

Lawrence Berkeley National Laboratory

Recent Work

Title

CORRECTING COIL DESIGN

Permalink

<https://escholarship.org/uc/item/0zk0h36p>

Author

Hoyer, Egon.

Publication Date

1982-06-01

LBID-574
c1



Lawrence Berkeley Laboratory

UNIVERSITY OF CALIFORNIA

Engineering & Technical Services Division

RECEIVED
LAWRENCE
BERKELEY LABORATORY

APR 21 1983

LIBRARY AND
DOCUMENTS SECTION

For Reference

Not to be taken from this room



LBID-514
c1

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

ENGINEERING NOTE

CODE

SL 06 01

SERIAL

M 5932

PAGE

1 of 6

AUTHOR

EGON HOFER

DEPARTMENT

LOCATION

DATE

6/11/82

PROGRAM - PROJECT - JOB

SYNCHROTRON LIGHT FACILITIES - WIGGLER / BEAM LINE II

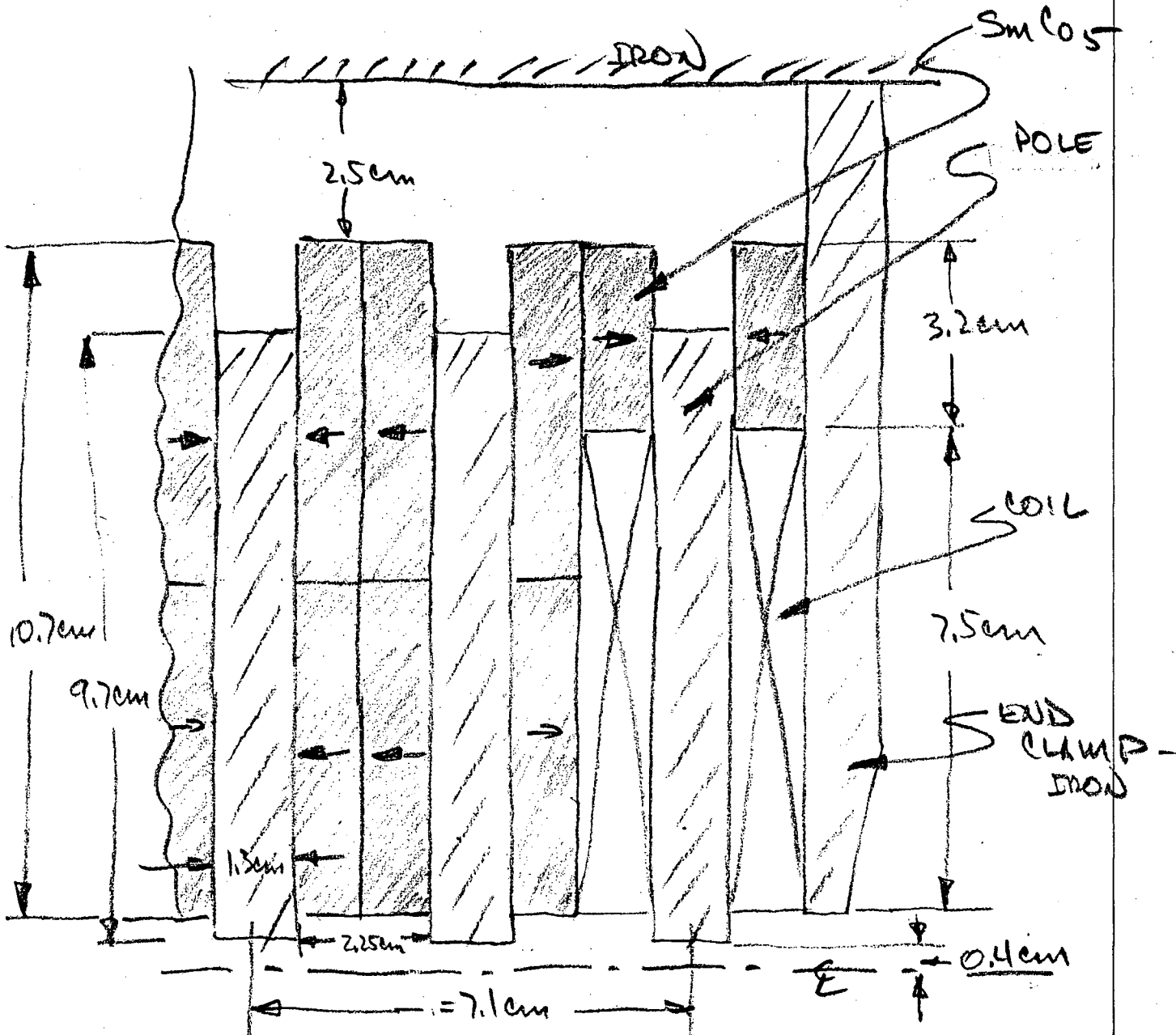
WIGGLER - END CONVERTING POLES

TITLE

CONVERTING COIL DESIGN

GENERAL

GERALD HARNETT HAS EXAMINED THE WIGGLER END GEOMETRY AND CURRENT REQUIREMENTS FOR THE END CONVERTING POLES (M 5935). HE RECOMMENDS 700 AMPERE TURNS / COIL WITH THE GEOMETRY SHOWN.



