# SLAC Traveler for LCLS Everson-Tesla Quadrupole Magnets

This traveler is intended to cover reception, preparation, mechanical fiducialization, and magnetic measurements of the Everson Tesla quadrupole magnets Thirty of these magnets were ordered, 12 for the injector, 7 for the linac, 7 for the LTU, and four are spares.

## Receiving:

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

| | | |
|---|---|---|
| Received by | [signature] | name |
| Date received | 9/23/2005 | mm/dd/yy |
| SLAC barcode number: | | # 408 |
| SLAC drawing number: | SA-380-309-00r0 | |
| Vendor serial number from magnet label: | 001 | # |
| SLAC approved electrical safety covers? | Y | (Y)/N |
| SLAC approved lifting eyes? | | (Y)/N |
| Shipping Damage? | | Y/(N) |
| Vendor tests passed on magnet label? | | (Y)/N |

| | |
|---|---|
| Place Duplicate BarCode Sticker Here: | SLAC LCLS 000408 |

All paper documentation that accompanies the magnets should be sent to Roger Carr, MS 102

| | | |
|---|---|---|
| Paperwork sent: | Roger Carr | technician name |

## Preparation:

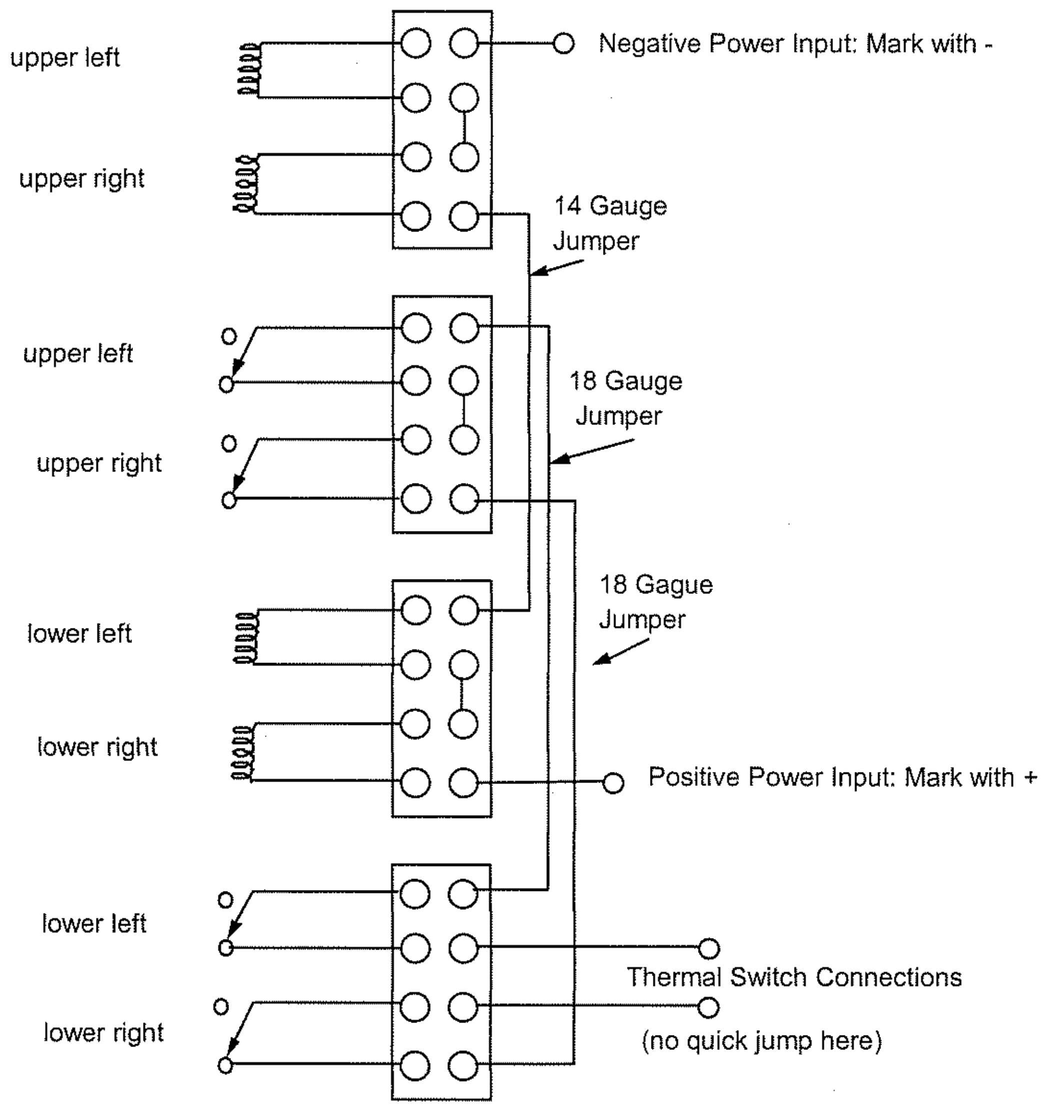
The following tasks are to be undertaken by the SLAC MFD group to prepare the magnets:

1) The mirror plates and standoffs are to be removed from these magnets. Please store these mirror plates and standoffs, and do not discard.

| | | |
|---|---|---|
| Mirror plates removed | Luis Juarez | technician name |

2) A beam direction arrow, with text "beam direction", is to be affixed to the top and connector side of the magnet, preferably by stenciling or rubber stamp, or by sticker supplied by LCLS The arrow is to point away from the face of the magnet that has the coil bus wires. The coil bus wires are thus on the upstream side of the magnet. The positive and negative power leads are to be marked with '+' and '-' stickers, as shown in the wiring diagram.

3) A 14 gauge multistrand wire with red, non-teflon insulation is to be prepared with spade lugs and installed as shown in the wiring diagram below:




left and right refer to observer looking downstream, in the beam direction

| | | |
|---|---|---|
| 14 Gauge Jumper installed | S. RYAN / | installer name |

4) Two 18 gauge multistrand wire jumpers with red, non-teflon insulation are to be prepared with spade lugs and installed as shown in the wiring diagram above.

| | | |
|---|---|---|
| 18 Gauge Jumpers installed | S. RYAN / | installer name |

5) The magnet is to be mounted a T-1 stage, oriented according to the correct beam direction, as shown in the photo:

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

This requirement is for the first 15 magnets; the next 9 may be mounted on various stages.

| | | |
|---|---|---|
| T-1 Stage Installed | S. RYAN | installer name |

**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 pole tips of the magnet, and location of tooling balls with respect to the center of this geometric axis when the poles are aligned precisely at ±45 degrees to horizontal and vertical axes.

| | | |
|---|---|---|
| CMM technician | KEITH CABAN 10/4/05 | name |

URL of on-line CMM fiducialization data:

| |
|---|
| \\Web002\www-group\met\Quality\FIDUCIAL REPORTS\LCLS QUADS\LCLS QUAD 001.pdf |

**Magnetic Measurements:**

Upon receipt of the magnet, the following information should be recorded:

| | | |
|---|---|---|
| Date of arrival to Mag. Meas. group: | 11/4/2005 | mm/dd/yy |
| Responsible measurement operator name: | Scott Anderson | name |

The magnetic measurements group is requested to perform the following tasks:

1) Verify that the magnets have mirror plates removed, jumpers correctly installed, and beam direction arrows put on. Also inspect magnet for any visible flaws and damage.

| | | |
|---|---|---|
| Incoming inspection OK | Scott Anderson | technician name |

2) Connect the magnet to a bipolar 12-A power supply, preferably an *MCOR12*. Use care in turning these supplies on and off to limit current spikes that may occur. Run the magnet up to 8 A for ~30 minutes to warm it up (record temperature).

| | | |
|---|---|---|
| Power supply type | MCOR 12 | text |
| Magnet connected and warmed up | Scott Anderson | technician name |
| Magnet temperature achieved | 26.43 | deg ~~F~~ C |

3) Standardize the magnet, starting from 0 to +12 A, then through 3 full cycles from +12 A to −12 A and back up to +12 A, finally ending at −12 A (the *MCOR12* ramp rate is not controllable, but a flat-top pause time of 10 seconds is desired at each maximum and minimum current).

| | | |
|---|---|---|
| Magnet standardized | [illegible] | technician name |

4) Maintaining the history cycle, measure length integrated ∫*Gdl* with a calibrated rotating coil, from −12 A to +12 A in 1-A steps, including zero (25 'up' measurements).

