



# TRIUMF ENGINEERING DESIGN REVIEW

DR: CYC-21-191

Conceptual/Preliminary

Final

Project/Experiment: Accelerator

Date: \_\_\_\_\_

System: Beam Line 2A

REA No: \_\_\_\_\_

Review Item: AC Steering Magnets

Account No: 2222

Review Date/Time 2/13/2007 | 14:00

Review Location: ISAC-II Conf Room

Person Responsible: Glen Stinson

Panel: Andy Hurst

Chair Distribution:

Rick Baartman

Klaus Reiniger

Yi-Nong Rao

Stu Austen

George Clark

Paul Schmor

Pierre Bricault

Bob Laxdal

**Action Required:**

<u>Item</u>	<u>Description</u>	<u>By</u>	<u>Approved</u>
1	Comment: The ANAC steerers fit the available space		
2	Comment: Acceptable tunes can be based on the existing magnets		
3	Comment: It is desirable to do a beam test		
4	Comment: Power supplies expected in March.		
5	Action: Measure dc and ac fields at the magnet measurement lab.		
6	Action: Proceed with design for beam line installation		

Approval to Proceed

Proceed with Comments:

Do Not Proceed and Resubmit By:

# TRIUMF Beam Lines

**TO:** Distribution  
**From:** Andy Hurst

**DATE:** Feb. 19, 2007.  
**FILE:**

Docushare

**RE:** DR Meeting Notes  
Tuesday February 13, 2007.

**CC:**

Attendance: A. Hurst, R. Baartman, P. Bricault, G. Clark, Y. Rao, G. Stinson.

The notes may include some coordinator comments that did not come up during the meeting and any late-breaking news.

## **Agenda:**

Preliminary design review of the use of ANAC AC X-Y steerers in beam line 2A for production of a hollow beam on ISAC targets.

Glen presented the results of his studies of existing and calculated tunes for beam line 2A and the related magnet requirements. Rick added comments about the latest developments in the operational tune.

In summary,

- The original tune was based on erroneous extraction parameters that were subsequently re-measured and up-dated.
- The latest operating tune - derived by Yi-Nong was - modified to give a smaller beam spot for rotating to make an annular beam spot.
- Q1-Q5 are used to minimize beam spill and to generate an image of the extraction foil.
- Q14-Q16 are used to set the target focus.
- At present, normal operation requires a large beam spot, for which Q15 and Q16 are set to very low values.
- Q15 and Q16 can be set to provide a 90 phase advance giving transport of parallel to point and point to parallel beams.
- Point to parallel transport will maximize the effect of the ac steerers.
- Magnet characteristics are known for dc and higher frequency operation, but ought to be measured at 10 Hz. *On Feb. 19, 2007, G. Clark reports that D. Evans has the instrumentation to measure the ac field, but would require a suitable digital oscilloscope.*
- Ultimately, the effects of beam halo need to be measured; therefore a beam test will be required.

## **Distribution :**

Electronic copy in Docushare. e-mail notice to trmail accounts:  
schmor, bricault, stua, krab, gsclark, devans, preddy, stinson, lax,marco, reiniger, dlouie, hurst.  
Cc remy, raso, decaire



# REQUEST FOR ENGINEERING ASSISTANCE

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Date: Jan. 24, 2007
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NAME:  
Andy Hurst

DIVISION:  
Accelerator

PHONE #:  
7410

PROJECT TITLE:  
Up-date 2A to install ac steering magnets

PROJECT DESCRIPTION: (Add sheets if necessary)  
Design the installation of existing ANAC ac steering magnets into beamline 2A downstream of 2AB3. Including support structure and beam line vacuum details.  
  
Note: To be coordinated with existing open REA-623 2A beamdump shine blocker.

EXPECTED SCHEDULE:  
To be completed for installation in Sept. 2007

FUNDING OR APPROVAL STATUS: PLEASE PROVIDE ACCOUNT NUMBER AND SUB-ACCOUNT:

Account: 2222	Sub-Account:
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ENGINEERING ASSESSMENT: (To be completed by Engineering Division)

GRADED RISK ASSESSMENT: Date Assessed:  
Low       Moderate       Critical

DESIGN OFFICE:

Design Office Job #:  D -
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ASSIGN TO/DATE:

CLOSURE INFORMATION:      SEE OVER

CLOSURE INFORMATION:

# ANAC

## Model 3521 X-Y Uniform Field Beam Steerer

August 1975

- Ion Beam Steering
- Beam Alignment
- AC Beam Sweep
- Shutter Operation
- Ion Microprobe Positioning



Model 3521N shown  
with optional vacuum chamber

The ANAC Model 3521 Uniform Field Beam Steerer is a compact magnetic ion beam steering device which provides X - Y steering without introducing significant beam distortion. It is designed to overcome field non-uniformity and/or size problems associated with box or C magnet steerers or steering coils on quadrupole lenses (1).

