DFLX - 38

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. 1 Date: August 18, 2003 Page 1 of 1 Author: Sandor Feher
	0. Cover Sheet for Check Out Form	

Power leads being tested: 7500 A DFLX 37 7500 A DFLX 38

Task #	Responsible	Task	Received Date,time		Performed Date,time	
1	Inspection	Unpack the leads			072403	
2	Inspection	IB4 mech. & Tolerances			072403	
3	Mechanical	Move the leads to MTF				
4	Electrical	Initial electrical check out			073103	
4a	Mechanical	Preliminary leak check			110303	
5	Mechanical	Installation of the current leads			110303	
6	Mechanical	Pressure test			110403	
7	Mechanical	Leak check			110503	
7a	Mechanical	Top plate insertion into the dewar			110703	
8	M. Tartaglia	Configuration of the DAQ system				
9	Electrical	Room temp. electrical test			111003	
10	Mechanical	Installation of the top plate			112003	
10.1	Electrical	Room temp. GHe hipot			112003	
12	Mechanical	Cool down			112503	
13	Electrical	Electrical & instrumentation test			112503	
14	Mechanical	Connect the leads to the Power Supply & configure			120803	
15	Electrical	Electrical & instrumentation test				
16	M. Thompson	Cold test of the power lead			120803	
17	Mechanical	Perform a Thermal cycle				
18	M. Thompson	Cold test of the power lead				
19	Mechanical	Warm up				
20	Electrical	Electrical & instrumentation test			121003	
21	Mechanical	Remove the top plate			121003	
22	Mechanical	Remove the leads from the top plate			121003	
23	Mechanical	Pack and move the leads			121803	

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 7/24/03 2:30PM

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 37 7500 A DFLX 38
(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: ______
Not tripped ☑ Tripped (Black) ☐ Remark: ______

1.4 Container content:
a. Power leads: 7500 A DFLX 37 ; 7500 A DFLX 38
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" ☒ MISSING.
3. One O-ring seal with brass insert ☒ MISSING

(+) UNIDENTIFIED PARTS.

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

7500 A OFLX 37

MM	DIM CYL -A-DIA= LOCATION OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	99.000	0.200	0.200	99.078	0.078	0.000

MM	DIM -A-= ROUNDNESS OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.200	0.000	0.038	0.038	0.000

MM	DIM -B-= FLATNESS OF PLANE PLN -B-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.050	0.000	0.010	0.010	0.000

MM	DIM PERP1= PERPEND OF PLANE PLN -B- TO CYLINDER CYL -A- EXTEND=0.000					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.400	0.000	0.109	0.109	0.000

MM	DIM PERP2= PERPEND OF PLANE LRG FLANGE TO CYLINDER CYL -A- EXTEND=560.000					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.400	0.000	0.046	0.046	0.000

MM	DIM -C- DIA= LOCATION OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	80.000	0.200	0.200	80.047	0.047	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	1.604	1.604	0.604

MM	DIM RND2= ROUNDNESS OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.200	0.000	0.096	0.096	0.000

MM	DIM DIST1= 2D DISTANCE FROM PLANE PLN -B- TO PLANE LRG FLANGE PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	561.000	1.000	1.000	561.207	0.207	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				123.574	0.003	
DF	18.000	0.200	0.200		17.982	-0.018	0.000
TP	RFS	0.130		0.000		0.007	0.000

MM	DIM LOC10= TRUE POSITION OF CIRCLE CIR3						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	-78.890				-78.970	-0.080	
Z	95.047				95.097	0.050	
DF	18.000	0.200	0.200		17.984	-0.016	0.000
TP	RFS	0.130		0.000		0.189	0.059

MM	DIM LOC11= TRUE POSITION OF CIRCLE CIR4						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	78.890				78.926	0.036	
Z	95.047				95.025	-0.022	
DF	18.000	0.200	0.200		17.985	-0.015	0.000
TP	RFS	0.130		0.000		0.084	0.000

MM	DIM LOC12= TRUE POSITION OF CIRCLE CIR5						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	78.890				78.877	-0.013	
Z	-95.047				-95.060	-0.013	
DF	18.000	0.200	0.200		17.985	-0.015	0.000
TP	RFS	0.130		0.000		0.036	0.000

MM	DIM 18.00 DIA HOLE= TRUE POSITION OF CIRCLE CIR6						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	-78.890				-79.028	-0.138	
Z	-95.047				-95.005	0.042	
DF	18.000	0.200	0.200		17.953	-0.047	0.000
TP	RFS	0.130		0.000		0.289	0.159

MM	DIM 8.433 DIA HOLE #1= TRUE POSITION OF CIRCLE SH1						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.604	0.054	
PA	-153.000				-153.070	-0.070	
DF	8.433	0.200	0.000	0.149	8.582	0.149	0.000
TP	MMC	0.080		0.149		0.247	0.018

MM	DIM 8.433 DIA HOLE #2= TRUE POSITION OF CIRCLE SH2						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.624	0.074	
PA	-171.000				-171.051	-0.051	
DF	8.443	0.200	0.000	0.121	8.564	0.121	0.000
TP	MMC	0.080		0.121		0.219	0.017

MM	DIM 8.433 DIA HOLE #3= TRUE POSITION OF CIRCLE SH3						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.470	-0.080	
PA	-135.000				-135.071	-0.071	
DF	8.433	0.200	0.000	0.166	8.599	0.166	0.000
TP	MMC	0.080		0.166		0.275	0.029

MM	DIM 8.433 DIA HOLE #4= TRUE POSITION OF CIRCLE SH4						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.648	0.098	
PA	171.000				170.999	-0.001	
DF	8.433	0.200	0.000	0.136	8.569	0.136	0.000
TP	MMC	0.080		0.136		0.196	0.000

MM	DIM 8.433 DIA HOLE #5= TRUE POSITION OF CIRCLE SH5						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.628	0.078	
PA	153.000				153.003	0.003	
DF	8.433	0.200	0.000	0.163	8.596	0.163	0.000
TP	MMC	0.080		0.163		0.157	0.000

MM	DIM 8.433 DIA HOLE #6= TRUE POSITION OF CIRCLE SH6						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.682	0.132	
PA	135.000				135.006	0.006	
DF	8.433	0.200	0.000	0.120	8.553	0.120	0.000
TP	MMC	0.080		0.120		0.265	0.065

MM	DIM 8.433 DIA HOLE #7= TRUE POSITION OF CIRCLE SH7						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.586	0.036	
PA	117.000				117.028	0.028	
DF	8.433	0.200	0.000	0.139	8.572	0.139	0.000
TP	MMC	0.080		0.139		0.115	0.000

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.534	-0.016	
PA	99.000				99.041	0.041	
DF	8.433	0.200	0.000	0.138	8.571	0.138	0.000
TP	MMC	0.080		0.138		0.133	0.000

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.557	0.007	
PA	81.000				81.036	0.036	
DF	8.433	0.200	0.000	0.130	8.563	0.130	0.000
TP	MMC	0.080		0.130		0.113	0.000

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.478	-0.072	
PA	63.000				63.024	0.024	
DF	8.433	0.200	0.000	0.138	8.571	0.138	0.000
TP	MMC	0.080		0.138		0.162	0.000

MM | DIM 8.433 DIA HOLE #11= TRUE POSITION OF CIRCLE SH11

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.498	-0.052	
PA	45.000				45.028	0.028	
DF	8.433	0.200	0.000	0.127	8.560	0.127	0.000
TP	MMC	0.080		0.127		0.137	0.000

MM | DIM 8.433 DIA HOLE #12= TRUE POSITION OF CIRCLE SH12

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.480	-0.070	
PA	27.000				27.006	0.006	
DF	8.433	0.200	0.000	0.133	8.566	0.133	0.000
TP	MMC	0.080		0.133		0.142	0.000

MM | DIM 8.433 DIA HOLE #13= TRUE POSITION OF CIRCLE SH13

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.504	-0.046	
PA	9.000				9.022	0.022	
DF	8.433	0.200	0.000		8.564	0.131	0.000
TP	RFS	0.080		0.000		0.116	0.036

MM | DIM 8.433 DIA HOLE #14= TRUE POSITION OF CIRCLE SH14

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.439	-0.111	
PA	-9.000				-8.978	0.022	
DF	8.433	0.200	0.000	0.114	8.547	0.114	0.000
TP	MMC	0.080		0.114		0.232	0.038

MM | DIM 8.433 DIA HOLE #15= TRUE POSITION OF CIRCLE SH15

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.434	-0.116	
PA	-27.000				-26.999	0.001	
DF	8.433	0.200	0.000	0.123	8.556	0.123	0.000
TP	MMC	0.080		0.123		0.233	0.030

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	1453.137	3.137	2.737

MM | DIM 130.0DIA= LOCATION OF CIRCLE OD1

AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	130.000	0.200	0.200	130.005	0.005	0.000

MM	DIM 502 COOLING HOLE= 2D DISTANCE FROM CIRCLE ID15 TO PLANE LRG FLANGE PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	502.000	0.400	0.400	501.113	-0.887	0.487

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	-4.726	-4.726	2.926

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	-1.053	-1.053	0.953

IN	DIM X LOC OF WARM TERM= LOCATION OF PLANE MID PLN					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.000	0.100	0.100	-0.057	-0.057	0.000

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	95.141	5.141	3.141

MM	DIM 442.5= 2D DISTANCE FROM LINE FRT END TO PLANE PLN -B- PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	442.500	1.500	1.500	445.973	3.473	1.973

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

7500 A DFLX 38

MM	DIM CYL -A-DIA= LOCATION OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	99.0000	0.2000	0.2000	99.1285	0.1285	0.0000

MM	DIM -A-= ROUNDNESS OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.0000	0.2000	0.0000	0.0616	0.0616	0.0000

MM	DIM -B-= FLATNESS OF PLANE PLN -B-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.0000	0.0500	0.0000	0.0074	0.0074	0.0000

MM	DIM PERP1= PERPEND OF PLANE PLN -B- TO CYLINDER CYL -A- EXTEND=0.0000					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.0000	0.4000	0.0000	0.0305	0.0305	0.0000

MM	DIM PERP2= PERPEND OF PLANE LRG FLANGE TO CYLINDER CYL -A- EXTEND=560.0000					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.0000	0.4000	0.0000	0.4339	0.4339	0.0339

MM	DIM -C- DIA= LOCATION OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	80.0000	0.2000	0.2000	79.9056	-0.0944	0.0000

MM	DIM CONCEN2=CONCENTRICITY FROM CYLINDER -C- TO CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.0000	1.0000	0.0000	1.1590	1.1590	0.1590

MM	DIM RND2= ROUNDNESS OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.0000	0.2000	0.0000	0.0421	0.0421	0.0000

MM	DIM DIST1= 2D DISTANCE FROM PLANE PLN -B- TO PLANE LRG FLANGE PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	561.0000	1.0000	1.0000	561.4550	0.4550	0.0000

MM	DIM LOC5= TRUE POSITION OF CIRCLE CIR2						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	0.0000				0.0000	0.0000	
Z	123.5710				123.7823	0.2113	
DF	18.0000	0.2000	0.2000		17.9763	-0.0237	0.0000
TP	RFS	0.1300		0.0000		0.4225	0.2925

