to determine joint resistances.

7500 A DFLX 25 (NEG. LEAD) R(joint1) = 0.000030 V / 7500 A = 4.0 nΩ (V2 - V3)
R(joint2) = 0.0000027 V / 7500 A = 3.6 nΩ (V3 - V4)

7500 A DFLX 26 (POS. LEAD) R(joint1) = 0.000034 V / 7500 A = 4.5 nΩ (V2 - V3)
R(joint2) = 0.0000028 V / 7500 A = 3.7 nΩ (V3 - V4)

16.3 Coolant loss test.
Apply 7500 A and

a) Close the coolant flow for 7500 A DFLX 25 (NEG LEAD)
Wait until QD detects the quench and record
T1 = 79 K ; T2 = 308 K; V12 = -0.100 V ; V23 = -0.00102 V ; V~~24~~34 = 0.00024 V

b) Re-establish operating conditions

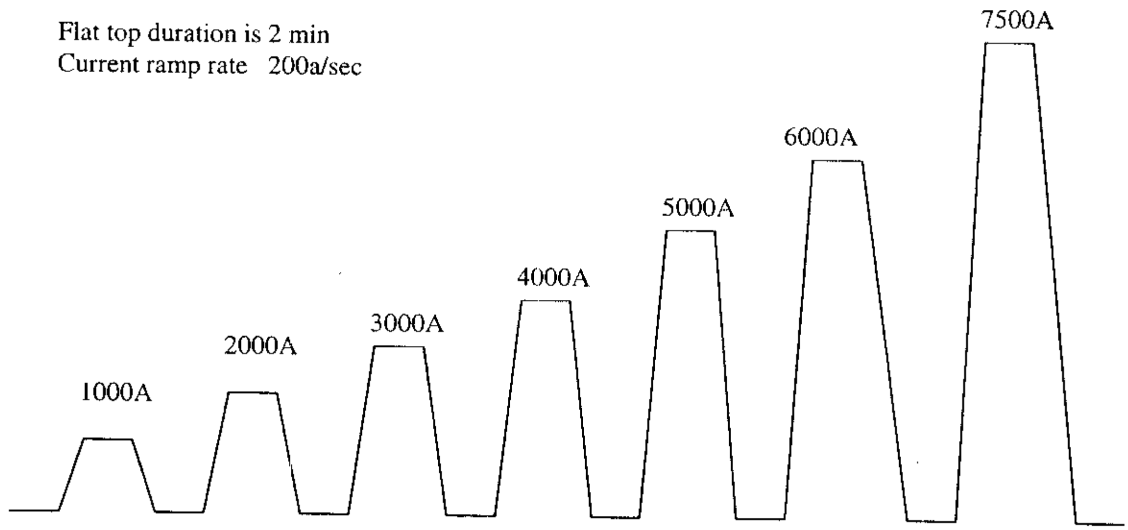
c) Close the coolant flow for 7500 A DFLX 26 (POS LEAD)
Wait until QD detects the quench and record
T1 = 75 K ; T2 = 294 K; V12 = 0.0961 V ; V23 = 0.000819 V ; V~~24~~34 = 0.00035 V

16.4 Set the upper HTS terminal temperature to 45 K and apply 7500 A apply current profile 2. Set HTS terminal temp to 50 K and apply current profile 2.