In particular, the coils are wound into a radially slotted yoke to approximate a sine  $\theta$  ampere turns distribution. Two sets of such windings generate mutually perpendicular fields which are uniform to  $\pm 0.4\%$  over 95% of the clearance aperture (2.6 inches) (2). The resultant field can be oriented at any angle about the beam axis by separately energizing the coils. In contrast to most box and C magnet steerers a single magnetic deflection field volume is generated, simplifying deflection geometry, alignment, and reducing space requirements. The high degree of field uniformity ensures that all ions receive the same deflection impulse regardless of their path through the aperture, preventing beam distortion.

The Model 3521 is ideally suited for AC sweep or shutter operation. Its laminated yoke prevents serious hysteresis losses. Electrically it behaves as a simple inductor with a 20 Hz corner frequency but operation to several thousand Hz is possible.

Low and high power versions are offered requiring natural air convection and water cooling respectively. These are electrically and magnetically identical differing only in their cooling and maximum current ratings.

Options include a 3 inch stainless steel vacuum chamber, stand, horizontal and vertical adjustment cradles, remote control panels, power supplies, and cabling. An overtemperature interlock is provided on all steerers.

1. See for instance: "Deflection Coil for an External Accelerator Beam", R. Benaroya and W.J. Ramler, Argonne National Laboratory, N.I.M., volume 10 (1961) 113-120.

2. More correctly: The field uniformity within the aperture is  $\pm 0.1\%$  but when fringing field effects are taken into account the value of the field integral is constant to  $\pm 0.4\%$  over 95% of the clearance aperture.

# ANAC Model 3521 X-Y Uniform Field Beam Steerer

## Specifications

**MODEL NUMBER**  
Type Cooling

↓

**3521N**  
Natural Air  
Convection

Aperture Diameter	(inches)	<b>3.04</b>
Vacuum Chamber Internal Clearance	(inches)	<b>2.60</b>
Overall Diameter	(inches)	<b>8.0</b>
Overall Length	(inches)	<b>11.65</b>
Effective Length	(inches)	<b>11.52</b>
Weight	(lbs)	<b>50</b>
Maximum Continuous Field	(gauss)	<b>133</b>
Maximum Continuous Power	(volts @ amps)	<b>15 @ 3.5</b>
Recommended Power Supply		
Unipolar	(volts @ amps)	<b>20 @ 4</b>
Bipolar	(volts @ amps)	<b>±36 @ 5</b>
Inductance	(henrys)	<b>0.032</b>
Corner Frequency	(hertz)	<b>20</b>

Field Uniformity –

The field integral is constant to  $\pm 0.4\%$  over 95% of the clearance aperture.

Linearity of Field vs Current –

Better than  $\pm 2\%$  up to 6A excitation current.

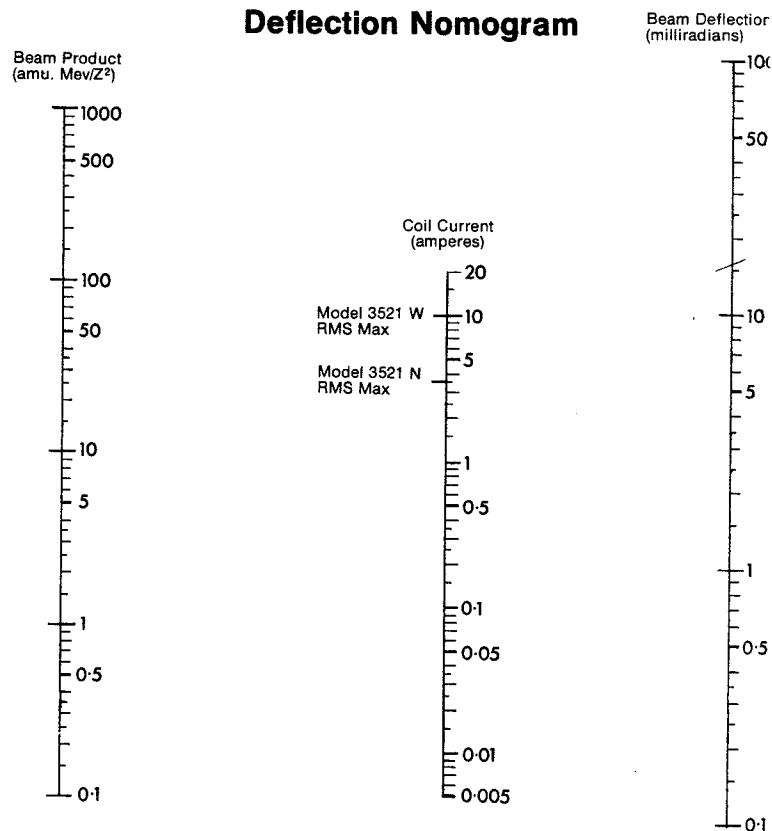
Independence of X and Y Fields –

X field strength at maximum setting affected less than 2% by zero to maximum variation of Y field (and vice versa).

## Options

- 3 inch stainless steel vacuum chamber with customer's choice of flanges (one removable)
- Remote control panel
- Horizontal mounting stand (specify beam height)
- Horizontal or vertical adjustments cradle ( $\pm 1$  inch travel)
- Power supplies
- Cabling

## Deflection Nomogram



## Frequency Response

