SLAC Traveler for LCLS-II 1.0D38.37, SA-344-100-01 Dipole Magnets, BRB1 and BRB2

(Oct. 29, 2018)

This traveler is intended to cover reception, preparation, mechanical fiducialization, and magnetic measurements of the BRB1 and BRB2 dipole magnets. These magnets are refurbished versions of the 1.0D38.37 (SA-344-100-01) that were previously installed in the PEPII Bypass line 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):	11/26/2018
SLAC barcode number:	4557
Vendor serial number from magnet label:	17
SLAC approved electrical safety covers? (Y or N):	N
SLAC approved lifting eyes? (Y or N):	N
Shipping Damage? (Y or N):	N/A
Vendor tests passed on magnet label? (Y or N):	N/A
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):	11/26/2018

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/4557/

2) Mark each magnet as BRB1 or BRB2. BRB1 is "negative" polarity (bending electrons to the right), and BRB2 is "positive" polarity (bending electrons to the left).

Magnet marked as (BRB1 or BRB2):	BRB1

3) Determine the main-coil connection polarity (with main supply outputting positive current) which produces a "positive" field polarity for BRB2 and "negative" field polarity for BRB1 as shown below:

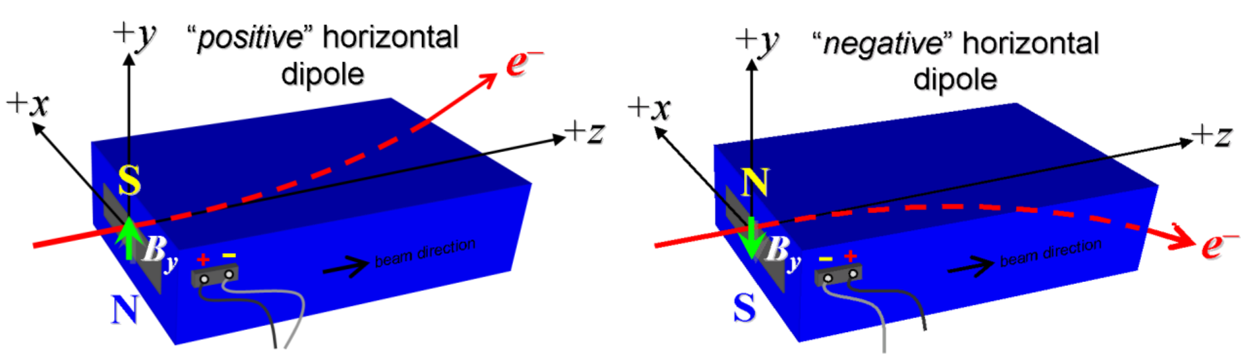

Figure 1. BRB2 is "positive" polarity (bending electrons left or up) and is "negative" polarity (bending electrons right or down).

4) Mark the polarity near the magnet leads with clear "+" and "–" labels as shown above.

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

5) Also for BRB1 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 "negative" for BRB1.

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

6) Connect the magnet terminals, in the correct polarity as established above, to a unipolar (or bipolar) power supply with maximum current $I \geq 265$ A.

7) 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 265 A for ~1 hour to warm it up (record, delta P, flow rate, and magnet coil and steel temperature).

LCW delta P (psi)	117 psi
LCW flow rate (gpm)	2.6 gpm
LCW delta T (°C)	3.4 °C
Ambient temperature (°C):	20.3°C
Final magnet steel temperature (°C):	25.7 °C

8) Standardize the magnet, starting from zero to 265 A and back to zero, through three full cycles, finally ending at zero, with a flat-top pause time (at both 0 and 265 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/sec

9) Maintaining this cycle history, measure the length-integrated vertical dipole field, $\int B_y dl$, from 0 to 265 A in 10-A steps, including zero (27 'up' measurements). Then, still maintaining the cycle history, measure $\int B_y dl$ back down from 265 A to 0 in 10-A steps, including zero (27 'down' measurements).

Filename & run number of ∫Bydl up & down data:	Wiredat.ru1, wireplt.ru1

10) **For one magnet only**, with main coil at 92 A (92 A ~= nominal int field of 3.266 kGm), use a stretched wire to measure the length-integrated vertical dipole field at multiple positions in x. With the wire located at the vertical mid-plane (y = 0), measure the length-integrated vertical dipole 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 vertical center. Record data file name:

Filename:	Measurement made on BRB2 (4560)

11) 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. The ramp type should be linear, 1 A/s with a 10 second settle time. Please note below the ramp type (i.e. 3_LINEAR), ramp rate (A/s), and settle time (s) to be used in the trim coil measurements.

Ramp type:	Linear
Ramp rate:	1 A/s
Settle time:	10 s

12) Still maintaining the cycle history, run the **main** coil up to 265 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} = 262 A:	Wiredat.ru2, wireplt.ru2

13) Set the **main** coil to 0 current by ramping first up to 265 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

14) For all magnets, with main coil at 262A, use a stretched wire to measure the length-integrated vertical dipole field at multiple positions in x. With the wire located at the vertical mid-plane (y = 0), measure the length-integrated vertical dipole 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

15) **For one magnet only**, use a rotating coil to measure the harmonics with main coil at 25A, 75A, 125A, 175A, 262A with at least a 0.5-inch diameter (use smaller probe only if 0.5-inch is not available, staying with largest diameter possible). Record probe designation, radius, and data file names:

Coil designation (text):	No Coil available of this size
Coil radius (m):	m
Filename:	

16) **For one magnet only**, and at a **main** current of 262 A with **trim** at zero, measure the vertical magnetic field component, B_y, at $x = y = 0$, as a function of the longitudinal beam-direction coordinate, z (from -10 cm to +30 cm in 1-cm steps, where $z = 0$ is defined at the iron edge), at the *downstream* end of this one magnet. Please also measure the background field at $z = +30$ cm with magnet switched off (separate file).

Filename of By vs. z data for exit edge:	bhvszdat.ru4, bhvszplt.ru4
Background filename of $B_y(z = 30\text{ cm})$, magnet OFF:	bhvszdat.ru5, bhvszplt.ru5

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

Inductance of main coil (mH):	1.818 mH
Resistance of **main** coil (Ohms):	0.0532 Ohm
Inductance of **trim** coil (mH):	0.696 mH
Resistance of **trim** coil (Ohms):	0.4506 Ohm

18) Measure pole tip field of the main at 265 A

Pole Tip Field and Current	0. 910 T @ 265.05193 Amps

19) 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/4557/BRB1.pptx