SLAC Traveler for LCLS-II 0.79D14.96, SA-375-150-60 H-Bend Magnets

(March 11, 2020)

This traveler is intended to cover mechanical fiducialization, and magnetic measurements of the 0.79D14.96 Bends BXDG0 and it's spare unit. These magnets are part of the injector line and each is paired with a HLAM 0.79SD14.96 Septum. The table below gives the MAD names, model drawing numbers, polarities, and installation directions of the bends.

MAD Name	Eng. Name	Drawing#	Barcode	Polarity	Bus Bars
BXDG0	0.79D14.96	SA-375-150-60	4491	P	Left Side
SPARE 0.79D14.96	0.79D14.96	SA-375-150-60	4487	P	Left Side

Table 1: Injector 0.79D14.96 Bend 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):	6/22/2020
SLAC barcode number:	4491
Serial number from magnet label:	1
S/LAC 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):	BR

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

https://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Fiducial%20Reports/4491%20Dipole%200.79D14.96%20ID7875%20SN01%20Tooling%20Balls%20(mm).txt

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/Dipole/4491

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 bus bars shall be oriented on the left side of the magnet while looking downbeam. The MAD name label should also be attached to the magnet. Polarity in the rectangular bending field channel must be verified, as shown below with the current polarity marked near the magnet lead terminals with clear "+" and "-" labels.

Beam Direction and MAD name marked (initials):	BXDG0
Polarity marked according Table 1 parameters and to Fig. 1:	P

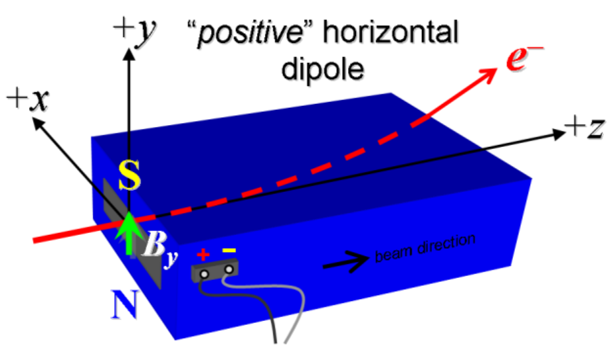

Figure 1 Bend 0.79D14.96 is "positive" polarity (bending electrons left).

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):	P

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

Inductance of **main** coil (mH):	0.183 mH
Resistance of **main** coil (Ohms):	0.298 Ohm
Inductance of **trim** coil (mH):	0.175 mH
Resistance of **trim** coil (Ohms):	0.0455 Ohm

4) Connect the magnet terminals, in the correct polarity as established above, to a unipolar 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 0.21 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)	80 psi
LCW flow rate (gpm)	0.25 gpm
LCW delta T (°C)	5.31 °C
Ambient temperature (°C):	25.7 °C
Final magnet steel temperature (°C):	26.8 °C

6) Ramp the main of the magnet to 130 A and measure the pole tip field. It should be close to 0.1312 Tesla.

Pole Tip Field and Current	0.1606 T @ 130.06476 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	0.00709 T @ 5.99862 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 cosine ramp rate of 10 A/sec, record the ramp rate used.

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

9) Align the stretched wire in the rectangular bending field channel. Measure the length-integrated vertical dipole field, $\int B_y dl$, 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 $\int B_y dl$ back down from 130 A to 0 in 10-A steps, including zero (13 'down' measurements).

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

11) Set the **main** coil to 0 current after standardizing. Measure $\int B_y dl$ 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 $\int B_y dl$ **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 $\int B_y dl$ vs x data at 130 A:	Wirevsx.ru1, wirepltvsx.ru1

13) 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/4491/BXDG0.pptx