| | | |
|---|---|---|
| Rotating Coil Designation | DC2_54 | name |
| Rotating coil radius | 0.012313 | meters |
| Final data file name & run number | strdat.ru3 | name and # |

5) Still maintaining the history cycle, measure ∫*Gdl* with a calibrated rotating coil back down from +12 A to −12 A in 1-A steps, including zero (25 'down' measurements).

| | | |
|---|---|---|
| Final data file name & run number | strdat.ru3 | name and # |

6) Measure field harmonics at −12, −6, +1, +6, and +12 A settings using a 1-inch or 0.8-inch diameter probe.

Coefficients of Magnetic Moment Series (expressed in % of n=2 -> 100%)
@ Radius = 0.012313

| Current (A) | Sextupole % (n = 3) | Dodecapole % (n = 6) | 20-pole % (n = 10) |
|---|---|---|---|
| −12 | 0.18218 | 0.28115 | 0.02143 |
| −6 | 0.16769 | 0.28012 | 0.01915 |
| +1 | 0.20563 | 0.27064 | 0.01479 |
| +6 | 0.16689 | 0.27778 | 0.01556 |
| +12 | 0.18352 | 0.28088 | 0.01794 |

Harmonics file = hardat.ru4

7) Measure the inductance and resistance of the full magnet:

| | | |
|---|---|---|
| Inductance of full magnet | 24.9 | mH @ 100 Hz |
| Resistance of full magnet | 0.395 | Ohm |

8) Record integrated moments:

| | Integraged Quadrupole Gradient at 12 Amps | Max Integrated Sextupole Error at ± 12 Amps | Max Integrated Dodecaple Error at ± 12 Amps |
|---|---|---|---|
| specification: | 1.88 T | 1% | 1% |
| measurement: | 2.0338 | 0.18352 | 0.28115 |

| | | |
|---|---|---|
| Date of completion of SLAC tests: | 04/26/2006 | mm/dd/yyyy |

URL of on-line magnetic measurement data:

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/quad/000408/

Upon completion of tests, send traveler to Paul Emma, ms 103

9 Approval and Assignment by Paul Emma:

| | | |
|---|---|---|
| Magnet accepted: | Paul E | (Y)/N |
| Assigned Location | QA01 | Mad Deck Name |

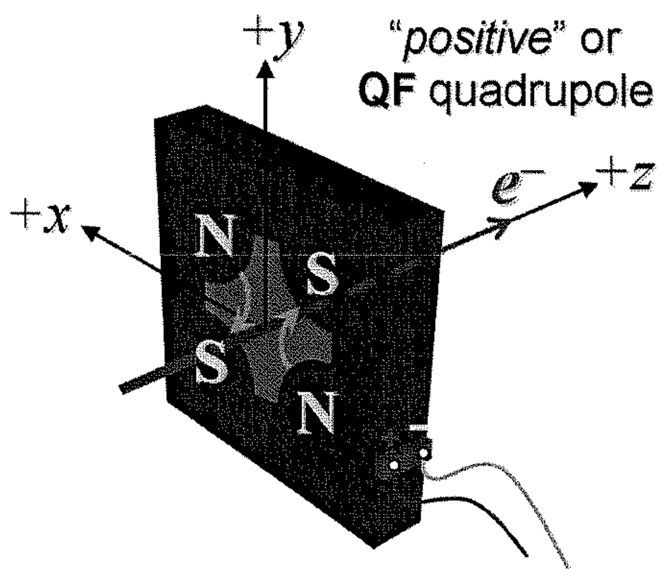
Upon completion, send traveler to Kathleen Ratcliffe at mailstop 18

Reference Information:

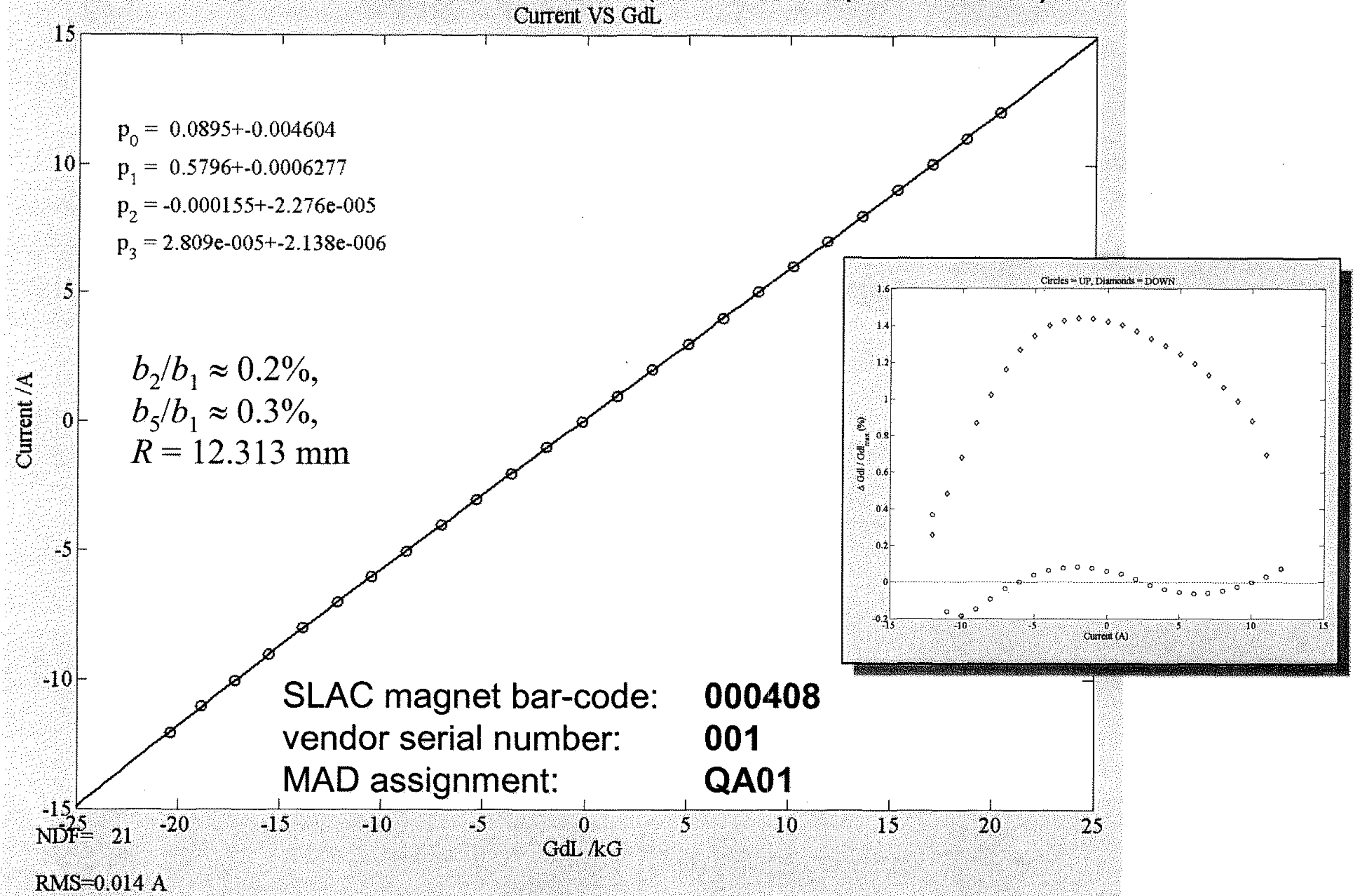
In a 24 hour measurement of the first article of this magnet type at 10 Amps, the temperature was found to rise to 31C over an ambient of 20C. See http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS/quad/QM-001/.

In a 36 hour test by Achim Wiedemann at 15.5 Amps, the temperature was found to rise to about 45 C from an ambient of 20C.

