SLAC Traveler for LCLS-II Speader Area 0.625SD38.98, SA-375-150-75 Septum Magnets
(June 26, 2019)

This traveler is intended to cover mechanical fiducialization, and magnetic measurements of the two Spreader Area septum magnets BLXSPH & BLXSPS. These magnets are part of the Beam Spreader line and each is paired with a kicker. Both septa have a round field free channel and a rectangular channel whose field will kick the beam. The table below gives the MAD names, model drawing numbers, polarities, and installation directions of the septa.

MAD Name	Eng. Name	Drawing#	Barcode	Polarity	Terminals
BLXSPH	0.625SD38.98	SA-375-150-75	4585	P	downstream
BLXSPS	0.625SD38.98	SA-375-150-75	4586	N	downstream

Table 1: Spreader Area Septa Parameters.

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):	6/26/2019
SLAC barcode number:	4586
Serial number from magnet label:	1
SLAC approved electrical safety covers? (Y or N):	N

Fiducialization:

Fiducialization will be done before magnetic measurements by the CMM or Alignment 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. The pole gap should also be measured.

CMM technician (initials):	

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

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Fiducial%20Reports/

Magnetic Measurements:

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/Septum/4586

1) 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. The MAD name label should also be attached to the magnet. Polarity in the rectangular bending field channel should be verified, as shown below with the current polarity marked near the magnet leads with clear "+" and "-" labels.

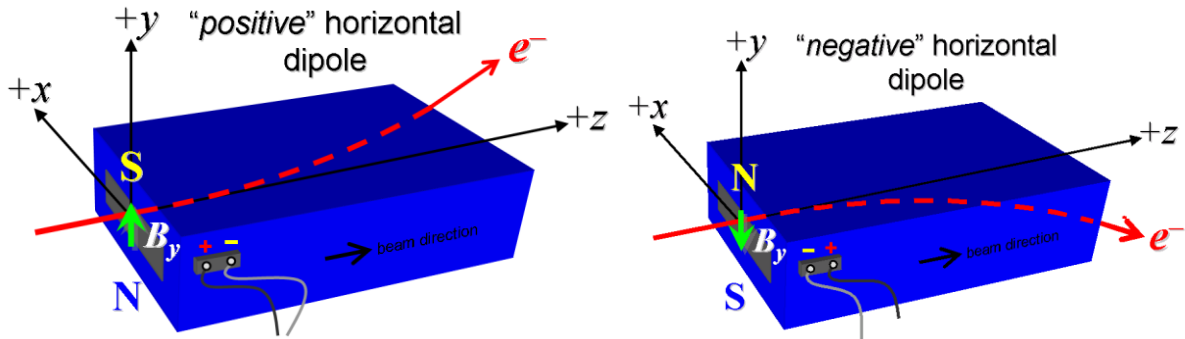|	
Beam Direction and MAD name marked (initials):	SDA
Polarity marked according Table 1 parameters and to Fig. 1:	N

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

2) 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.

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

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

Inductance of **main** coil (mH):	0.804 mH
Resistance of **main** coil (Ohms):	0.0355 Ohm
Inductance of **trim** coil (mH):	0.293 mH
Resistance of **trim** coil (Ohms):	0.1121 Ohm

4) Connect the magnet terminals, in the correct polarity as established above, to a unipolar (or bipolar) power supply with maximum current $I \geq 130$ A.

5) Connect magnet to LCW supply. Adjust supply pressure to a delta P of ~51 psi to achieve a flow rate of 0.46 gpm. Run the magnet up to 130 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)	0.38 gpm
LCW delta T (°C)	3.0 °C
Ambient temperature (°C):	23.0 °C
Final magnet steel temperature (°C):	25.8 °C

6) Ramp the main of the magnet to 130 A and measure the pole tip field. It should be > 0.387 Tesla.

Pole Tip Field and Current	0.45506 T @ 129.95912 Amps

7) Ramp the main of the magnet to 0 A and then ramp the trim to +6 A and measure the pole tip field. After measurement turn off trim supply.

Trim Pole Tip Field and Current	0.01144 T @ 6.00328 Amps

8) Standardize the magnet, starting from 0 to 130 A and back to zero, through three full cycles, finally ending at zero, with a flat-top pause time (at both 0 and 130 A) of 10 seconds. Use a three-linear ramp rate of 10 A/sec, record the ramp rate used.