MM	DIM LOC10= TRUE POSITION OF CIRCLE CIR3						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	-78.8897				-78.9519	-0.0622	
Z	95.0470				95.2955	0.2485	
DF	18.0000	0.2000	0.2000		17.9749	-0.0251	0.0000
TP	RFS	0.1300		0.0000		0.5124	0.3824

MM	DIM LOC11= TRUE POSITION OF CIRCLE CIR4						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	78.8903				78.9364	0.0461	
Z	95.0470				95.2562	0.2092	
DF	18.0000	0.2000	0.2000		17.9764	-0.0236	0.0000
TP	RFS	0.1300		0.0000		0.4285	0.2985

MM | DIM LOC12= TRUE POSITION OF CIRCLE CIR5

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	78.8900				78.8764	-0.0136	
Z	-95.0470				-94.8290	0.2180	
DF	18.0000	0.2000	0.2000		17.9425	-0.0575	0.0000
TP	RFS	0.1300		0.0000		0.4369	0.3069

MM | DIM 18.00 DIA HOLE= TRUE POSITION OF CIRCLE CIR6

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	-78.8900				-78.9920	-0.1020	
Z	-95.0470				-94.7657	0.2813	
DF	18.0000	0.2000	0.2000		17.9301	-0.0699	0.0000
TP	RFS	0.1300		0.0000		0.5984	0.4684

MM | DIM 8.433 DIA HOLE #1= TRUE POSITION OF CIRCLE SH1

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.3892	-0.1608	
PA	-153.0000				-153.1598	-0.1598	
DF	8.4330	0.2000	0.0000	0.2000	8.7592	0.3262	0.1262
TP	MMC	0.0800		0.2000		0.5983	0.3183

MM | DIM 8.433 DIA HOLE #2= TRUE POSITION OF CIRCLE SH2

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.4808	-0.0692	
PA	-171.0000				-171.1563	-0.1563	
DF	8.4430	0.2000	0.0000	0.2000	8.7713	0.3283	0.1283
TP	MMC	0.0800		0.2000		0.5128	0.2328

MM | DIM 8.433 DIA HOLE #3= TRUE POSITION OF CIRCLE SH3

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.3352	-0.2148	
PA	-135.0000				-135.1318	-0.1318	
DF	8.4330	0.2000	0.0000	0.2000	8.7846	0.3516	0.1516
TP	MMC	0.0800		0.2000		0.5982	0.3182

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.5427	-0.0073	
PA	171.0000				170.8341	-0.1659	
DF	8.4330	0.2000	0.0000	0.2000	8.7784	0.3454	0.1454
TP	MMC	0.0800		0.2000		0.5246	0.2446

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.6498	0.0998	
PA	153.0000				152.8169	-0.1831	
DF	8.4330	0.2000	0.0000	0.2000	8.7705	0.3375	0.1375
TP	MMC	0.0800		0.2000		0.6126	0.3326

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.6823	0.1323	
PA	135.0000				134.8753	-0.1247	
DF	8.4330	0.2000	0.0000	0.2000	8.7710	0.3380	0.1380
TP	MMC	0.0800		0.2000		0.4749	0.1949

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

AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.7393	0.1893	
PA	117.0000				116.8757	-0.1243	
DF	8.4330	0.2000	0.0000	0.2000	8.7636	0.3306	0.1306
TP	MMC	0.0800		0.2000		0.5459	0.2659

MM	DIM 8.433 DIA HOLE #8= TRUE POSITION OF CIRCLE SH8						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.7998	0.2498	
PA	99.0000				98.9460	-0.0540	
DF	8.4330	0.2000	0.0000	0.2000	8.7342	0.3012	0.1012
TP	MMC	0.0800		0.2000		0.5280	0.2480

MM	DIM 8.433 DIA HOLE #9= TRUE POSITION OF CIRCLE SH9						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.6778	0.1278	
PA	81.0000				81.0196	0.0196	
DF	8.4330	0.2000	0.0000	0.1890	8.6220	0.1890	0.0000
TP	MMC	0.0800		0.1890		0.2631	0.0000

MM	DIM 8.433 DIA HOLE #10= TRUE POSITION OF CIRCLE SH10						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.6651	0.1151	
PA	63.0000				63.0016	0.0016	
DF	8.4330	0.2000	0.0000	0.1960	8.6290	0.1960	0.0000
TP	MMC	0.0800		0.1960		0.2303	0.0000

MM	DIM 8.433 DIA HOLE #11= TRUE POSITION OF CIRCLE SH11						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.6433	0.0933	
PA	45.0000				45.0582	0.0582	
DF	8.4330	0.2000	0.0000	0.1923	8.6253	0.1923	0.0000
TP	MMC	0.0800		0.1923		0.2621	0.0000

MM	DIM 8.433 DIA HOLE #12= TRUE POSITION OF CIRCLE SH12						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.6306	0.0806	
PA	27.0000				27.0880	0.0880	
DF	8.4330	0.2000	0.0000	0.2000	8.6443	0.2113	0.0113
TP	MMC	0.0800		0.2000		0.3217	0.0417

MM	DIM 8.433 DIA HOLE #13= TRUE POSITION OF CIRCLE SH13						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.5665	0.0165	
PA	9.0000				9.0822	0.0822	
DF	8.4330	0.2000	0.0000		8.6363	0.2033	0.0033
TP	RFS	0.0800		0.0000		0.2618	0.1818

MM	DIM 8.433 DIA HOLE #14= TRUE POSITION OF CIRCLE SH14						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.5077	-0.0423	
PA	-9.0000				-8.8518	0.1482	
DF	8.4330	0.2000	0.0000	0.2000	8.7737	0.3407	0.1407
TP	MMC	0.0800		0.2000		0.4758	0.1958

MM	DIM 8.433 DIA HOLE #15= TRUE POSITION OF CIRCLE SH15						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.5500				90.4340	-0.1160	
PA	-27.0000				-26.8454	0.1546	
DF	8.4330	0.2000	0.0000	0.2000	8.7759	0.3429	0.1429
TP	MMC	0.0800		0.2000		0.5407	0.2607

MM	DIM 1450= 2D DISTANCE FROM LINE FRT END TO LINE LIN2 PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	1450.0000	0.4000	0.4000	1452.1221	2.1221	1.7221

MM	DIM 130.0DIA= LOCATION OF CIRCLE OD1					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	130.0000	0.2000	0.2000	129.9433	-0.0567	0.0000

PART NUMBER=7.5 KA CURRENT LEAD ASSY (LBNL01) DATE=7/25/2003 TIME=4:40:24 PM PAGE#=4

MM	DIM 502 COOLING HOLE= 2D DISTANCE FROM CIRCLE ID15 TO PLANE LRG FLANGE PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	502.0000	0.4000	0.4000	502.1280	0.1280	0.0000

MM	DIM X LOC OF COOLING HOLE= LOCATION OF CIRCLE ID15					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.0000	1.8000	1.8000	1.2694	1.2694	0.0000

DEG	DIM WARM TERMINAL= 3D ANGLE (TRUE) FROM PLANE PLN2 TO ZAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
A	0.0000	0.1000	0.1000	1.9229	1.9229	1.8229

MM	DIM X LOC OF WARM TERM= LOCATION OF PLANE MID PLN					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.0000	2.5400	2.5400	5.0019	5.0019	2.4619

MM	DIM POLAR ANGLE OF COOLING HOLE= LOCATION OF CIRCLE ID15					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
PA	90.0000	2.0000	2.0000	88.6307	-1.3693	0.0000

MM	DIM 442.5= 2D DISTANCE FROM LINE FRT END TO PLANE PLN -B- PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	442.5000	1.5000	1.5000	444.1921	1.6921	0.1921

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	4. Initial 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 EDDY (name typed) Dan Eddy (signature)

Date & time 7/31/03 PAIR 37 3 38

Power Lead 7500 A DFLX 38

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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)	87 V	Pin 2 - pin 3 (225uv)	262 V
Pin 1 - pin 3 (300uv)	348 V	Pin 3 - pin 4 (240uv)	292 V
Pin 1 - pin 4 (530uv)	638 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)	89 V	Pin 2 - pin 3 (225uv)	263 V
Pin 1 - pin 3 (300uv)	354 V	Pin 3 - pin 4 (240uv)	278 V
Pin 1 - pin 4 (530uv)	632 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	1.13	Ω
Resistance between Pin 1 and pin 3	109.72	Ω
Resistance between Pin 1 and pin 4	109.73	Ω
Resistance between Pin 2 and pin 3	109.74	Ω

4. Initial Electrical Checkout

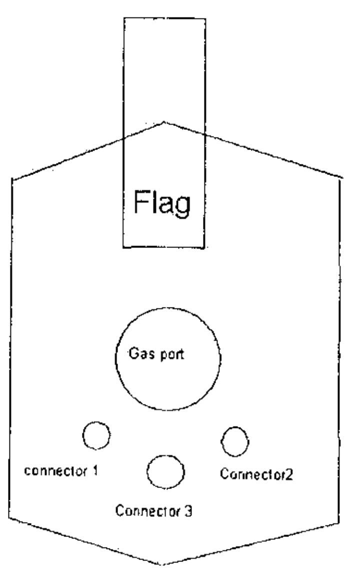
Resistance between Pin 2 and pin 4 109.75 Ω
Resistance between Pin 3 and pin 4 1.09 Ω
Pins 1-4 resistance to lead ∞ Ω Pins 1-4 resistance to flange ∞ Ω

Resistance between Pin 5 and pin 6 1.09 Ω
Resistance between Pin 5 and pin 7 109.83 Ω
Resistance between Pin 5 and pin 8 109.82 Ω
Resistance between Pin 6 and pin 7 109.86 Ω
Resistance between Pin 6 and pin 8 109.85 Ω
Resistance between Pin 7 and pin 8 1.10 Ω
Pins 5-8 resistance to lead ∞ Ω Pins 5-8 resistance to flange ∞ Ω

Resistance between Pin 9 and pin 10 .986 Ω
Resistance between Pin 9 and pin 11 109.70 Ω
Resistance between Pin 9 and pin 12 109.67 Ω
Resistance between Pin 10 and pin 11 109.73 Ω
Resistance between Pin 10 and pin 12 109.71 Ω
Resistance between Pin 11 and pin 12 1.02 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 108.63 Ω (I+ at pin 1, I- at pin 2, U+ at pin 3, U- at pin 4)
Resistance of T2 108.74 Ω (I+ at pin 5, I- at pin 6, U+ at pin 7, U- at pin 8)
Resistance of T3 108.69 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

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	4. Initial 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 EDDY (name typed) [signature] (signature)

Date & time 7/31/03 PAIR 37 ; 38

Power Lead 7500 A DFLX 37

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) 89 V	Pin 2 - pin 3	(225uv) 265 V
Pin 1 - pin 3	(300uv) 356 V	Pin 3 - pin 4	(240uv) 286 V
Pin 1 - pin 4	(530uv) 643 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) 87 V	Pin 2 - pin 3	(225uv) 255 V
Pin 1 - pin 3	(300uv) 344 V	Pin 3 - pin 4	(240uv) 288 V
Pin 1 - pin 4	(530uv) 633 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 1.16 Ω
Resistance between Pin 1 and pin 3 109.77 Ω
Resistance between Pin 1 and pin 4 109.75 Ω
Resistance between Pin 2 and pin 3 109.77 Ω