The magnet polarity is shown in the schematic diagram below:



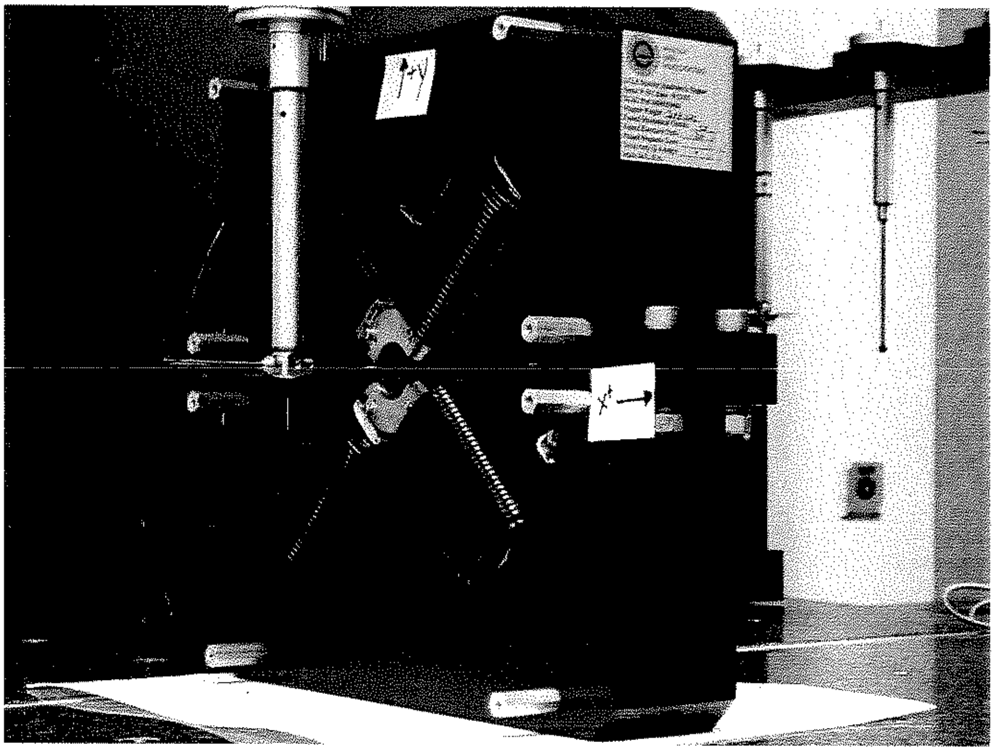
# ET Quadrupole without Mirror-Plates (measured April 25, 2006)




http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS/quad/000408/strdat.ru3

LCLS Linac Coherent Light Source — Stanford Linear Accelerator Center — Stanford Synchrotron Radiation Laboratory

# LCLS Injector Quadrupole Magnet
# FIDUCIALIZATION REPORT



| | |
|---|---|
| Inspector: | Keith Caban |
| Responsible Engineer: | Roger Carr |
| Date: | Monday, October 03, 2005 |
| Work Order/Charge No.: | N/A |
| Serial Number | 000408 |

**Part Set-up – Coordinate System Set-up**

Planar Alignment

- Mid-Plane of the magnet

Spatial Alignment

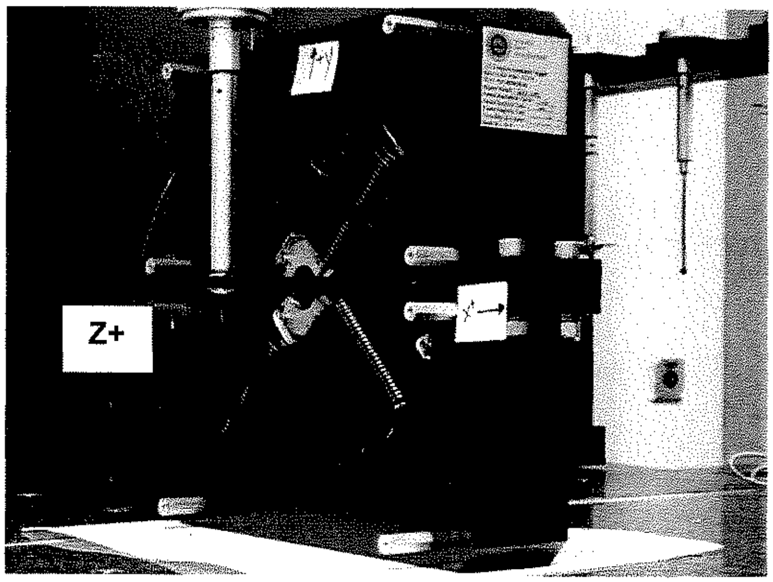
- A line on the top part of the magnet
    - +X goes towards (Magnet Info Label)

