## SLAC Traveler for LCLS-II 1.0D38.37, Dipole Magnets, BRDAS1 and BRDAS2 for S30XL

**(June 27, 2022)**

This traveler is intended to cover reception, preparation, mechanical fiducialization, and magnetic measurements of the BRDAS1 and BRDAS2 dipole magnets. 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:

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| Received by (initials): | SDA |
| Date placed on test stand (dd-mmm-yyyy): | 8/1/2022 |
| SLAC barcode number: | L204588 |
| Vendor serial number from magnet label: | PR10 |
| SLAC approved electrical safety covers? (Y or N): | N |

**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. Mark the MAD names.

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| Beam-direction arrow in place (initials): | SDA |
| Magnet marked as (BRDAS1 or BRDAS2): | BRDAS2 |

**Fiducialization:**

Fiducialization must be done before the magnetic measurements. The magnet is to be fiducialized by the CMM or alignment group. This will require the 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 magnet gap at both ends will be recorded.

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| CMM technician (initials): | HI |

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

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| <http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Fiducial%20Reports/LCLS-II> L204588 BRDAS2 1.0D38.37 Fiducial Report.xlsx |

**Magnetic Measurements:**

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

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| http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Dipole/4588 |

1. Perform Safety Checks

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| **Safety Check** | **Intitials** |
| Disconnect Thermal Switch Chain and Verify Trip Power Supply Interlocks | SDA |
| Verify that no Water Flow trips the Flow Switch Power Supply Interlocks | SDA |

1. Mark the polarity of each horizontal dipole magnet. BRDAS1 is a “negative” polarity (bending electrons right) and BRDAS2 is a “positive” polarity (bending electrons left). Determine the main-coil connection polarity (with main supply outputting positive current) which produces a “negative” field polarity for BRDAS1 and a “positive” field polarity for BRDAS2, as shown below:



**Figure 1. BRDAS1 is a “negative” polarity (bending electrons right) and BRDAS2 is a “positive” polarity (bending electrons left).**

1. Mark the polarity near the magnet leads with clear “+” and “” labels as shown above

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

1. Connect the magnet terminals, in the correct polarity as established above, to a unipolar power supply with maximum current *I* ≥ 200 A.
2. 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).

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| --- | --- |
| LCW delta P (psi) | 109 psi |
| LCW flow rate (gpm) | 2.9 gpm |
| LCW delta T (°C) | 2.93 °C |
| Ambient temperature (°C): | 27.4°C |
| Final magnet steel temperature (°C): | 29.0°C |
| Final magnet coil temperature (°C): | 32.4 °C |

1. 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 cosine ramp rate of 10 A/sec, if possible, and record the ramp rate used.

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

1. Maintaining this cycle history, measure the length-integrated horizontal dipole field, ∫*Bydl*, from 0 to 200 A in 10-A steps, including zero (21 ‘up’ measurements). Then, measure ∫*Bydl* back down from 200 A to 0 in 10-A steps, including zero (20 ‘down’ measurements).

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

1. With the main coil at 200 A, 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:

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| --- | --- |
| Filename & run number of ∫*Bydl vs X* data: | Wirevsx.ru1, wirepltvsx.ru1 |

1. **For one magnet only**, and at a **main** current of 200 A, measure the vertical magnetic field component, *By*, 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 *upstream* end of this one magnet. Please also measure the background field at *z* = +30 cm with magnet switched off (separate file).

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| Filename of *By* vs. *z* data for exit edge: | Measured on LCLS-II Dipole 4558 |
| Background filename of *By*(*z* = 30 cm), magnet OFF: | Measured on LCLS-II Dipole 4558 |

1. Measure the inductance and resistance of the **main** magnet coils:

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| --- | --- |
| Inductance of **main** coil (mH): | 4.83 mH |
| Resistance of **main** coil (Ohms): | 0.541 Ohm @ 29.2 C |

1. Measure pole tip field with the main at 200 A and the trim at 0.

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| Pole Tip Field and Main Current | 0.693 T @ 200.02104 A |

1. 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

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| Magnet data accepted and data analysis file produced | SDA |
| Enter name of magnetic measurements analysis data file : | BRDAS2.pptx |