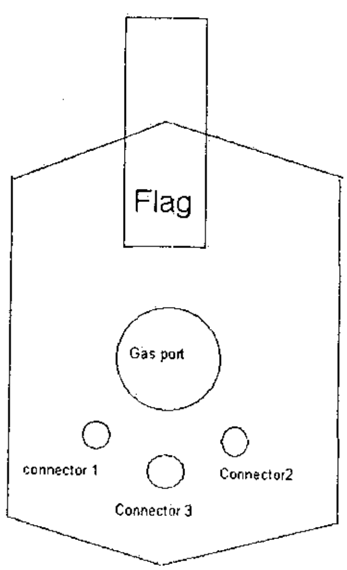
Resistance between Pin 2 and pin 4 109.77 Ω
Resistance between Pin 3 and pin 4 1.09 Ω
Pins 1-4 resistance to lead ∞ Ω Pins 1-4 resistance to flange ∞ Ω

Resistance between Pin 5 and pin 6 1.20 Ω
Resistance between Pin 5 and pin 7 109.84 Ω
Resistance between Pin 5 and pin 8 109.90 Ω
Resistance between Pin 6 and pin 7 109.84 Ω
Resistance between Pin 6 and pin 8 109.80 Ω
Resistance between Pin 7 and pin 8 1.14 Ω
Pins 5-8 resistance to lead ∞ Ω Pins 5-8 resistance to flange ∞ Ω

Resistance between Pin 9 and pin 10 1.11 Ω
Resistance between Pin 9 and pin 11 110.00 Ω
Resistance between Pin 9 and pin 12 109.73 Ω
Resistance between Pin 10 and pin 11 110.07 Ω
Resistance between Pin 10 and pin 12 109.81 Ω
Resistance between Pin 11 and pin 12 1.28 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 108.65 Ω (I+ at pin 1, I- at pin 2, U+ at pin 3, U- at pin 4)
Resistance of T2 108.64 Ω (I+ at pin 5, I- at pin 6, U+ at pin 7, U- at pin 8)
Resistance of T3 108.71 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

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7500 A HTS Power Leads for the LHC DFBX:
4a. Preliminary Leak Check Procedure

Lead Number: 38

Signed C.E. Hess Date 11.03.03

1. **Preparation for Leak Checking**
   1.1 Attach the lifting/insertion tool to the lead flag as shown in Figure 1.1 and remove the lead from the shipping container.

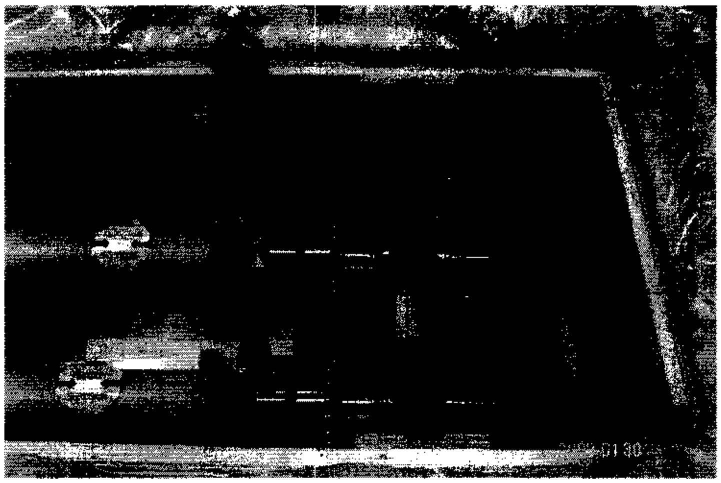

Figure 1.1 The lifting/insertion tool bolted to a power lead in preparation for removing it from the shipping container.

   1.2 Remove the plastic plug from the 4-20 K gas inlet on the lead body.
   1.3 Put the power lead on the steel table, with the power lead lower flange resting in a V-block.
   1.4 Hose clamp a rubber gasket and PVC clamshells around the lead to cover and seal the 4-20 K inlet.
   1.5 Attach an adapter to the top of the power lead so that a leak detector can be connected.
   1.6 Wrap the voltage tap wires around the bottom of the lead and secure them with tape.

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

Baseline: 4.6 e-8 atm cc sec⁻¹

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

Maximum reading: 4.3 e-8 atm cc sec⁻¹

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Technical Division

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

Lead Pair

Negative Lead: 38

Positive Lead: 37

Signed C. E. Hess Jr. Date 11.06.03

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.

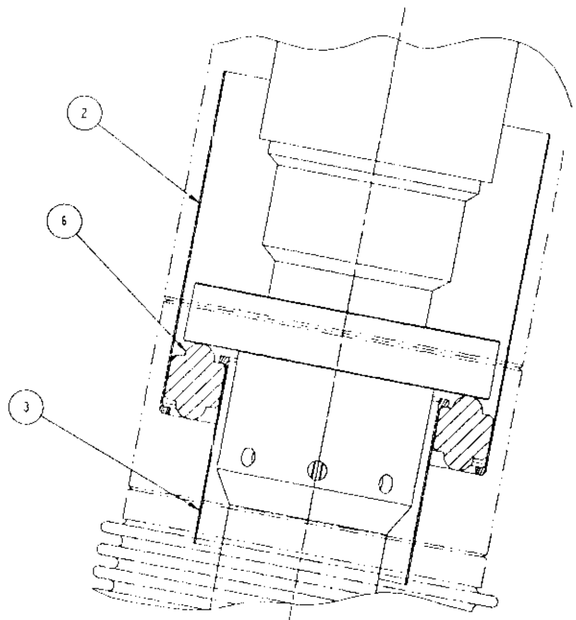


Figure 1.3 2 – Upper Insulator, 3 – Lower Insulator, 6 – PEEK Seal

1.6 Attach the lifting/insertion tool to the lead flag as shown in Figure 1.6 and lift the lead from the steel table where the preliminary leak check was performed.

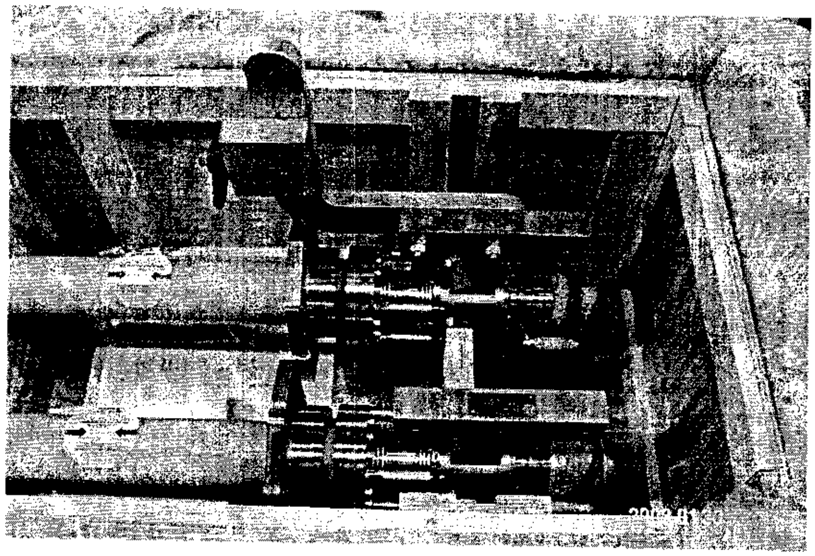


Figure 1.6 The lifting/insertion tool bolted to a power lead.

1.7 Remove the rubber gasket and PVC clamshells 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.

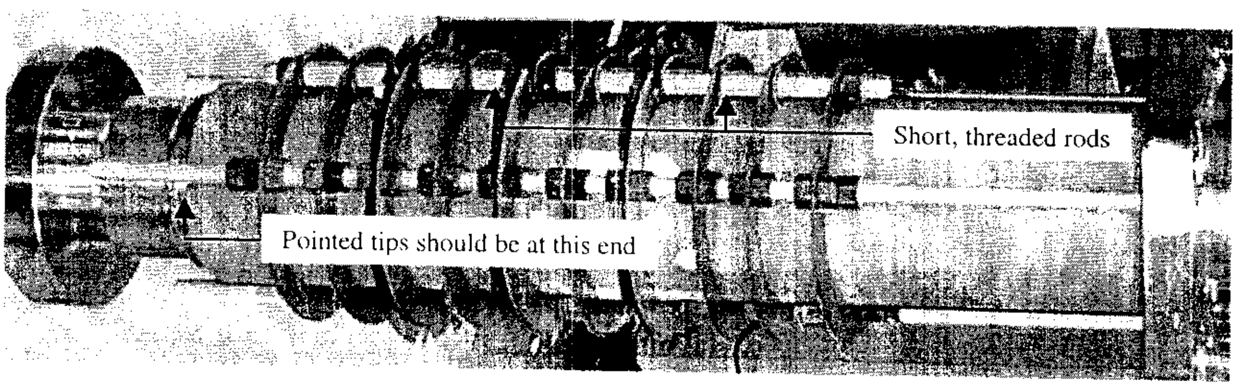


Figure 1.11 A baffle installed on a power lead.

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.

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.

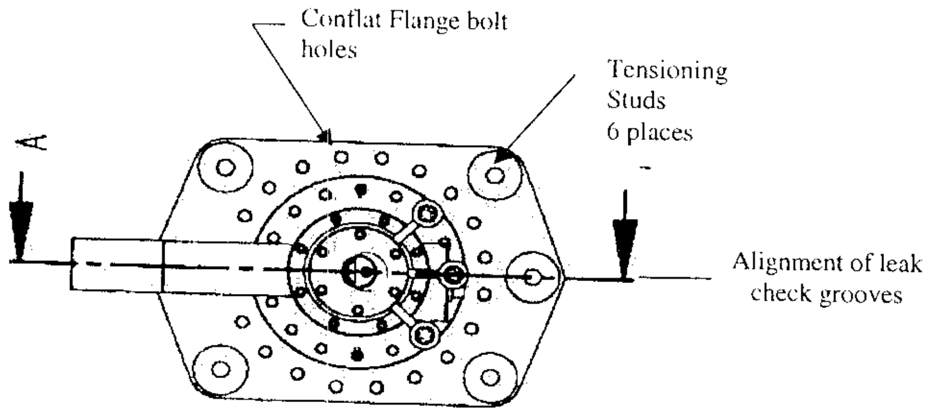


Figure 1.15 The 20-hole Conflat bolt pattern is bisected by center tensioning studs.

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.

