**Revision History**

| Revision | Date Released | Description of Change |
|---|---|---|
| R0 | September 13, 2017 | Original Release. |
| R1 | February 12, 2019 | Updated contact, URL, and labeling information |

This traveler is intended to cover reception, preparation, mechanical fiducialization, and magnetic measurements of the six sector 14 bunch-compressor (BC14) chicane type 1.34D19.3 dipole magnets. There are two variants of this dipole,

- "center" variant SA-257-060-44, with straight pole edges (4 pcs), corresponding to MAD designations BCX14796 and BCX14808
- "edge" variant SA-257-060-40 with pole featuring an entrance/exit angle (2 pcs), corresponding to MAD designations BCX14720 and BCX14883

to be used at the beamline locations shown in Figure 2 at the end of this document. The magnet design is based on the existing LCLS-II BC2 dipole 1D19.7, featuring the same main and trim coils, and this traveler is also based on the LCLS-II version, containing the same tests but with current levels and target values updated where appropriate.

**Receiving:**

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

| | |
|---|---|
| Received by (initials): | SDA |
| Date received (dd-mmm-yyyy): | 3/21/2019 |
| Vendor serial number from magnet label: | Center 1 |
| SLAC approved electrical safety covers? (Y or N): | Y |
| SLAC approved lifting eyes? (Y or N): | N |
| Shipping Damage? (Y or N): | N |
| Vendor tests passed on magnet label? (Y or N): | Y |
| SLAC drawing number (enter number): | SA-257-060-44 |

**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):

| |
|---|
| http://www-group.slac.stanford.edu/met/MagMeas/MagData/FACET_II/Fiducial%20Reports/http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/FACET_II/Fiducial%20Reports/1.34D19.3%20BC14%20PO180085%20CENTER%20SN001.xlsx |

**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): | 3/21/2019 |

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

| |
|---|
| http://www-group.slac.stanford.edu/met/MagMeas/MagData/FACET_II/Dipole/ BCX14976/ |

2) Determine the main-coil connection polarity (with main supply outputting positive current) which produces a “positive” field polarity for the “edge” variant dipoles (below left), but a “negative” field polarity for the “center” variant dipoles (below right), as shown in Figure 1 below.

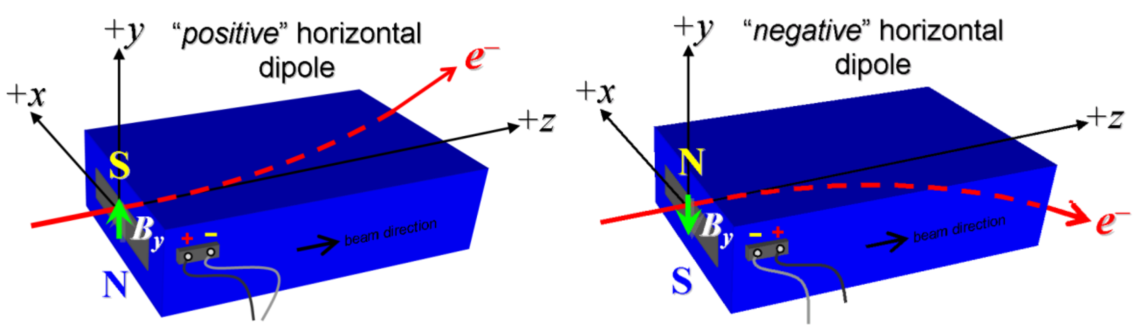


**Figure 1: “edge” dipoles SA-257-060-40 are “positive” (left), while “center” dipoles SA-257-060-44 are “negative” (right).**

3) Mark the polarity near the **main** magnet leads with clear “+” and “–” labels as shown above.

| | |
|---|---|
| **Main** coil polarity chosen from Figure 1 is (P or N): | N |

4) Also 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 the "edge" variant dipoles and "negative" for the "center" variant dipoles, following the same conventions as for LCLS-II[1].

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

5) Connect the **main** magnet terminals (not the trims), in the correct polarity as established above, to a unipolar power supply with maximum current $I \geq 200$ A (assuming this current produces about 8.6 kG-m integrated field). Leave the trim coil disconnected for now.