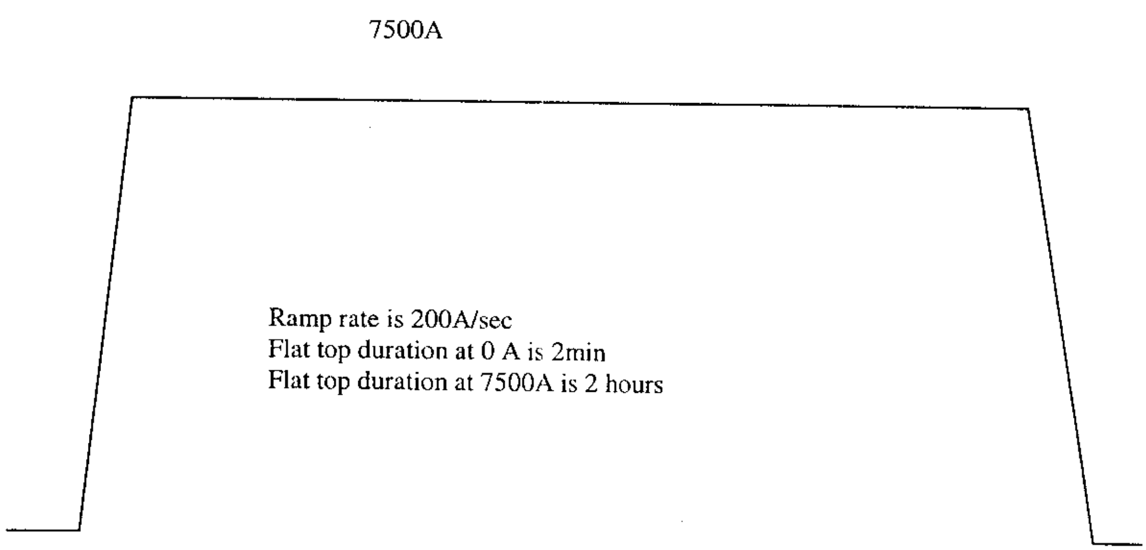
16.5 When test is completed, set the ScribeLeads and ScribeFix32 Data Logging Intervals to 300 seconds.

Note: If any irregularity occur call Sandor.

Profile 1:



Profile 2:



FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:April 2, 2003 Page 1 of 2 Author: Sandor Feher
	16. Cold test of the power leads	

Performed by ROGER RABEHL (name typed) Roger Rabehl (signature)

Date & time AUGUST 6, 2003

Power Lead 7500 A DFLX 25 & 7500 A DFLX 26

✓16.0 Set the DAQ system ScribeLeads and ScribeFix32 Data Logging Intervals to capture data every ~~10~~ 5 seconds.

16.1. Establish cryogenic parameters for normal high current operating conditions.
Set the liquid level at 6in location using the 1 foot LL probe ✓
Set the copper section inlet cooling gas temperature to 15-20K range ✓
Set the LHe vapor cooling control loop in automatic mode to keep the upper HTS terminal temperature at 45 K for ½ hour ✓
Set the upper HTS temperature to 50 K and keep it there for ½ hour ✓

16.1.1 Set software quench detection thresholds by executing:
✓ /usr/vmtf/sh/~~the Int~~ lhchts_setquenchthreshold_run.sh

16.2 Stair step profile test.
Turn on the Power Supply. Set HTS terminal temperature to 50K and apply current profile 1 ✓
Monitor voltages and make sure that the data is recorded.
Run data analysis tool on the obtained data file to determine joint resistances.

7500 A DFLX 25 (NEG. LEAD) R(joint1) = 0.000302 V / 7500 A = 40 nΩ (V2-V3)
R(joint2) = 0.0000027 V / 7500 A = 3.6 nΩ (V3-V4)

7500 A DFLX 26 (POS. LEAD) R(joint1) = 0.000286 V / 7500 A = 38 nΩ (V2-V3)
R(joint2) = 0.0000028 V / 7500 A = 3.7 nΩ (V3-V4)

16.3 Coolant loss test.
Apply 7500 A and
a) Close the coolant flow for 7500 A DFLX 25 (NEG LEAD) TRIPPED ON V1-V2 > 1 mV
Wait until QD detects the quench and record
T1 = 80 K ; T2 = 307 K ; V12 = -0.101 V ; V23 = -0.000849 V ; V~~24~~34 = 0.000233 V ;