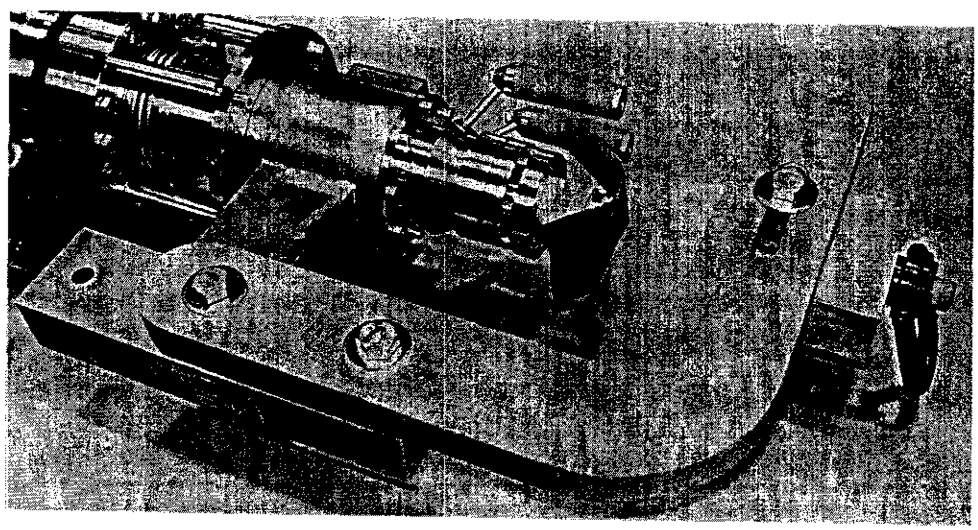


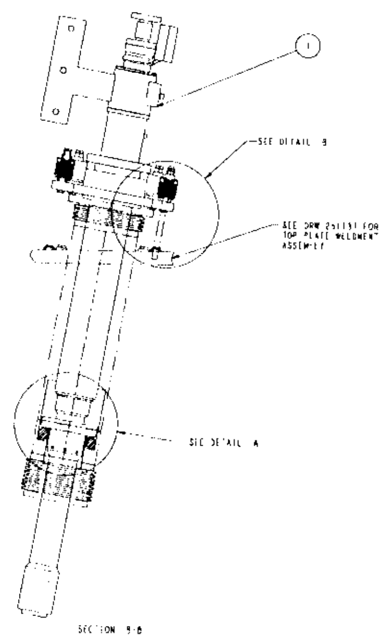
Figure 1.17 The lifting/insertion tool in position to lift the power lead into a vertical position.

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.

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.



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

Negative Lead DFLX ____________ Positive Lead DFLX ____________

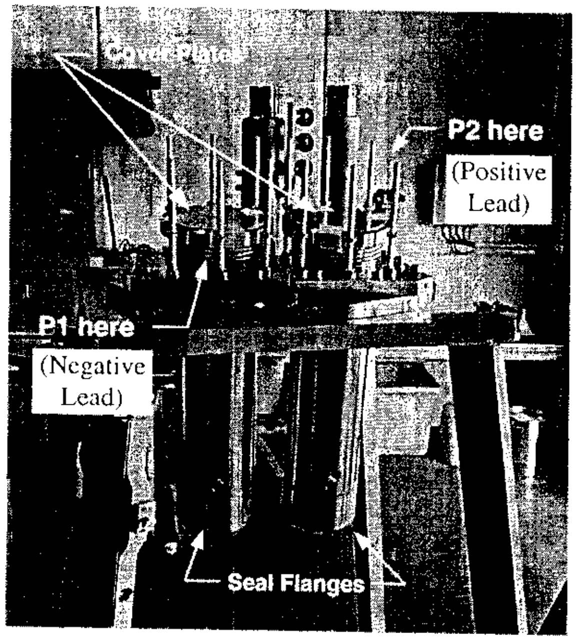


Figure 1.21b Locations of the negative and positive leads.

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

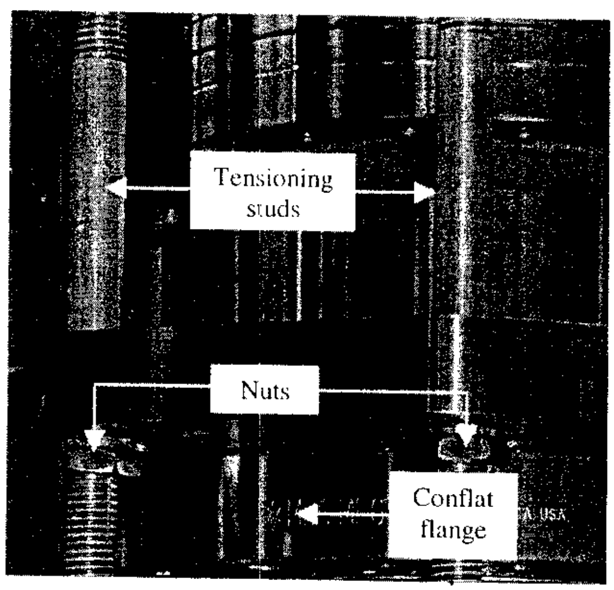


Figure 1.22 The positions of the tensioning studs, nuts, and top plate Conflat flange as the 20 Conflat bolts are tightened.

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.

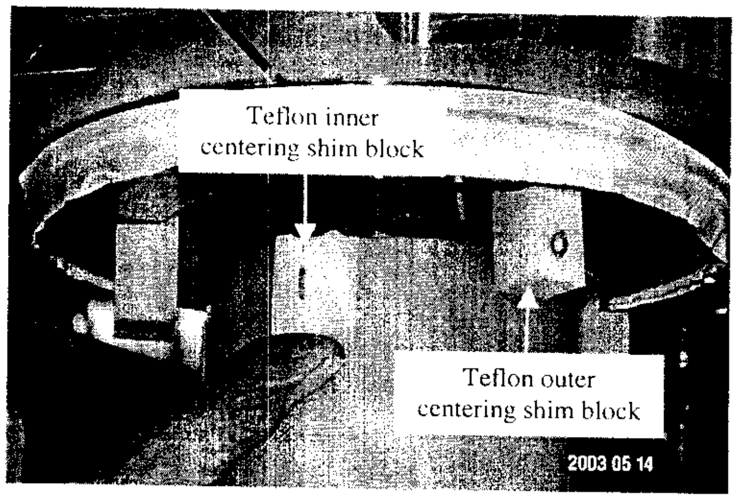


Figure 1.23 The installed Teflon centering shim blocks.

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

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.

Negative Lead DFLX ______________ Positive Lead DFLX ______________

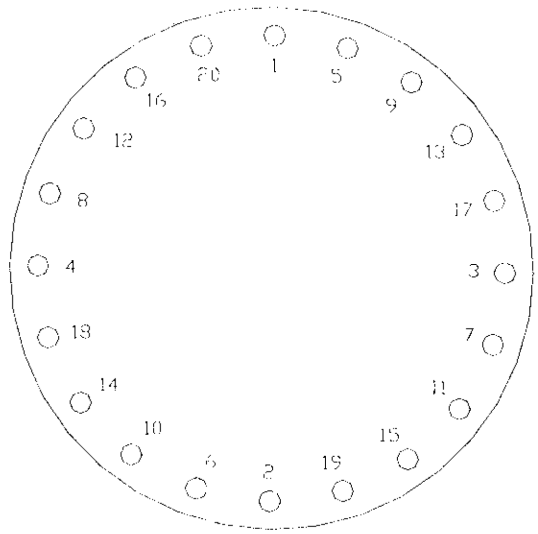


Figure 1.24 Tightening sequence for the 20 Conflat bolts.

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.

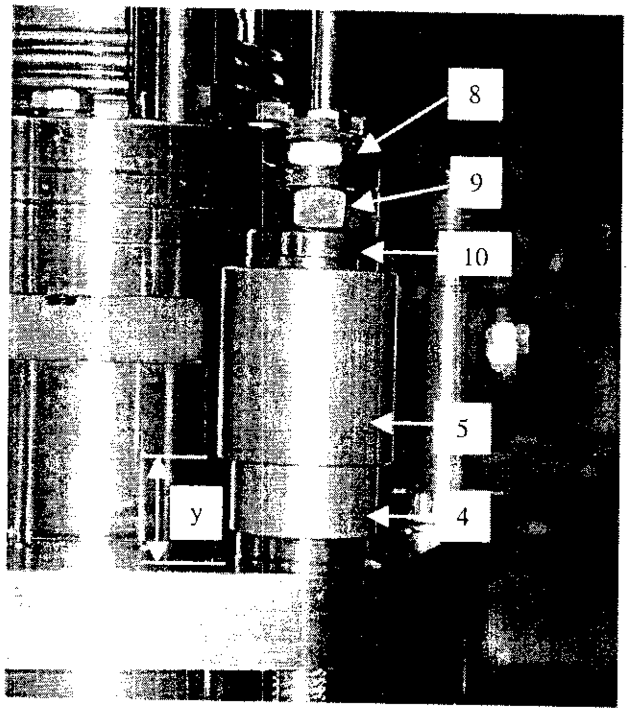


Figure 1.28a An installed Belleville Washer Assembly.

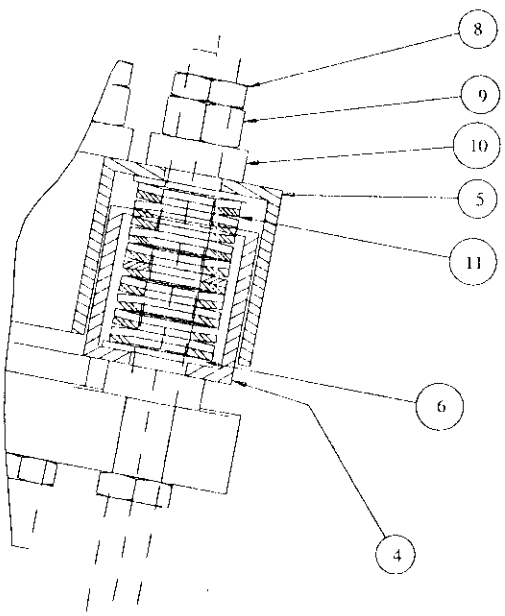


Figure 1.28b An installed Belleville Washer Assembly.

1.29 Tighten the 6 Belleville Washer Assemblies to apply load to the PEEK seal.

1.29.1 Washers for Lead **DFLX** ________

Negative Lead DFLX ______________ Positive Lead DFLX ______________

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 24.48 C 23.73 D 23.66 E 23.97 F 23.63

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 22.68 C 21.93 D 21.86 E 22.17 F 21.83

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 ________ Positive Lead DFLX ________

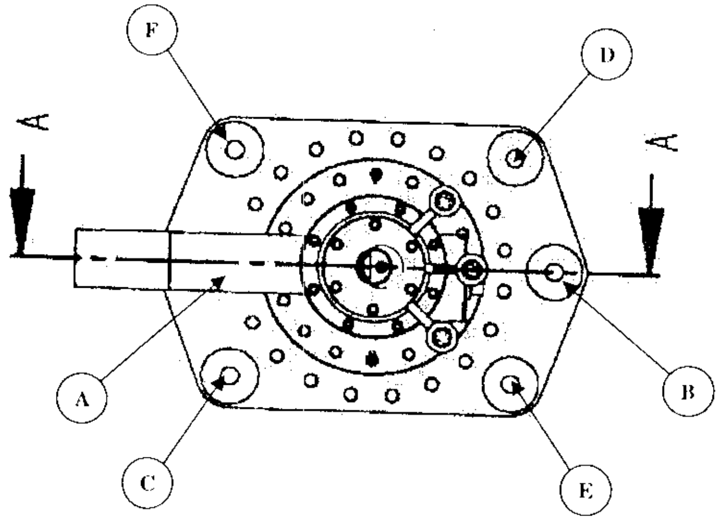


Figure 1.29.1.5 The specified sequence for tightening the Belleville Washer Assemblies.

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

A 22.15 B 22.62 C 21.92 D 21.64 E 21.83 F 21.80

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

1.29.2 Washers for Lead **DFLX** ________

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 24.22 B 23.95 C 23.84 D 24.43 E 24.08 F 24.06

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 22.42 B 22.15 C 22.04 D 22.63 E 22.28 F 22.26

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 ✓ 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 ______

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

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

A 22.42 B 22.15 C 22.04 D 22.62 E 22.19 F 22.25

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 Clean the LTS pigtails with alcohol.

