SLAC Traveler for LCLS Cu to SXR 1.0D38.37, SA-344-100-01 Dipole Magnets, BRCUS1

(Oct. 8, 2018)

This traveler is intended to cover reception, preparation, mechanical fiducialization, and magnetic measurements of the BRCUS1 dipole magnet. These magnets are refurbished versions of the 1.0D38.37 (SA-344-100-01) that were previously installed in the PEPII Bypass and are about 1m long.

Receiving:

The following information is to be noted upon receipt of the magnets by the SLAC MM group:

Received by (initials):	SDA
Date placed on test stand (dd-mmm-yyyy):	1/7/2019
SLAC barcode number:	4563
Vendor serial number from magnet label:	
SLAC approved electrical safety covers? (Y or N):	
SLAC drawing number (enter number):	SA-344-100-01

Preparation:

A beam direction arrow, with text "beam direction", is to be applied to the top and/or connector side of the magnet with a sticker supplied by LCLS-II. The terminals shall be oriented down beam.

Beam-direction arrow in place (initials):	SDA

Fiducialization:

Fiducialization may be done before or after magnetic measurements. The magnet is to be fiducialized by the CMM group. This will require the installation of removable tooling balls, location of the geometric axis of the poles of the magnet, and location of tooling balls with respect to the center of this geometric axis when the poles are aligned precisely horizontal.

CMM technician (initials):	MR

URL of on-line CMM fiducialization data (please modify or correct if necessary):

Magnetic Measurements:

1) Verify that the magnets are complete and undamaged, including wiring connections.

Incoming inspection OK (initials):	SDA
Date of arrival to mag. meas.(mmm-dd-yyyy):	1/7/2019

Enter URL of on-line magnetic measurements data (please modify or correct if necessary):

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Dipole/4563

2) Mark the magnet as BRCUS1. BRCUS1 is “positive” horizontal bend in polarity (bending electrons up).

Magnet marked as (BRCUS1):	**BRCUS1**

3) Determine the main-coil connection polarity (with main supply outputting positive current) which produces a “positive” horizontal diploe field polarity for BRCUS1 as shown below:

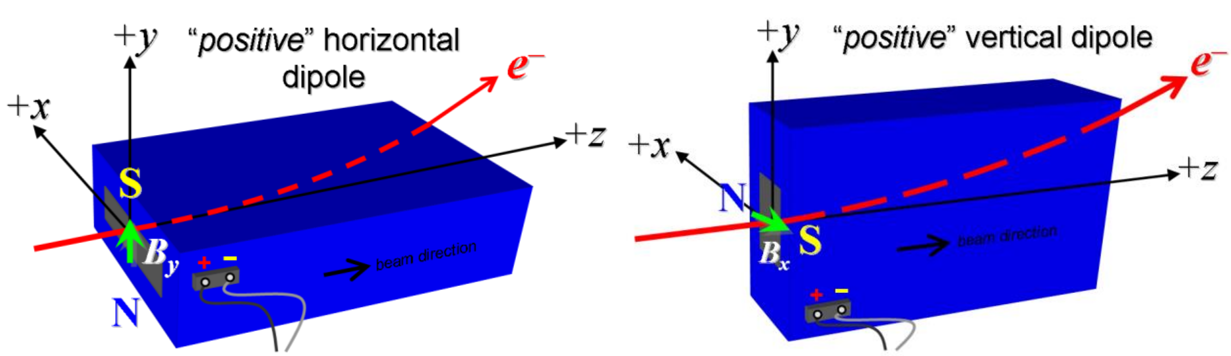

Figure 1. BRCUS1 is “positive” polarity (bending electrons left).

If trim coils exist, mark the polarity near the magnet leads with clear “+” and “–” labels as shown above.

Polarity is marked according to Fig. 1 (initials):	P

4) Also for BRCUS1 mark the **trim** leads with clear "+" and "–" labels such that, with the trim supply outputting positive current, the trim coil *increases* the absolute value of the magnetic field established by the main coil. This will set the trim polarity as "positive" for BRCUS1.

Trim coil polarity chosen from Fig. 1 is (P):	P

5) Connect the magnet terminals, in the correct polarity as established above, to a unipolar (or bipolar) power supply with maximum current $I \geq 200$ A.