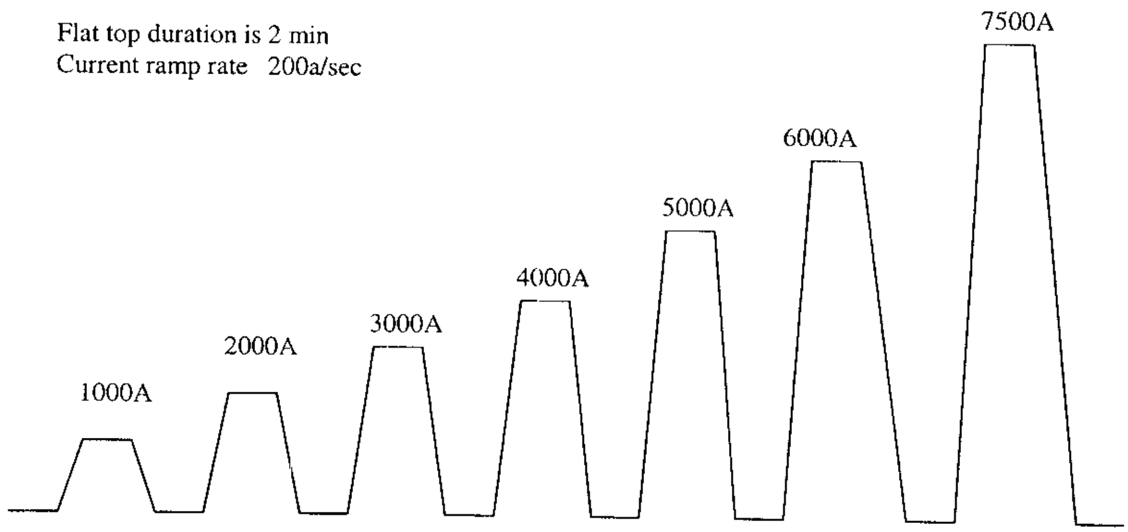
b) Re-establish operating conditions
c) Close the coolant flow for 7500 A DFLX 26 (POS LEAD) ** TRIPPED ON V2-V4 > 1 mV **
Wait until QD detects the quench and record
T1 = 80 K ; T2 = 267 K ; V12 = 0.0884 V ; V23 = 0.000851 V ; V~~24~~34 = 0.000344 V ;

16.4 Set the upper HTS terminal temperature to 45 K and apply 7500 A apply current profile 2. Set HTS terminal temp to 50 K and apply current profile 2.

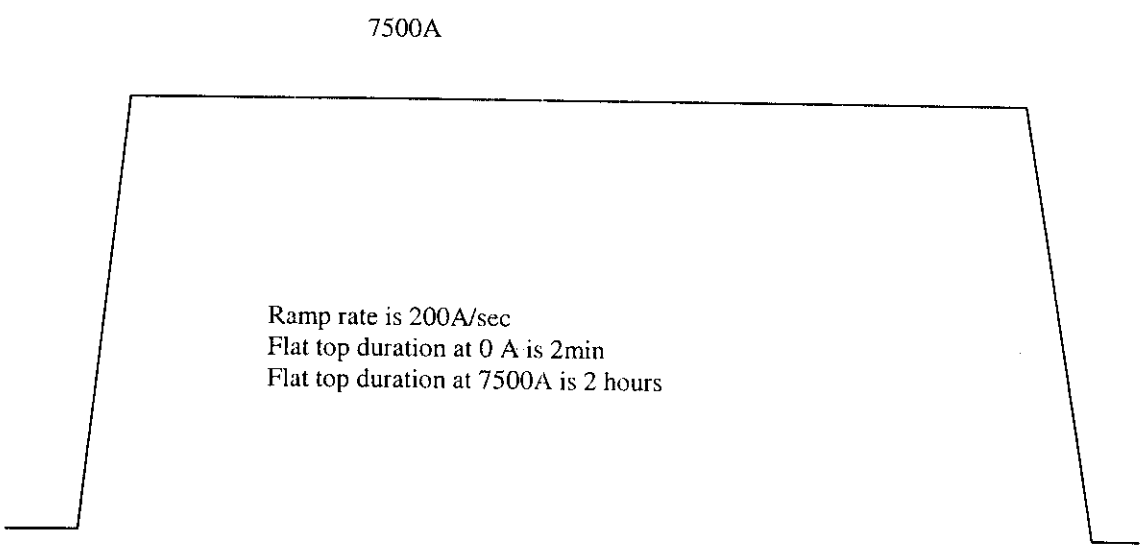
16.5 When test is completed, set the ScribeLeads and ScribeFix32 Data Logging Intervals to 300 seconds.

Note: If any irregularity occur call Sandor.

Profile 1:



Profile 2:



FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date: March 5,2003 Page 1 of 1 Author: Dan Eddy
	20. Warm Temp Hi-pot In Gasous He Environment	

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

Performed by DAN EDDY (Name typed) Dan Eddy (Signature)

Date & time 8/7/03

Pos. Power Lead 7500 A DFLX 24 and Neg. Power Lead 7500 A DFLX 25

This hi-pot should be performed after dewar has been filled with gaseous helium after the second test cycle has been completed and the dewar is at room temperature. When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binders.