4.3 Make connection to LTS pigtails. The joint is a mechanical connection with a stainless steel clamp block (supplied by LBNL) and indium foil between the cables to ensure good electrical contact. Torque each of the clamp block fasteners to **10 ft-lbf**. Figure 4.3a shows a rendition of the installed power leads. Figure 4.3b shows the G-10 clamshell clamp, the clamp support, and the mechanical clamp.

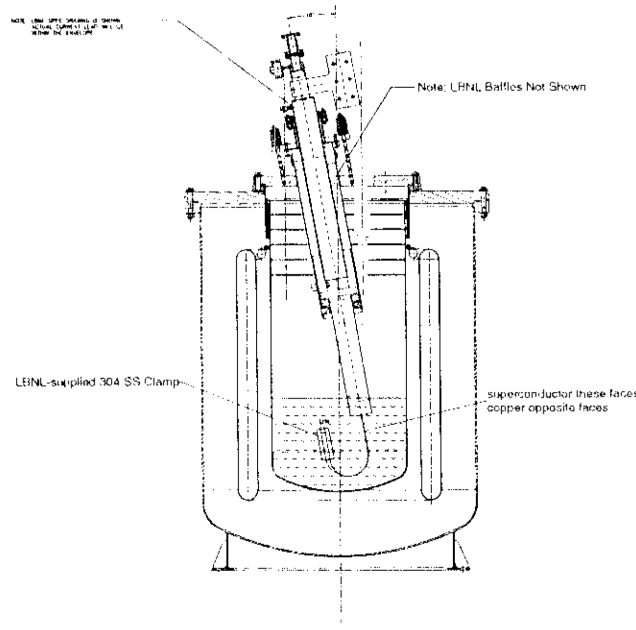


Figure 4.3a Side View of Lead in Cryostat with the LTS cables connected.

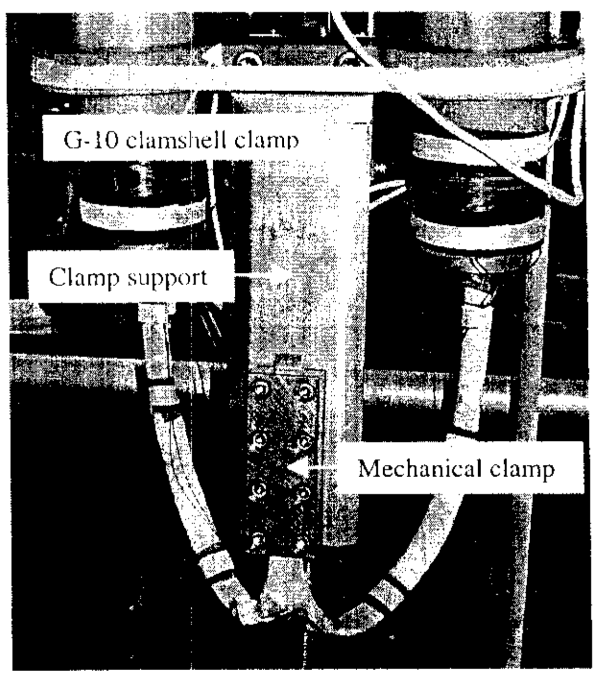


Figure 4.3b Electrical integration of the LTS sections.

Negative Lead DFLX ________________ Positive Lead DFLX ________________

4.4 Clamp a piece of bus wire and a small amount of 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.

4.5 Insulate the superconducting cable with Kapton and glass tape.

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

4.7 Install the bottom fill tube.

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

4.9 Measure and record dimensions required for the insert map.

FERMILAB
Technical Division

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

Lead Pair

Negative Lead: 38

Positive Lead: 37

Signed C.E. Hess Jr. Date 11.04.03

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: 65.2 psic 08:53

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

Final pressure: 65.2 08:59

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 38 Positive Lead DFLX 37

FERMILAB
Technical Division

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

Lead Pair

Negative Lead: 38

Positive Lead: 37

Signed C. E. Hess Jr. Date 11.05.03

FERMILAB Technical Division Development & Test	**7500 A HTS Power Leads for the LHC DFBX:** **7. Leak Check Procedure**	Doc. No. Rev. – (RJR) Rev. Date: February 7, 2003 Page 2 of 2

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.

Baseline: 1.35e-8

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

Maximum reading: 1.36e-8

Note: There is a leak at Pos Lead No. 38 PEEK Seal to saturation

Negative Lead DFLX 38 Positive Lead DFLX 37

FERMILAB Technical Division Development & Test	**7500 A HTS Power Leads for the LHC DFBX: 7a. Top Plate Insertion into the Dewar**	Doc. No. Rev. 1 (RJR) Rev. Date: Sept. 3, 2003 Page 2 of 2

√ **1.** Grease and install an o-ring on the top flange of the dewar extension.

√ **2.** Remove the 10 degree blocks from under the top plate.

√ **3.** Lift the top plate and insert from the roll-around cart and set them onto the dewar extension. The leads must be on the south side of the test dewar.

√ **4.** Install a power lead vent stack on each power lead, keeping in mind the orientation of the vent line.

√ **5.** Verify that the heaters are bolted to the power leads.

Negative Lead DFLX 38 Positive Lead DFLX 37

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX: 7a. Top Plate Insertion into the Dewar

Lead Pair

Negative Lead: 38

Positive Lead: 37

Signed C.E. Hess Jr. Date 11.07.03

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 Steve Helis ____ (signature)
(Name typed) (Signature)
Date & time 11/10/03 10:00

Pos. Power Lead 7500 A DFLX 37 and Neg. Power Lead 7500 A DFLX 38

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.
Cool down and check pos and neg lead heaters. ~1ohm
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

Primary = Left Redundant=Right

2.0 Voltage drop measurement for Vtap & flag cables.

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 Connect before and After Flags ring terminals to both leads.
2.3 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).
2.4 Turn on Kepco power supply and set the output for 10 amps. (5v on HP meter=10 amps)
2.5 Connect stand 3 trim current cable to shunt current monitor above the Kepco power supply.
2.6 Log into cryo computer (left computer at Stand 3). Password is: ScMagsRU
NOTE: Be sure that Mike T has rebooted the system and scans are active or values will not show
2.7 Bring up a terminal and type the following to bring up the numerical display
ssh mdtf34
The password is: ScMagsRU (can also rlogin mdtf24)
You should be in the directory mdtf34: home/mdtf34/cryo

Type the command: numdisp –n mtfvx27&
(numeric display on mtfuz27 shows up)
Click on chooser
Click the File button on numeric display.
Then choose Load setup
Enlarge window
In **directories**, double click: home/mdtf34/cryo/Setups and then home/mdtf34/cryo/Setups/Stand3
After you are in the Stand3 directory, under **Files**: double click LHC02_Dvm_CheckoutVariables.numdisp_setup
This will bring up a preset display with the trim current and all Stand 3 RTD's
You won't need to check the RTD's until later in checkout.
Record the applied current(trim) 9.92 A (Should be approx. 10A)

2.8 Connect both primary and redundant Vtap cables to positive and negative leads.
2.9 Remove the four primary and redundant Vtap cables from the back of the Vtap distribution box (these cables are located on the right side).
2.10 Using the dual 8-pin breakout box, connect the cables as per the following instructions:
2.11 Use HP3457 DVM, set it to 40-line cycle integration time.

Positive Lead (single cable test)
Voltage tap Connector 1 (**Primary**)

Pin 1 - pin 2	**(160uv)** 164u V	Pin 2 - pin 3	**(450uv)** 473u V
Pin 1 - pin 3	**(610uv)** 641u V	Pin 3 - pin 4	**(480uv)** 494u V
Pin 1 - pin 4	**(1.1mv)** 1.1m V	Pin 4 - pin 5	**(3.5mv)** 3.4m V
Pin 1 - pin 5	**(4.7mv)** 4.5m V	Pin 5 - pin 6	**(float)** — V
Pin 1 - pin 6	**(float)** — V	Pin 6 – pin 7	**(float)** — V
Pin 1 - pin 7	**(-20uv)** -49u V	Pin 7 – pin 8	**(0v)** 0 V
Pin 1 - pin 8	**(-20uv)** -49u V		

Voltage tap Connector 2 (**Redundant**)

Pin 1 - pin 2	**(160uv)** 162u V	Pin 2 - pin 3	**(450uv)** 472u V
Pin 1 - pin 3	**(610uv)** 634u V	Pin 3 - pin 4	**(480uv)** 498u V
Pin 1 - pin 4	**(1.1mv)** 1.1m V	Pin 4 - pin 5	**(3.5mv)** 3.4u V
Pin 1 - pin 5	**(4.7mv)** 4.5m V	Pin 5 - pin 6	**(float)** — V
Pin 1 - pin 6	**(float)** — V		

DFLX 37 DFLX 38

Negative Lead (single cable test)

Voltage tap Connector 1 (**Primary**)

Pin 1 - pin 2 **(-160uv)** -160μ V   Pin 2 - pin 3 **(-450uv)** -475μ V
Pin 1 - pin 3 **(-600uv)** -636μ V   Pin 3 - pin 4 **(-480uv)** -510μ V
Pin 1 - pin 4 **(-1.1mv)** -1.1m V   Pin 4 - pin 5 **(-3.5mv)** -3.3m V
Pin 1 - pin 5 **(-4.7mv)** -4.5m V   Pin 5 - pin 6 **(float)** —— V
Pin 1 - pin 6 **(float)** —— V   Pin 6 – pin 7 **(float)** —— V
Pin 1 - pin 7 **(+20uv)** +187μ V   Pin 7 – pin 8 **(0v)** -17μ V
Pin 1 - pin 8 **(+20uv)** +166μ V

Voltage tap Connector 2 (**Redundant**)

Pin 1 - pin 2 **(-160uv)** -161μ V   Pin 2 - pin 3 **(-450uv)** -475μ V
Pin 1 - pin 3 **(-600uv)** -638μ V   Pin 3 - pin 4 **(-480uv)** -506μ V
Pin 1 - pin 4 **(-1.1mv)** -1.1m V   Pin 4 - pin 5 **(-3.5mv)** -3.3m V
Pin 1 - pin 5 **(-4.7mv)** -4.5m 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)** 3.4m V
Positive Lead Pin 1 - Negative Lead pin 4 **(7.3mv)** 6.8m V
Positive Lead Pin 1 - Negative Lead pin 3 **(7.7mv)** 7.3m V
Positive Lead Pin 1 - Negative Lead pin 2 **(8.2mv)** 7.8m V
Positive Lead Pin 1 - Negative Lead pin 1 **(8.3mv)** 7.9m V

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

Positive Lead Pin 1 - Negative Lead pin 5 **(3.7mv)** 3.4m V
Positive Lead Pin 1 - Negative Lead pin 4 **(7.3mv)** 6.8m V
Positive Lead Pin 1 - Negative Lead pin 3 **(7.7mv)** 7.3m V
Positive Lead Pin 1 - Negative Lead pin 2 **(8.2mv)** 7.8m V
Positive Lead Pin 1 - Negative Lead pin 1 **(8.3mv)** 7.9m V

2.12 When finished taking voltage measurements reconnect the Vtap cables on back of the Vtap Distribution box.

3.0 Voltage Drop measurements for Quench Character Cables

3.1 Connect QC POS LEAD & QC NEG LEAD Connectors on Stand 4 platform Quench Management Vtap Box to the breakout box.

3.2 Use a 3457 DVM to check the voltages on specified pins.

QC POS LEAD (+VTAP QC RR STN3 DBOX +VTAP QC STN4 QMBOX)

Pin 1 - pin 2 **(160uv)** 161μ V
Pin 3 - pin 4 **(950uv)** 976μ V
Pin 5 - pin 6 **(480uv)** 498μ V
Pin 7 - pin 8 **(3.5mv)** 3.4m V

QC NEG LEAD

Pin 1 - pin 2 **(-160uv)** -161μ V
Pin 3 - pin 4 **(-950uv)** -978μ V
Pin 5 - pin 6 **(-480uv)** -508μ V
Pin 7 - pin 8 **(-3.5mv)** -3.3m V

Restore QC cables

3.3 When voltage measurements are complete, turn off kepco power supply and disconnect kepco power cable on positive and negative LHC power leads. Disconnect the before and After Flags.