6) Connect magnet to LCW supply. Adjust supply pressure to a delta P of ~100 psi to achieve a flow rate of 2.32 gpm. Run the magnet up to 200 A for ~1 hour to warm it up (record, delta P, flow rate, and magnet coil and steel temperature).

LCW delta P (psi)	116 psi
LCW flow rate (gpm)	2.6 gpm
LCW delta T (°C)	0.5 °C
Ambient temperature (°C):	17.9 °C
Final magnet steel temperature (°C):	24.3 °C

7) Standardize the magnet, starting from zero to 200 A and back to zero, through three full cycles, finally ending at zero, with a flat-top pause time (at both 0 and 200 A) of 10 seconds. Use a three-linear ramp rate of 10 A/sec, if possible, and record the ramp rate used.

Standardization complete (initials):	SDA
Ramp rate used (A/sec):	10 A/s

8) Maintaining this cycle history, measure the length-integrated horizontal dipole field, $\int B_y dl$, from 0 to 200 A in 10-A steps, including zero (22 'up' measurements). Then, still maintaining the cycle history, measure $\int B_y dl$ back down from 200 A to 0 in 10-A steps, including zero (22 'down' measurements).

Filename & run number of $\int B_y dl$ up & down data:	wiredat.ru1, wireplt.ru1

9) With the **main** coils still hooked up, connect the **trim** coil to a bipolar 6-A (MCOR6) supply with proper trim polarity as determined above.

10) Still maintaining the cycle history, run the **main** coil up to 200 A, pause at least 10 seconds, and measure $\int B_y dl$ as a function of **trim** coil current from 0 to +6 A in 0.5-A steps, including zero (13 'up' measurements), and again from +6 to –6 A in 0.5-A steps (25 'down' measurements). Set the **trim** current back to 0.

Filename & run # of $\int B_y dl$ **trim** data at I_{main} = 200 A:	Wiredat.ru2, wireplt.ru2

11) Set the **main** coil to 0 current by ramping first up to 200 A, then down to zero at the same ramp rate used in the standardization cycle. Measure $\int B_y dl$ as a function of **trim** coil current from 0 to –6 in 0.5-A steps, including zero (13 'down' measurements), and again from –6 to +6 A in 0.5-A steps (25 'up' measurements). Set the **trim** current to 0.

Filename & run # of $\int B_y dl$ **trim** data at I_{main} = 0:	Wiredat.ru3, wireplt.ru3

12) For all magnets, with main coil at 200A, use a stretched wire to measure the length-integrated vertical field at multiple positions in x. With the wire located at the vertical mid-plane (y = 0), measure the vertical length-integrated field at each 3-mm step of horizontal wire position, from x = –30 mm to +30 mm, with x = 0 centered at the magnet's horizontal center. Record data file name:

Filename:	wirevsx.ru1, wirepltvsx.ru1

13) Confirm zero integrated field trim current. Use data from step 11 and find the current (zero current) that gives a zero intregrated field for the magnet. Standardize the main, set it to 0 current and turn off main supply. Measure the length-integrated vertical field at zero_current +/- 0.5, 1, 1.5 and 2 A. Confirm that the zero field trim current is correct to within the specified tolerance. Confirm that the zero field trim current is correct to within the specified tolerance. If not, repeat measurements using new data to determine the zero field trim current.

Filename:	Wiredat.ru4, Wireplt.ru4
Zero field trim current (A)	-1.9417 +/- 8.4094e-03
Measured integrated field with trim at zero field current. (T-m)	0.000014 +/- 0.000056

14) Measure the inductance and resistance of the **main** and **trim** magnet coils:

Inductance of **main** coil (mH):	2.034 mH
Resistance of **main** coil (Ohms):	0.0535 Ohm
Inductance of **trim** coil (mH):	0.733 mH
Resistance of **trim** coil (Ohms):	0.4408 Ohm

15) Measure pole tip field of the main at 200 A

Pole Tip Field and Current	0.696 T at 200.0194 A

16) Upon completion of tests, send data link to Mark Woodley who will produce a data analysis file. Place data analysis file in magnetic measurements data directory

Magnet data accepted and data analysis file produced	SDA

Enter URL of on-line magnetic measurements analysis data :

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Dipole/4563