6) Connect magnet to LCW supply. Adjust supply pressure to a delta P of ~119 psi to achieve a flow rate of 2.25 gpm. Run the magnet up to 200 A for ~1 hour to warm it up (record, delta P, flow rate, and temperature).

| | |
|---|---|
| LCW delta P (psi) | 118 psi |
| LCW flow rate (gpm) | 2.7 gpm |
| LCW delta T (°C) | 6.0 °C |
| Ambient temperature (°C): | 20.1 °C |
| Final magnet temperature (°C): | 24.6 °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 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 |

8) Maintaining this cycle history, measure the length-integrated vertical dipole field, $\int B_y dl$, from 0 to 200 A in 20-A steps, including zero (11 'up' measurements). Please record (below) the current necessary to achieve 6.3 kG-m. Then, still maintaining the cycle history, measure $\int B_y dl$ back down from 200 A to 0 in 20-A steps, including zero (11 'down' measurements).

| | |
|---|---|
| Main coil excitation current at 6.3 kG-m: | 145.7865 Amps |
| Filename & run number of $\int B_y dl$ up & down data: | Wiredat.ru1, wireplt.ru1 |

[1] LCLS-II-2.4-PR-0064, https://docs.slac.stanford.edu/sites/pub/Publications/Polarity.pdf

9) With the **main** coils still hooked up, connect the **trim** coil to a bipolar 12-A (MCOR12) supply with proper trim polarity as determined above.

10) 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 –12 in 1-A steps, including zero (13 'down' measurements), and again from –12 to +12 A in 1-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.ru2, wireplt.ru2 |

11) For all four dipoles, with stretched wire, measure the vertical length-integrated field component over a horizontal span of ±45 mm (±1.7 inches), at each 3-mm interval, at the following **main** and **trim** coil current settings.

- $I_{main}$ = 143 A, and $I_{trim}$ = 0
- $I_{main}$ = 143 A, and $I_{trim}$ = +12 A
- $I_{main}$ = 200 A, and $I_{trim}$ = 0

| | |
|---|---|
| Filename & run # of $\int B_y dl$ vs. $x$ data at 143, 0 A: | Wirevsx.ru3, wirepltvsx.ru3 |
| Filename & run # of $\int B_y dl$ vs. $x$ data at 143, +12 A: | Wirevsx.ru4, wirepltvsx.ru4 |
| Filename & run # of $\int B_y dl$ vs. $x$ data at 200, 0 A: | Wirevsx.ru1, wirepltvsx.ru1 |

12) **For the first "edge" variant dipole only**, and at a **main** current of 143 A, with **trim** current at zero, measure the vertical magnetic fringe 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 *angled* end of this one magnet. Please also measure the background field at $z$ = +30 cm with magnet switched off (separate file).

| | |
|---|---|
| Filename of $B_y$ vs. $z$ data: | Measured on BCX14720 |
| Background filename of $B_y(z = 30$ cm), magnet OFF: | Measured on BCX14720 |

13) **For one magnet only**, perform this final thermal test. Run the **main** current up to 200 A, and with **trim** also set at its maximum operating current of +12 A, measure the magnet temperature after it stabilizes (~1 hour). Record the temperature below.

| | |
|---|---|
| Ambient temperature (°C): | Measured on BCX14720 |
| Final stable magnet temperature at 200 A (°C): | Measured on BCX14720 |

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

| | |
|---|---|
| Inductance of **main** coil (mH): | 4.927 mH |
| Resistance of **main** coil (Ohms): | 0.1625 Ohm |
| Inductance of **trim** coil (mH): | 2.255 mH |
| Resistance of **trim** coil (Ohms): | 0.2829 Ohm |

15) Upon completion of tests, send traveler to Glen White at MS 54.

This section is to be completed by Glen White.

| | |
|---|---|
| Magnet accepted: | Via email |
| Assigned beamline location (MAD-deck name): | BCX14976 |
| Magnet marked with assigned MAD-deck name (initials): | SDA |
| Beam-direction arrow in place (initials): | Not applied, no drawing given |

The beam direction arrow, with text “beam direction”, is to be applied to the top and/or tunnel aisle side of the magnet with a sticker supplied by FACET-II. The beam direction should agree with the magnet mechanical orientation at the assigned location according to the sector 14 bunch compressor installation drawing ID-257-002-01.