4.0 RTD resistance measurements.

4.1 Using the special RTD test cable (cable should be located in the bottom of the rack for Stand 3), use the standard blue breakout box (box should be in the breakout box cabinet), connect it to each LEADS RTD connectors. This is the connector between the primary and redundant Vtap connectors. Each RTD connector connect to 3 sets of RTDs. The LHC lead RTD's are

4.2 511-3, 512-3, 509-3A, 509-3B, 510-3A, and 510-3B.

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

Resistance between Pin 1 and pin 2 **(.800)** 0.8 Ω
Resistance between Pin 1 and pin 3 **(109)** 109 Ω
Resistance between Pin 1 and pin 4 **(109)** 109 Ω
Resistance between Pin 2 and pin 3 **(109)** 109 Ω
Resistance between Pin 2 and pin 4 **(109)** 109 Ω
Resistance between Pin 3 and pin 4 **(.800)** 0.6 Ω

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

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Resistance between Pin 5 and pin 6 (**.800**) 0.7 Ω
Resistance between Pin 5 and pin 7 (**109**) 109 Ω
Resistance between Pin 5 and pin 8 (**109**) 109 Ω
Resistance between Pin 6 and pin 7 (**109**) 109 Ω
Resistance between Pin 6 and pin 8 (**109**) 109 Ω
Resistance between Pin 7 and pin 8 (**.800**) 0.7 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**) 0.6 Ω
Resistance between Pin 9 and pin 11 (**109**) 109 Ω
Resistance between Pin 9 and pin 12 (**109**) 109 Ω
Resistance between Pin 10 and pin 11 (**109**) 109 Ω
Resistance between Pin 10 and pin 12 (**109**) 109 Ω
Resistance between Pin 11 and pin 12 (**.800**) 0.6 Ω

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

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

Resistance of T1 108.3 Ω(**108.5**)(I+ at pin 1,U+ at pin 2,I- at pin 3,U- at pin 4)
Resistance of T2 108.3 Ω(**108.5**) (I+ at pin 5, U+ at pin 6, I- at pin 7, U- at pin 8)
Resistance of T3 108.5 Ω(**108.5**)(I+ at pin 9,U+ at pin 10,I- at pin 11,U- at pin 12)

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

Resistance between Pin 1 and pin 2 (**.800**) 0.7 Ω
Resistance between Pin 1 and pin 3 (**109**) 109 Ω
Resistance between Pin 1 and pin 4 (**109**) 109 Ω
Resistance between Pin 2 and pin 3 (**109**) 109 Ω
Resistance between Pin 2 and pin 4 (**109**) 109 Ω
Resistance between Pin 3 and pin 4 (**.800**) 0.6 Ω

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

DFLX 37 DFLX 38

Resistance between Pin 5 and pin 6 **(.800)** 0.6 Ω
Resistance between Pin 5 and pin 7 **(109)** 109 Ω
Resistance between Pin 5 and pin 8 **(109)** 109 Ω
Resistance between Pin 6 and pin 7 **(109)** 109 Ω
Resistance between Pin 6 and pin 8 **(109)** 109 Ω
Resistance between Pin 7 and pin 8 **(.800)** 0.7 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)** 0.6 Ω
Resistance between Pin 9 and pin 11 **(109)** 109 Ω
Resistance between Pin 9 and pin 12 **(109)** 109 Ω
Resistance between Pin 10 and pin 11 **(109)** 109 Ω
Resistance between Pin 10 and pin 12 **(109)** 109 Ω
Resistance between Pin 11 and pin 12 **(.800)** 0.6 Ω
Pins 9-12 resistance to lead **(infinite)** _______ Ω
Pins 9-12 resistance to ground **(infinite)** ______ Ω

4.6 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:
Resistance of T1 108.2 Ω**(108.5)**(I+ at pin 1,U+ at pin 2,I- at pin 3,U- at pin 4)
Resistance of T2 108.3 Ω **(108.5)**(I+ at pin 5, U+ at pin 6, I- at pin 7, U- at pin 8)
Resistance of T3 108.5 Ω**(108.5)**(I+ at pin 9,U+ at pin 10,I- at pin 11,U- at pin 12)

4.7 **Check remaining RTDs**
Connect the following cables
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 Stand 3 RTD's can be read out on the numeric display that was opened earlier in the checkout. Be sure that Mike T has rebooted the system and scans are active. Check that all Temps for the RTDs read approximately 295K on all channels below.

507-3A ✓, 507-3B ✓, 509-3A ✓, 509-3B ✓, 510-3A ✓, 510-3B ✓, 511-3 ✓, 512-3 ✓, 513-3 ✓, 514-3 ✓, 515-3 ✓, 516-3 ✓, 526-3 ✓, 530-3 ✓, 531-3 ✓, 532-3 ✓, 533-3 ✓, 534-3 ✓, 535-3 ✓, 594-3 ✓

DFLX 37 DFLX 38

4.8 TE 507-3B doesn't always read the correct temp; the display will have 507-3B's resistance. It should read approx. 60 Ω.
To exit click Exit.

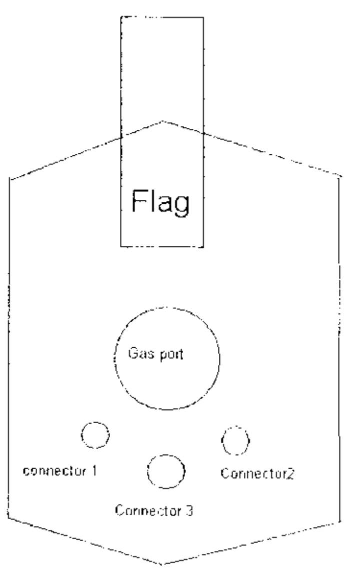
4.9 Check all three liquid levels probes (12", 30", and 36").
The 12" liquid level is connected to pins 9-12 of "dewar inlet HE tc/ll" cable.
Connect 4-pin cable on top plate for 30" probe.
Disconnect J1 at the back of each liquid level meter and do a 4-wire resistance measurement on each probe.

Using a breakout box measure the resistance of each probe on J1:

1. pin1(red) to pin 8(blue)	should be approx. 5 Ω
2. pin 8(blue) to pin 6(yellow)	should be approx. (13.75 X active length of probe) 165 Ω for 12" and 412.5 Ω for 30"
3. pin 6(yellow) to pin 7(black)	should be something less than 5 Ω
4. pin 1(red) to pin 7(black)	should approximately equal resistance from #2 + #1

4.10 Do a 4-Wire resistance measurement:
12" Dewar 163.7 30" Dewar 402 30" Phase sep. 403

	12" Dewar	30"Dewar	30" Phase sep
1. 1(red) to 8(blue)	7.0	7.0	7.5
2. 8(blue) to 6(yellow)	166	405	406
3. 6(yellow) to 7(black)	6.3	1.5	2.3
4. 1(red) to 7(black)	171	410	411



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

DFLX 37 DFLX 38

9. Room Temperature Electrical Checkout

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 37 DFLX 38

FERMILAB
Technical Division

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

Lead Pair

Negative Lead: 38

Positive Lead: 37

Signed C. E. Kerr Jr. **Date** 11.20.03

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

✓ 7. 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.

✓ 8. 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.

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

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

Negative Lead DFLX ______________ Positive Lead DFLX ______________

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 Steve Helis (Name typed) [signature] (Signature)

Date & time 11/20/03 15:00

Pos. Power Lead 7500 A DFLX 37 and Neg. Power Lead 7500 A DFLX 38

This hi-pot should be performed after dewar has been filled with gaseous helium. <u>Notify the Cryo Operator before you disconnect cables</u>. 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 0.0064 A

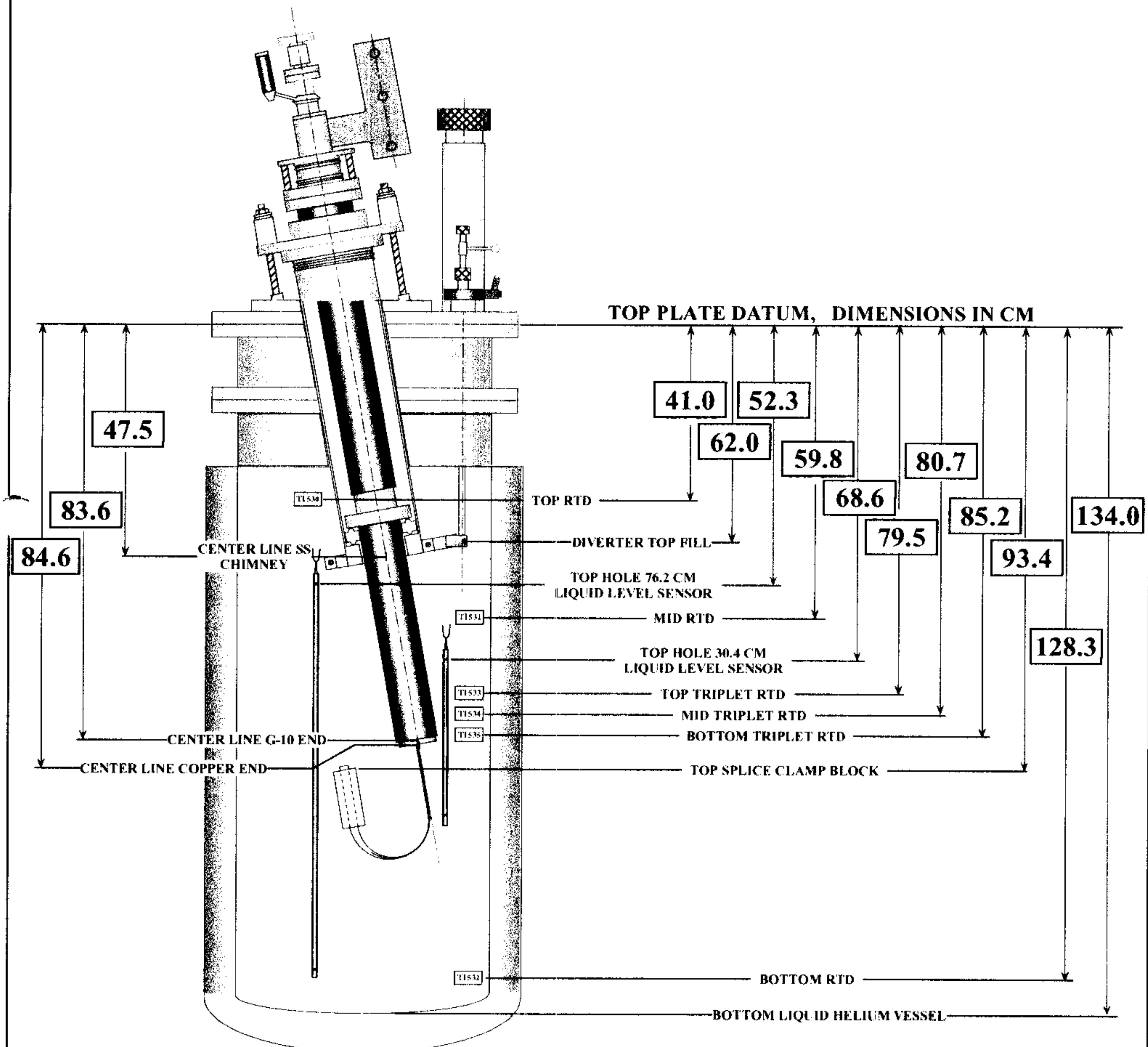
1.2 Hi-pot the leads in a gaseous He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector 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 0.0144 A.
Record approximate temp. 296 K. (Record Temp of TI532-3)
Record approximate test dewar pressure 14.9 PSIA.

