SLAC Magnetic Measurement Plan and Traveler for the FACET Sextupole Magnet S3E#1 S202195T (style 1.625SX9.06)

Account Number to be charged: 9141206

This traveler covers the magnetic measurements plan for one of 2 identical water-cooled sextupoles, of engineering type 1.625SX9.06, called S3E#1, to be used as S202195T in sector 20 in FACET.

This new sextupole uses part of the steel core of a much longer sextupole that was made in 1986 at SLAC and previously ran in the SLC FF here at SLAC. Consequently it may have a very little residual radioactivity, the levels are marked on radiation tags and Jim Allan (ext 4064) can provide you further information on the type of radiation and what precautions you should take when handling these magnets.

This magnet weighs about 280 lb, and comes to you on a special channel support which sits on its final T1 mount; the whole assembly weighs 405 lb. It has yellow labels that indicate its beamline position in FACET (S202195T). It will run on the same power supply as S3E#2. There are two other magnets in the S3E family, S3E#3 & S3E#4 they have their own PS.

1. Receiving Information:

Received by (MM initials)	SDA
Date received : (dd-mm-yyyy):	1-4-2011
Checked Magnet Number(S3E#1),Optics name(S202195T)	SDA
Magnet Engineer (Cherrill Spencer or her substitute) verifies that this magnet is ready to be magnetically measured.	Consider this signed by Spencer, 3rd Jan 2011
If sextupole does not have a barcode sticker then ask Magnet Engineer to add one and she will write the 6 digit barcode number here:	002726

Preparation:

2. Power and LCW Connections: Unipolar PS >=50A , 20 V required. Cosine-shaped ramp that mimics the ramps produced by an Ethernet-driven controller.

High pressure LCW system will be needed to cool this magnet in your measurement lab.

3. Magnet Orientation:

A beam direction arrow, should be visible on the top or side of the core, .Notice: This magnet has coil interconnects, power terminals and water fittings **downstream.** If there is no arrow, contact Cherrill Spencer, x3474.

Beam-direction arrow in place (initials):	SDA

4. Magnet Alignment:

This magnet has sockets for 4 new tooling balls (TBs), they were recently fiducialized on the CMM in Bld 26 by Keith Caban and he has sent their fiducialization data to Mike Gaydosh who

will give it to the Alignment crew.

Fiducialization of new TBs complete (Alignment Initials :)	JM

Alignment crew should do set up on measurement stand , and use the x,y,z axes of the whole magnet (as defined by TB measurements) such that the roll angle (angle of horizontal axis) is less than about 1400 milliradian (looser tolerance than usual), and pitch and yaw is also minimized.

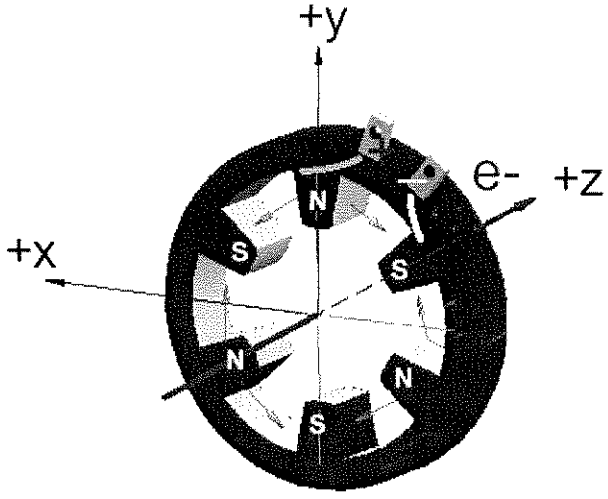
Fiducialization data on location of tooling balls with respect to geometric axis when poles are aligned perfectly horizontally should be saved.

Alignment completed, Roll Angle = ___Ø___ millirad (Alignment Initials :)	JM

The rotating coil should have its windings oriented so that a 'zero' angle quoted for a pole is indeed zero relative to the horizontal axis defined by the alignment crew. (Angle of first south pole, and of higher multipoles is important). A stretched wire will be used before the rotating coil – see step 11.

5. Power leads and polarity:

The required polarity for S3E#1 is *defocussing for electrons on the positive x side of the center.*
This means the topmost pole must be a NORTH pole as shown in the figure below.
This cartoon shows the power terminals upstream, in fact they will be downstream, so ignore the terminals in this cartoon.



Determine the electrical connection polarity (with supply outputting positive current) which produces the required magnetic field polarities.
Place + and - labels on or near the main power flags for the required polarity.

Polarity established, power +/- labels applied	SDY

6. Cooling Water Flow Check:

Each sextupole has 3 water circuits, there are 2 coils in series in a water circuit. There are 2 LCW input spiggots and 3 output spiggots. I have previously given you the top assembly drawing SA-235-019-60 so you can see which are LCW inputs and which outputs. There is no water manifold coming with the sextupole, please use your own manifold.

Setting to desired current (BDES) : ramp UP to BDES at 5 amps/second

All operating currents should be approached from below; except when I request a series of decreasing currents – these will be approached from a higher current. When moving from one current to another for the strength or harmonics measurements use 5 amps/second and wait at least 30 seconds after the operating current has been reached before making any magnetic measurements. Put basic standardization details in all datafile comments.