16) Upon full completion, send this traveler to Eric Bong at MS 51.

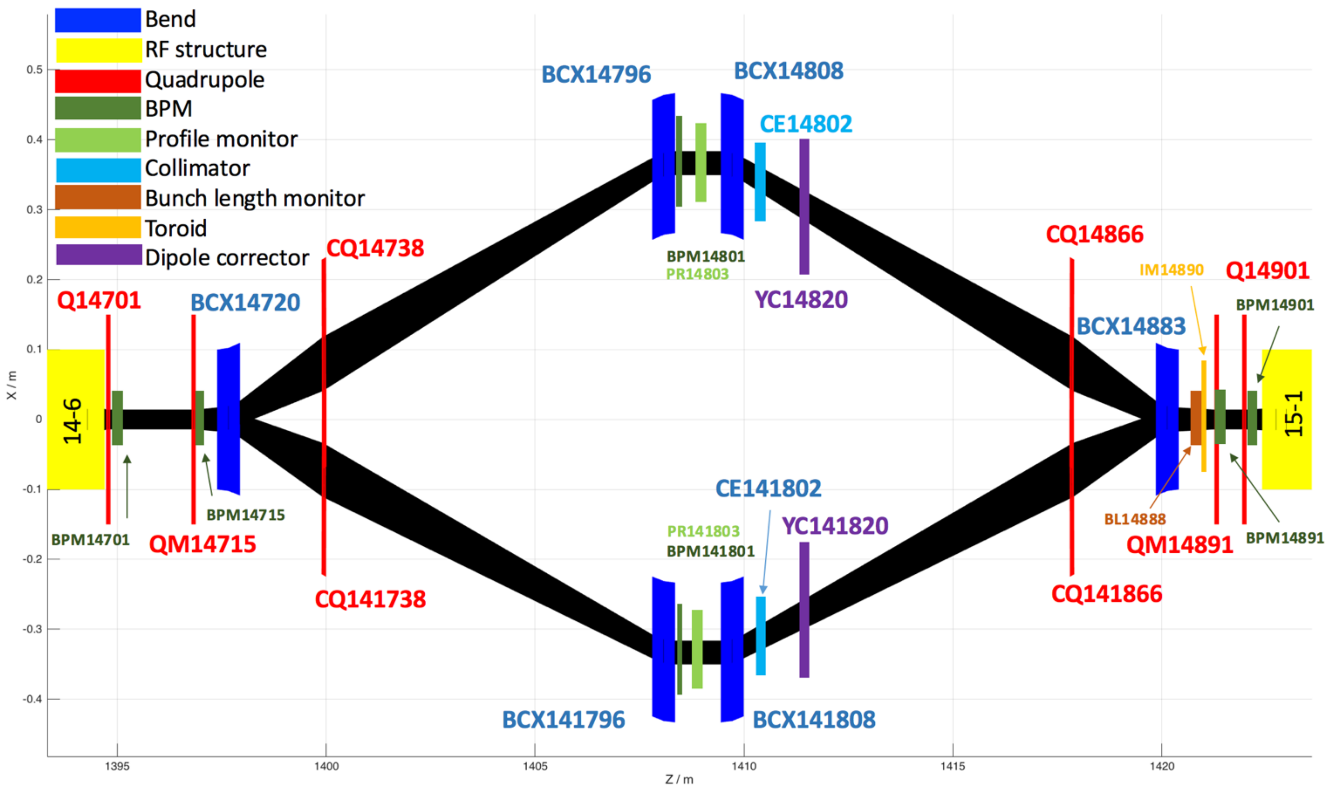


Figure 2: from "FACET-II-PR-042" sector 14 bunch compressor layout schematic in Z,X coordinates with magnet MAD-deck names indicated. The electron beam path goes through the +X side of bunch compressor and the positron beam path goes through the –X side. The "center" variant dipole, drawing number SA-257-060-44 is used at lattice locations BCX14796 and BCX14808 (electron side) and at lattice locations BCX141796 and BCX141808 (positron side). The "edge" variant dipole, drawing number SA-257-060-40, is used at lattice locations BCX14720 and BCX14883.