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).

LHC HTS POWER LEAD TESTING @ TEST STAND 3
PAIR - DFLX-_03_ (-) & DFLX-_04_ (+)



SUBJECT	TITLE	DATE	SKETCH/ DWG NO.
LHC HTS POWER LEADS (-) DFLX-_03_ & (+) DFLX-_04_	POWER LEAD TEST DIMENSION MAP	12.15.03	CEH031215-1

FERMILAB
Technical Division

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

Lead Pair

Negative Lead: DFLX 38

Positive Lead: DFLX 37

Signed A.Rusy Date 11.25.03

AR 1. ±5 A applied to the current leads during cooldown.

AR 2. DAQ system is operational (temperature sensor readouts in the test dewar helium space are updating).

AR 3. Test dewar and power leads cooled down as per the cooldown procedure "7500 A HTS Power Leads for the LHC DFBX: 12a. Cryogenic Operating Procedure".

FERMILAB Technical Division	**7500A HTS Power leads for the LHC DFBX** **13. Cold Temp Hi-pot In 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 [illegible] (Name typed) [illegible] (Signature)

Date & time 11/25/02 9:15

Pos. Power Lead 7500 A DFLX 37 and Neg. Power Lead 7500 A DFLX 38

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

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 1 µ A.
Record approximate temp. 4.5 K. (Record Temp of TI532-3)
Record approximate test dewar pressure 4.5 PSIA.

NOTE: Reconnect Vtaps and RTDs when finished.

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

Lead Pair

Negative Lead: DFLX38

Positive Lead: DFLX37

Signed Roger Rabehl Date 11/25/03

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 μΩ.

✓ 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.

Negative lead DFLX 38 Positive lead DFLX 37

__✓__ **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.

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

Lead Pair

Negative Lead: DFLX 38

Positive Lead: DFLX 37

Signed Roger Rabehl Date 12/8/03

1. Bus Connection Changes – VMTF End

__✓__ 1.1 Visually verify completion of electrical connection of the green flex leads to the Stand 4 hard bus in the trench.

__✓__ 1.2 Visually verify completion of LCW connections between the green flex leads and the Stand 4 hard bus in the trench.

__✓__ 1.3 Visually verify completion of electrical connection of the 1000 MCM flexible leads and Main Injector dipoles.

__✓__ 1.4 Record the flow indicator readings for LCW flow to the 1000 MCM flexible leads and the Main Injector dipoles.

1000 MCM Flexible lead flow ~~FI2231~~ FI2239 (IB1 south wall): __1.2__ gpm (REQ. 1.2)
Main Injector dipole 1 flow FI22XX: __5__ gpm (REQ 5 gpm)
Main Injector dipole 2 flow FI22XX: __5__ gpm (REQ. 5 gpm)
MI MAGNET COMBINED FI2236: 10 gpm

__✓__ 1.5 Visually verify all exposed bus has been wrapped with rubber insulation for personnel safety.

2. Bus Connection Changes – Stand 4 Platform

__✓__ 2.1 Visually verify that the Stand 3 hard bus has been mated with the Stand 4 flexible bus on the Stand 4 platform and that the polarity is correct.

3. Bus Connection Changes – Stand 3 Test Dewar

__✓__ 3.1 Visually verify the flex leads and chill blocks have been bolted to the power lead flags. with Penetrox E conductive grease applied to the cooling block-lead flag joint.

__✓__ 3.3 Visually verify that voltage taps VFF-A and VFF-B have been connected at the negative and positive flex lead flags, respectively, and voltage taps VLF-A and VLF-B have been connected at the negative and positive power lead flags, respectively. These taps will allow the combined voltage drop across the flex lead/chill block joint and chill block/power lead joint to be measured.

__✓__ 3.4 Visually verify Kapton-wrapped platinum temperature sensors TE515-3 and TE516-3 have been attached to the positive and negative lead flags, respectively, using glass tape.

✓ 3.5 Visually verify the power lead flags have been wrapped with rubber insulation for personnel safety.

✓ 3.6 Visually verify the plexiglass enclosure has been installed around the power leads for personnel safety.

3. Power Supply System Configuration

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

✓ 3.2 Switch warning lights at the VMTF pit and at the Stand 4 platform to the "Stand 3" position.

✓ 3.3 Adjust the power supply time constant by setting the resistance to 500 μΩ.

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

✓ 3.5 Adjust the dump resistance to 30 mΩ.

✓ 3.6 Place the VMTF ground switch in the "off" position.

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

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

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

✓ 3.10 SWITCH LCW SWITCH TO STD 3 POSITION TO ENABLE FLOW SWITCHES IN PLC LOGIC

GREEN FLEX LEADS
FI 2230 11 gpm (REQ. 12 gpm)
FI 2231 9 gpm (REQ 12 gpm)

FI 558-3 3.9 gpm
FI 556-3 12 gpm
FI 554-3 4 gpm
FI 553-3 4 gpm

Negative lead DFLX 38 Positive lead DFLX 37

16. Cold test of the power leads

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

Date & time NOVEMBER 25, 2003 0900

Power Lead 7500 A DFLX 38 & 7500 A DFLX 37

✓16.0 Set the DAQ system ScribeLeads and ScribeFix32 Data Logging Intervals to capture data every 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 ✓

Neg. lead flow rate 0.149 g/s Pos. lead flow rate 0.150 g/s

Neg. lead diff. pressure 0 mbar Pos. lead diff. pressure 0 mbar

Set the upper HTS temperature to 50 K and keep it there for ½ hour ✓

Neg. lead flow rate 0.131 g/s Pos. lead flow rate 0.131 g/s

Neg. lead diff. pressure 0 mbar Pos. lead diff. pressure 0 mbar

Frost observed on leads? (Y/N) N

✓16.1.1 Set software quench detection thresholds by executing:

/usr/vmtf/sh/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 (/usr/vmtf/sh/hmtf3_run_prf.sh) ✓

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 38 (NEG) R(joint between V2 & V3) = $\frac{0.000152+0.000171\ V}{7500\ A}$ = 43 nΩ

R(joint between V3 & V4) = $\frac{0.000134-0.000109\ V}{7500\ A}$ = 3.3 nΩ

7500 A DFLX 37 (POS) R(joint between V2 & V3) = $\frac{0.000412-0.000106\ V}{7500\ A}$ = 41 nΩ

R(joint between V3 & V4) = $\frac{0.000295-0.000266\ V}{7500\ A}$ = 3.9 nΩ

16.3 Coolant loss test.

Apply 7500 A and

a) Close the coolant flow for 7500 A DFLX 38 (NEG. LEAD)

Wait until QD detects the quench and record

T1 = 80 K ; T2 = 304 K ; V12 = -47.8 mV; V23 = -0.84 mV; V34 = 0.11 mV ;

T1 is the HTS warm terminal temp., TI509-3 (neg. lead) or TI510-3 (pos. lead).

T2 is the upper copper temp., TI511-3 (neg. lead) or TI512-3 (pos. lead).

b) Re-establish operating conditions

c) Close the coolant flow for 7500 A DFLX 37 (POS. LEAD)
   Wait until QD detects the quench and record
   T1 = 79 K ; T2 = 297 K ; V12 = 98.1 mV ; V23 = 1.08 mV ; V34 = 0.29 mV ;

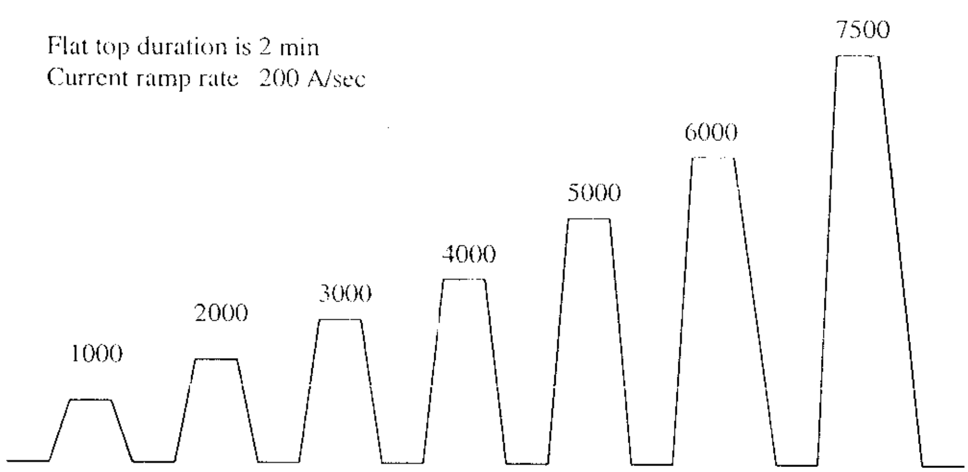
X 16.4a Set the upper HTS terminal temperature to 45 K and apply current profile 2.
Neg. lead flow rate ________ Pos. lead flow rate ________
Neg. lead diff. pressure ________ Pos. lead diff. pressure ________

X 16.4b Set HTS terminal temp to 50 K and apply current profile 2.
Neg. lead flow rate ________ Pos. lead flow rate ________
Neg. lead diff. pressure ________ Pos. lead diff. pressure ________

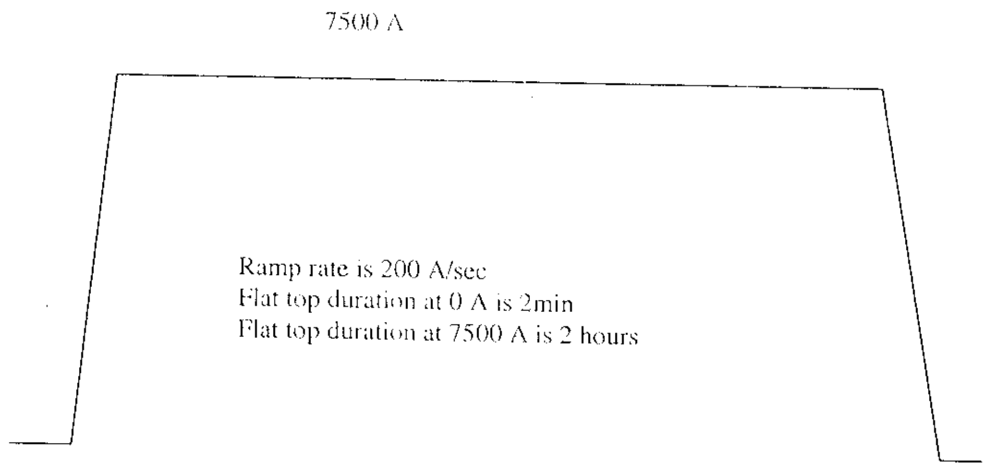
✓ 16.5 When test is completed, set the ScribeLeads and ScribeFix32 Data Logging Intervals to 300 seconds.