1.1 Short all of the temperature sensors together using the special RTD high pot cable. High pot each set of temperature sensor to 300v with respect to the Lead (ground).

Record breakdown voltage (if any) — V.
Record current .03 uA A

1.2 Hi-pot the leads in a cold (4.5K) He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector to the flag of each lead. **Be sure to disconnect the redundant voltage taps on both leads and the power connections from Kepco power supply.**

Record breakdown voltage (if any) — V.
Record current .2uA A.
Record approximate temp. 295 K.
Record approximate test dewar pressure 16.9 ~~PSIG~~ PSIA

NOTE: Reconnect Vtaps and RTDs when finished.

FERMILAB
Technical Division

Stand 3 LHC-HTS Lead Testing:
23. Pack and Ship the Leads

Lead Pair

Negative Lead: DFLX-25

Positive Lead: DFLX-26

Signed [signature] 12328 Date 8-14-03

1. **Pack the Leads**

1.1 With the lead on the steel table, swing the insertion/lifting tool 180° so that the lead can be picked up and remain horizontal as shown in Figure 1.1.

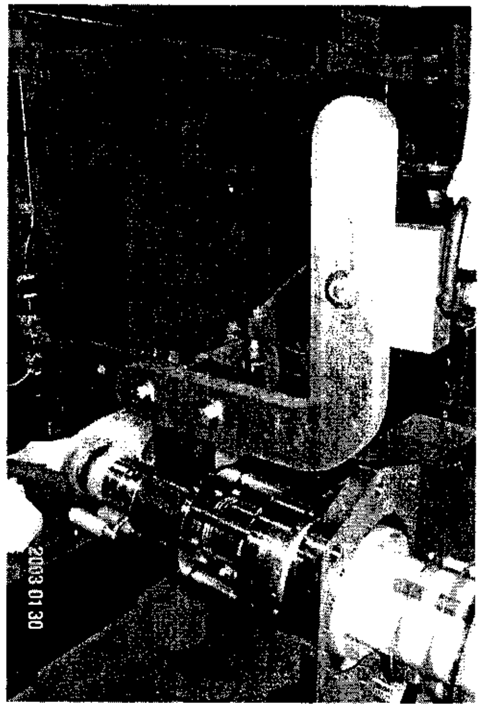


Figure 1.1 Orientation of the insertion/lifting tool to allow the power lead to be held horizontally.

1.2 Lift the power lead off of the steel table.

1.3 While supporting the lead from the crane, remove the end support clamped around the lower flange of the power lead.

1.4 Complete the lead preparation checklist:

X ✓ **a)** Install the protective covers for the lead top plate knife edge sealing surface and for the lower flange sealing surface on each lead. Secure them with tape.

X ✓ **b)** Insert a protective plastic cap into the 4-20 K gas port for each lead.

X ✓ **c)** Reattach the g-force indicators that were attached to the leads when they arrived.

X ✓ **d)** Wrap the ceramic insulator at the top of each lead in bubble wrap.

X ✓ **e)** Place a cap on the Conflat flange at the top of each lead.

Negative Lead DFLX 25 Positive Lead DFLX 26

X ✓ f) Wrap the power lead vacuum pumpout in aluminum foil.

X ✓ g) Secure the power lead bus and voltage tap wires to the power lead lower G-10 section with tape.

X ✓ h) Set each lead in the shipping crate and remove the insertion/lifting tool.

1.5 Complete the packing checklist:

X a) Reinstall the wooden supports in the crate to hold the lead in place during shipping.

✓ b) Make two photocopies of all documents in the lead travelers, and place the power lead travelers in the shipping crate. One copy of the documents is for Sandor, the second copy is for Marsha Schmidt.

✓ c) Verify the following items are in the shipping crate:

✓ i) Two flag heaters

✓ ii) Two flag heater connectors

✓ iii) Vacuum pumpout actuator

✓ iv) NW16 clamp

✓ v) NW16 o-ring

1.6 Close the shipping crate

2. Ship the Leads

2.1 Complete the shipping checklist:

✓ a) Call Marsha Schmidt (X-4377) to request that the power leads be shipped to storage.