Confirm that magnet will ramp at 5 A/s (initials:)	SDA

9 (b) Multiple standardization cycles to be carried out BEFORE any measurements are made. NEW instruction for the remaining FACET magnets.

To avoid the situation where the integrated strength at a fixed current continues to vary when the magnet is powered off and then on again and measured after a single standardization procedure, I ask you to carry out many standardization cycles on this style sextupole before any measurements are made on it. This will "train" the magnet into a state to produce a repeatable integrated strength when it is powered up in the beamline. Take the sextupole through 75 standardization cycles (equivalent to 15 standardization procedures)

Sextupole has undergone 15 standardization procedures	Date: 1/4/2011 Start time: 16:00

10. Poletip Field Measurements

When it is convenient, maybe when the rotating coil is not in the sextupole's aperture, please use a Hall probe to measure the poletip field at 37.5 amps (after a regular standardization procedure) . Please make a correction in the field value for the thickness of the Hall probe.

Current	Actual current	Poletip field :
37.4 A nominal	37.426 Amps	0.166 T
Date and inititals:		1 / 4 /2010 SDA

11 (a) Stretched Wire Measurement to calibrate the rotating coil:
If a stretched wire is used to calibrate the rotating coil then record the datafile name and URL:

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/FACET_Sector_20/
S3E#1/Coil Calibration/

11 (b) Stretched Wire Measurement to Estimate Harmonics- do this on S3E#1 ONLY

Based on observations of the behavior of the rotating coil DC34qadd we need to make some stretched wire measurements to estimate the sizes of the multipoles, especially the 18-pole.
Set up a stretched wire along the x=0, y=0 magnetic center of the sextupole's aperture, have an Alignment Crew help set it up as well as they can.

Standardize and ramp up to 37.5 amps at 5 amps/second. Pause for 30 seconds before taking any

data.
Measure integral B.dl at the following x positions (and y=0) with the stretched wire:
-1.8,-1.5,-1.2,-0.9,-0.6,-0.3, 0.0, 0.3, 0.6, 0.9, 1.2, 1.5, 1.8 cm
Go back across the aperture at the same x in same order and measure integral B.dl at 37.5 amps.
Put all the data in the same data file.
Tell the Magnet Engineer when this data is available and don't remove the stretched wire until the Magnet Engineer or her substitute says it's OK to proceed.

Filename of Wire-Harmonics Measurement	wiresx .ru 2
Date of measurement, initials	1/6/2010 SDA

12. Rotating Coil Magnetic Measurements: ∫G'.dl and harmonics at various currents.
Purpose of these measurements is to find the transfer functions (Current required to reach a certain integrated gradient-primed strength) especially for the desired integrated gradient-primed, and to check that the multipole harmonics do not exceed FACET requirements.

For S3E#1, the desired ∫G'dl is -2013.8932 kGauss/m (will need about 37.5 A)

Rotating Coil Designation (Name)	DC55
Rotating Coil Radius	0.01624

13. Integrated Strength Measurements:
Measure the integrated gradient' ∫G'dl at these currents:
5, 10, 15, 20, 25, 30, 35, 37.5, 40, 45, 50 amps
Then back to 5 amps from 50 amps, measure the ∫G'dl at the same set of currents in reverse order. Remember to ramp at 5 amps/second and wait for 30 seconds after reaching the new current before starting a measurement.

Filename of Int. Strength Measurement	Strdat .ru 1
Date of measurement, initials	1/7/2010 SDA

14. Harmonics Measurements (with rotating coil, still do this, for comparison with stretched wire measurements in step 11(b)):
Measure the strength and angle of each multipole component at 37.5 amps.
(or at the operating current provided after analysis of integrated strength measurement).
Multipole values should be given as a percentage of the sextupole moment calculated at a 1cm radius, PLEASE. Also provide the magnetic center X and Y coordinates measured during the harmonics measurements at the above current.

Filename of Harmonics Measurement	hardat .ru 1
Date of measurement, initials	1/7/2010 SDA

22. This section is to be completed by FACET Beam Physicist (Walter Wittmer).

Checked that integrated strength data is satisfactory and have generated the polynomial function for the controlling database to set the magnet. Nominal operating current is 33.0 amps. Checked that this is within the capability of the assigned power supply max 41 A and Max std = 50	Signature and date: 01/20/11
Checked that the multipole values at r=10mm are below the Physics Requirements tolerances (initial):	
Magnet accepted for FACET (signed):	
Date accepted (Month-Day-Year):	01/20/11

When this traveler is completed, attach it to the fabrication traveler of this magnet and send these hardcopies to the designated person in Kathleen Ratcliffe's group at MS 18 to be scanned into a pdf file. Then that electronic file will be stored in a place TBD and the hardcopies will be returned to sit with the magnet until it is installed in the beamline.

Two travelers for this magnet been scanned into a pdf file; by Catherine Creech	Name of pdf file magnet S3E#1 S202195T
Two travelers been returned to sit with magnet in its "waiting for installation" place.	Signed & dated: 1.28.11

Further Tasks to be done on this magnet will be recorded on its Fabrication Traveler.

END OF FACET S3E#1 (S202195T) MAGNET MAGNETIC MEASUREMENT PLAN AND TRAVELER