Note: If any irregularity occur call Sandor.

Profile 1:



Profile 2:


7500 A
Ramp rate is 200 A/sec
Flat top duration at 0 A is 2min
Flat top duration at 7500 A is 2 hours

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	16. Cold test of the power leads	

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

Date & time DECEMBER 8, 2003 1200

Power Lead 7500 A DFLX 37 & 7500 A DFLX 38

✓16.0 Set the DAQ system ScribeLeads and ScribeFix32 Data Logging Intervals to capture data every 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 ✓

Neg. lead flow rate 0.141 g/s Pos. lead flow rate 0.146 g/s

Neg. lead diff. pressure 0 mbar Pos. lead diff. pressure 0 mbar

Set the upper HTS temperature to 50 K and keep it there for ½ hour ✓

Neg. lead flow rate 0.127 g/s Pos. lead flow rate 0.130 g/s

Neg. lead diff. pressure 0 mbar Pos. lead diff. pressure 0 mbar

Frost observed on leads? (Y/N) N

✓16.1.1 Set software quench detection thresholds by executing:

/usr/vmtf/sh/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 (/usr/vmtf/sh/hmtf3_run_prf.sh) ✓

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 38 R(joint between V2 & V3) = $\frac{0.000165 + 0.000159 \text{ V}}{7500 \text{ A}}$ = 43.6 nΩ

(NEG. LEAD) R(joint between V3 & V4) = $\frac{0.000115 - 0.0000922 \text{ V}}{7500 \text{ A}}$ = 3.0 nΩ

7500 A DFLX 37 R(joint between V2 & V3) = $\frac{0.000464 - 0.000120 \text{ V}}{7500 \text{ A}}$ = 45.9 nΩ

(POS. LEAD) R(joint between V3 & V4) = $\frac{0.000292 - 0.000263 \text{ V}}{7500 \text{ A}}$ = 3.9 nΩ

✓16.3 Coolant loss test.

Apply 7500 A and

a) Close the coolant flow for 7500 A DFLX 38 (NEG. LEAD)

Wait until QD detects the quench and record

T1 = 82 K ; T2 = 300 K; V12 = -96.5 mV; V23 = -0.86 mV; V34 = 0.092 mV;

T1 is the HTS warm terminal temp., TI509-3 (neg. lead) or TI510-3 (pos. lead).

T2 is the upper copper temp., TI511-3 (neg. lead) or TI512-3 (pos. lead).

b) Re-establish operating conditions

c) Close the coolant flow for 7500 A DFLX 37 (POS LEAD)
Wait until QD detects the quench and record
T1 = 81 K ; T2 = 297 K; V12 = 98.6 mV ; V23 = 1.06 mV ; V34 = 0.28 mV ;

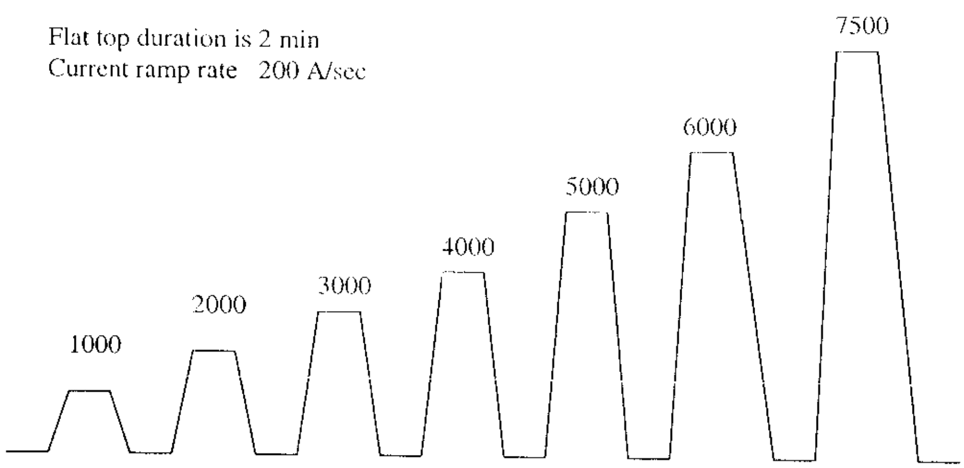
✓ 16.4a Set the upper HTS terminal temperature to 45 K and apply current profile 2.
Neg. lead flow rate 0.484 g/s Pos. lead flow rate 0.473 g/s
Neg. lead diff. pressure 6.0 mbar Pos. lead diff. pressure 4.6 mbar

✓ 16.4b Set HTS terminal temp to 50 K and apply current profile 2.
Neg. lead flow rate 0.455 g/s Pos. lead flow rate 0.447 g/s
Neg. lead diff. pressure 5.6 mbar Pos. lead diff. pressure 4.3 mbar

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

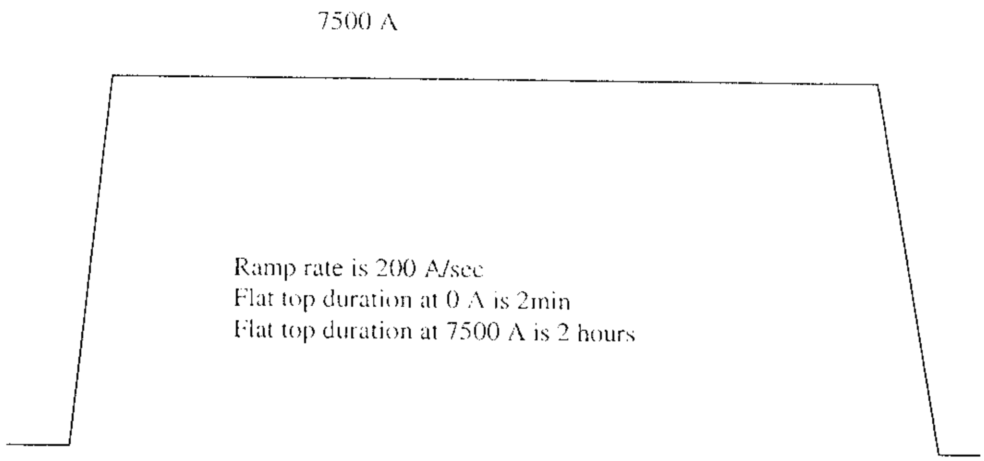
Note: If any irregularity occur call Sandor.

Profile 1:



16. Cold test of the power leads

Profile 2:



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	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 W___ (Name typed) ___________ (Signature)

Date & time ___12/10/03___

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 38

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 ___.002 µ___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 ___.06 µ___A.
Record approximate temp. ___295___K. (Record Temp of TI532-3)
Record approximate test dewar pressure ___3___PSIA.

NOTE: Reconnect Vtaps and RTDs when finished.
Turn OFF Main Power Switch to Hoffman Enclosure on Side of END RACK!!!!

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7500 A HTS Power Leads for the LHC DFBX: 21. Removal of the Top Plate from the Dewar

1. **Electrical Disconnections**
   - **1.1** Put the power system into LOTO.
   - **1.2** Remove the plexiglass shield around the power leads.
   - **1.3** Remove the Kapton-wrapped platinum temperature sensors TE515-3 and TE516-3 from the positive and negative lead flags, respectively.
   - **1.4** Remove voltage taps VF-A and VF-B from the negative and positive flex lead flags, respectively.
   - **1.5** Disconnect the flex leads and chill blocks from the power lead flags.

2. **Piping Disconnections**
   - **2.1** Disconnect the GN2 warmup supply line from the 4-20 K supply line.
   - **2.2** Disconnect the GN2 warmup supply line from the top plate.
   - **2.3** Remove the Hot Watt if it was used to during the warmup.
   - **2.4** Disconnect the lines labeled "+ LD PDT +" and "- LD PDT +" from the 4-20 K female bayonet vacuum jacket. The lines connect to the high side of the differential pressure transducers.
   - **2.5** Disconnect the lines labeled "+ LD PDT – " and "- LD PDT –" from the positive and negative lead vent stacks, respectively. These lines connect to the low side of the differential pressure transducers.
   - **2.6** Disconnect the vent lines (thermally insulated, non-conductive hoses) to the power lead vent stacks.
   - **2.7** Remove the power lead vent stack from each power lead.
   - **2.8** Remove the test dewar flexible vent line.
   - **2.9** Remove the transfer lines supplying the 4-20 K circuit.

3. **Top Plate and Insert Removal**
   - **3.1** Remove all bolts fastening the top plate to the dewar extension.
   - **3.2** Lift the top plate and insert from the test dewar and set them onto the roll-around cart.
   - **3.3** Tighten the nuts on the underside of the current lead top plate against the plate to provide stability during transportation.

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Stand 3 LHC-HTS Lead Testing:
22. Removal of the Current Leads

1. **Electrical Disconnection of Current Leads from Test Facility**
   - **1.1** Unbolt the heater from each power lead flag.
   - **1.2** Remove the bottom fill tube.
   - **1.3** Remove the He space temperature sensors and the liquid level probes.
   - **1.4** Remove the Kapton and glass tape insulating the low temperature superconducting cable.
   - **1.5** Unclamp the V5 voltage tap wires from the LTS cable.
   - **1.6** Unwind the excess voltage tap wire from around the bottom of each power lead and gather it into a coil. Secure it with tape and let it hang from the end of the power lead.
   - **1.7** Separate the joined LTS cables by opening the mechanical clamp. Recover as much indium as possible.
   - **1.8** Remove the mechanical clamp, the clamp support, and the G-10 clamshell clamp.

2. **Mechanical Removal of Current Leads from Test Facility**
   - **2.1** Using wedges, tilt the insert by 10° so that the power leads are vertical.
   - **2.2** Remove the jam nuts from the tensioning studs.
   - **2.3** Remove the loading nuts and Belleville washer assemblies from the tensioning studs. Put each Belleville washer assembly/loading nut/jam nut group on a threaded rod for storage.
   - **2.4** Use a 5/16 12-point socket to loosen and remove the 20 Conflat bolts connecting the lead plate to the insert top plate.
   - **2.5** Attach the lifting/insertion tool to the lead flag and carefully lift the lead from the top plate.
   - **2.6** With the lead supported by the crane at a reasonable working height, remove the power lead baffle.
   - **2.7** Remove the Conflat copper gasket from the knife edge on the underside of the lead plate.
   - **2.8** Clamp the end support around the lead lower flange so that the handles can rest on the backs of C-channels when the lead is put on a steel table.
   - **2.9** Place the lead on the C-channels, using the end support to prevent any loading on the lower part of the lead.
   - **2.10** Recover as much indium as possible from the power lead LTS cables.
   - **2.11** Remove the upper insulator, PEEK seal, and lower insulator from each chimney.
   - **2.12** Put each upper insulator, PEEK seal, and lower insulator in LN_2. This will drive off the absorbed helium and will greatly improve the system background during the leak check of the next pair of leads to be tested.