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

9) Align the stretched wire in the rectangular bending field channel. Measure the length-integrated vertical dipole field, ∫$B_y dl$, from 0 to 130 A in the rectangular bending field channel in 10-A steps, including zero (14 'up' measurements). Then, still maintaining the cycle history, measure ∫$B_y dl$ back down from 130 A to 0 in 10-A steps, including zero (13 'down' measurements).

Filename & run number of ∫$B_y dl$ up & down data:	Wiredat.ru1, wireplt.ru1

10) Still maintaining the cycle history, run the **main** coil up to 130 A, pause at least 10 seconds, and measure ∫$B_y dl$ in the rectangular bending field channel as a function of **trim** coil current from 0 to -6 A 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 back to 0. Use a 0.6 A/s linear ramp rate with a 10 second settle time for the trim.

Filename & run # of ∫$B_y dl$ **trim** data at I_{main} = 130 A:	Wiredat.ru2, wireplt.ru2

11) Set the **main** coil to 0 current after standardizing. Measure ∫$B_y dl$ in the rectangular bending field channel 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 ∫$B_y dl$ **trim** data at I_{main} = 0:	Wiredat.ru3, wireplt.ru3

12) With the main coil at 130 A, measure the length-integrated vertical field at multiple x positions in the rectangular bending field channel. 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 = −21 mm to +21 mm, with x = 0 centered at the magnet's horizontal center. Record data file name:

Filename of ∫$B_y dl$ vs x data at 130 A:	Wirevsx.ru1, wirepltvsx.ru1

13) Align the stretched wire into field free round channel. Standardize the magnet and measure ∫$B_y dl$ in the field free channel as a function of **main** coil current at 0, 50, 100 and 130 A steps. Also measure the ∫$B_y dl$ in the field free channel with the main power supply off.

Filename of ∫$B_y dl$ vs main current in field free region:	Wiredat.ru4, wireplt.ru4

14) Standardize the magnet and set the **main** coil to 0 A, then measure ∫$B_y dl$ in the field free channel as a function of **trim** coil current from 0 to -6 in -2 A steps, including zero 4 'down' measurements), and again from -6 to 6 A in 2 A steps (5 'up' measurements). Set the **trim** current to 0.

Filename of ∫$B_y dl$ in field free region *with Main at 0 A vs* trim current	Wiredat.ru5, wireplt.ru5

15) Standardize the magnet and set the **main** coil to 130 A, then measure $\int B_y dl$ in the field free channel as a function of **trim** coil current from 0 to -6 in -2 A steps, including zero (4 'down' measurements), and again from -6 to 6 A in 2 A steps (6 'up' measurements). Set the **trim** current to 0.

Filename of $\int B_y dl$ in field free region *with Main at 130 A vs* trim current	Wiredat.ru6, wireplt.ru6

16) Standardize the magnet and set the **main** coil to 130 A, then measure $\int B_y dl$ in the field free channel vs X from -6 to + 6 mm in 2 mm steps.

Filename of $\int B_y dl$ *vs X* in field free region *with Main at 130 A*	Wirevsx.ru7, wirepltvsx.ru7

17) Standardize the magnet and measure $\int B_x dl$ in the field free channel as a function of **main** coil current at 0, 50, 100, and 130 A steps. Also measure the $\int B_x dl$ in the field free channel with the main power supply off.

Filename of $\int B_x dl$ *vs* main current in field free region:	Wiredat.ru8, wireplt.ru8

18) Standardize the magnet and set the **main** coil to 0 A, then measure $\int B_x dl$ in the field free channel as a function of **trim** coil current from 0 to -6 in -2 A steps, including zero (4 'down' measurements), and again from -6 to 6 A in 2 A steps (6 'up' measurements). Set the **trim** current to 0.

Filename of $\int B_x dl$ *with Main at 0 A vs* trim current in field free region:	Wiredat.ru9, wireplt.ru9

19) Standardize the magnet and set the **main** coil to 130 A, then measure $\int B_x dl$ in the field free channel as a function of **trim** coil current from 0 to -6 in -2 A steps, including zero (4 'down' measurements), and again from -6 to 6 A in 2 A steps (6 'up' measurements). Set the **trim** current to 0.

Filename of $\int B_x dl$ *with Main at 130 A vs* trim current in field free region:	Wiredat.r10, wireplt.r10

20) Standardize the magnet and set the **main** coil to 130 A, then measure $\int B_x dl$ in the field free channel vs Y from -6 to + 6 mm in 2 mm steps.

Filename of $\int B_y dl$ *vs X* in field free region *with Main at 130 A*	Wirevsx.r11, wirepltvsx.r11

21) 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/Septum/4586/BLXSPS_4586.pptx