"Z" Zero

- Mid-Plane of the magnet

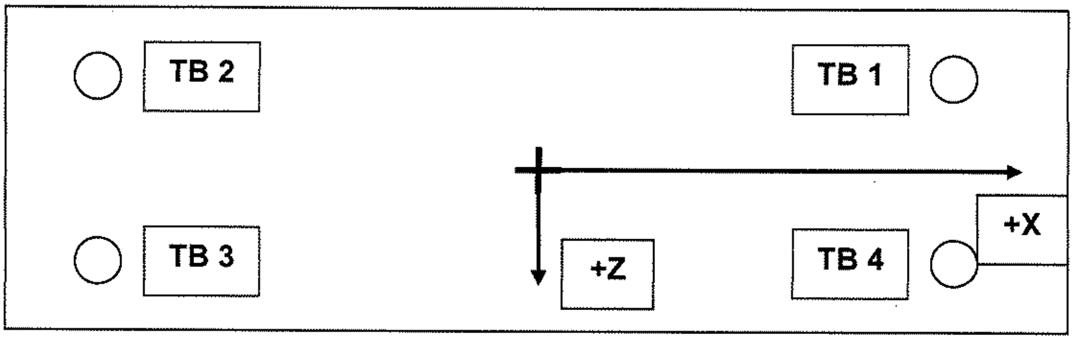
"X" & "Y" Zero

- On both ends
    - Tangent point of each radii (4 on each end, 8 total).
        - Create a line between diagonal tangent points creates 2 lines.
            - Intersect the lines.
                - Creates a point on each end.
- Create a line of these 2 end points
    - This is the "X" & "Y" Zero, and Beamline or" Z" Axis.



## Tooling Ball Measurements/Locations

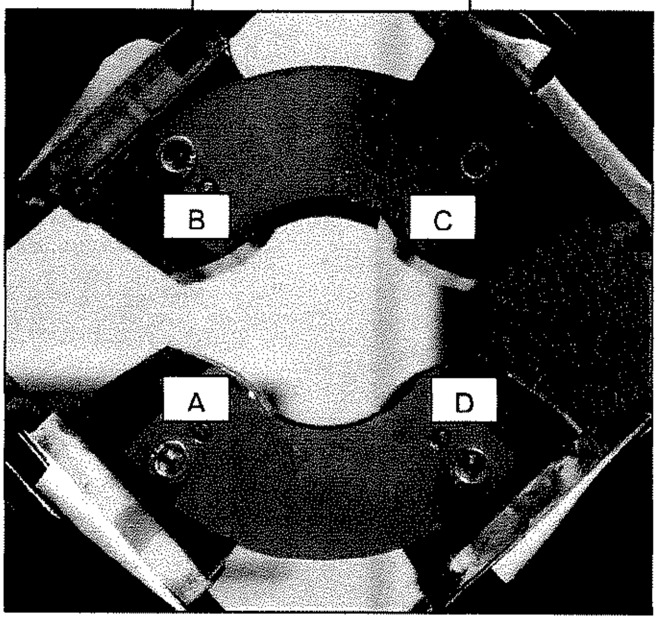
Top of magnet; view from "+Y"




| Tooling Ball | FORM | DIAMETER | X | Y | Z |
|---|---|---|---|---|---|
| **TB 1** | 0.00077 | 0.49549 | 6.50043 | 8.87843 | -1.24861 |
| **TB 2** | 0.00045 | 0.49802 | -6.49959 | 8.87643 | -1.24936 |
| **TB 3** | 0.00049 | 0.49688 | -6.50041 | 8.87714 | 1.25042 |
| **TB 4** | 0.00066 | 0.49616 | 6.50140 | 8.87805 | 1.25143 |

## Additional Requested Measurements

View From +Z




Tangent Point Straightness
A. 0.00025
B. 0.00021
C. 0.00032
D. 0.00049

Parallelism to Beamline
A. 0.00114
B. 0.00064
C. 0.00129
D. 0.00049

Distance of opposite Tangent Axis

A-C = 1.26016 (0.63009, 0.63007)
B-D = 1.25877 (0.62945, 0.62932)

## Profile of Pole Comparisons