ENGINEERING NOTE

SLO601

M 5932

2 OF 6

AUTHOR

EGON HOYER

DEPARTMENT

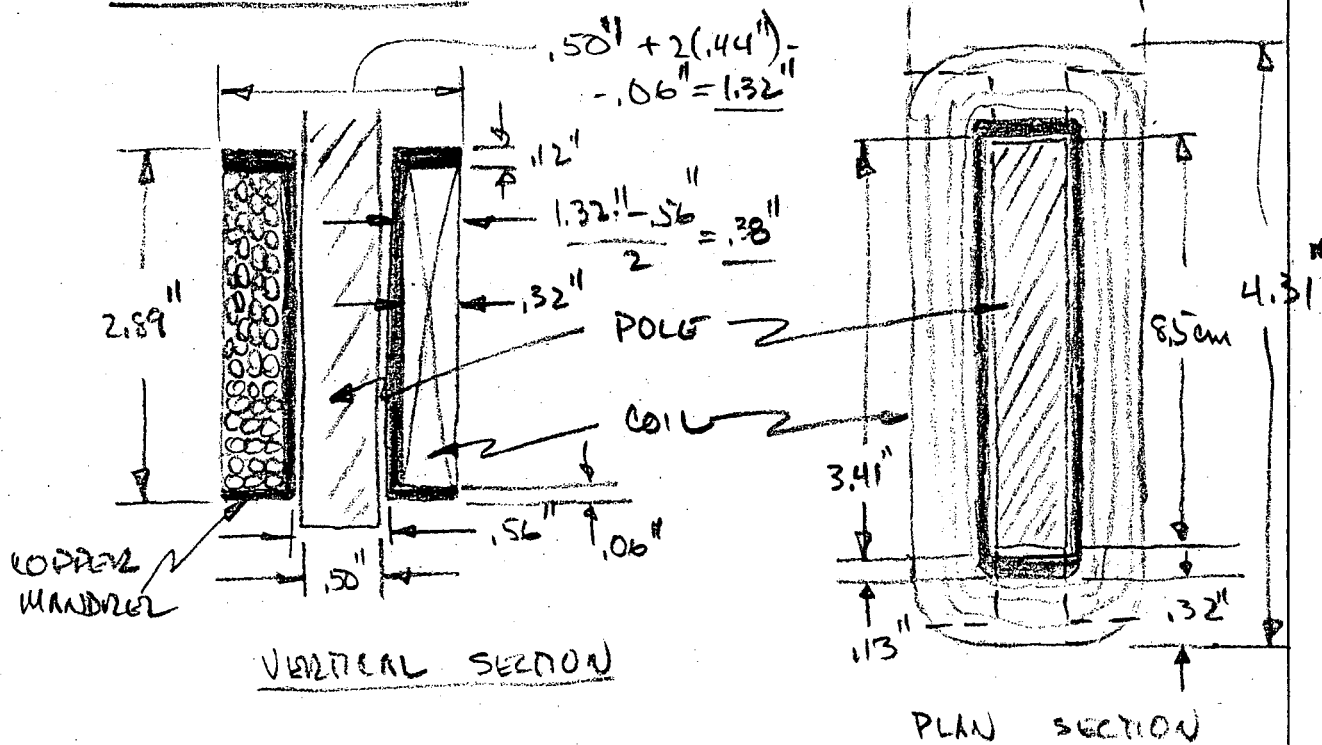
LOCATION

DATE

6/11/82

DESIGNAMPERE TURNS:

$$NI = 1000 \text{ A-T}$$

CONFIGURATION:NO. OF CONDUCTION LAYERS:

MUST BE AN EVEN INTERGER BECAUSE
LEADS MUST LEAVE AWAY FROM THE
MID PLANE

CONSIDER: $N = 4$

CONDUCTION DIAMETER:

$$d = \frac{1.32"}{4} = .08" \rightarrow \text{USE}$$

13 AWG
HEAVY FILM
COATED COPPER
WIRE
.076" DIA. MAX COATED
.072" DIA. - BASE

ENGINEERING NOTE

CODE

SL0001

SERIAL

M 5932

PAGE

3 OF 6

AUTHOR

EGON HOYER

DEPARTMENT

LOCATION

DATE

6/11/82

NO. OF TURNS / LAYER:

$$M = \frac{2.89'' - (.06'')(3)}{.08''} - 1$$

$$= 32$$

NO. OF TURNS / COIL:

$$N = M n$$

$$= (32)(4)$$

$$N = 128 \text{ TURNS}$$

COIL CURRENT:

$$I = \frac{NI}{N}$$

$$= \frac{1000}{128}$$

$$I = 7.8 \text{ AMPS}$$

COIL CONDUCTION LENGTH:

$$l_c = N \bar{l}$$

$$\bar{l} = 2 \left[3.41 + (.13)(2) + .56 + (.06)(2) \right] + (\pi)(.32'')$$

$$= 9.7''$$

$$l_c = (128)(9.7'') \left(\frac{\text{FT}}{12''} \right)$$

$$= 104 \text{ FT} \quad (1242'')$$

ENGINEERING NOTE

CODE

SLOW1

SERIAL

M 59324

PAGE

4 OF 6

AUTHOR

EGON HOVER

DEPARTMENT

LOCATION

DATE

6/11/82

COIL RESISTANCE:

$$R_c = \frac{\rho L_c}{A}$$

$$\rho = .75 \times 10^{-6} \Omega \cdot \text{in} \quad (\text{Cu} @ 50^\circ \text{C})$$

$$R_c = \frac{(.75 \times 10^{-6} \Omega \cdot \text{in}) (1242'')}{\pi/4 (0.072'')^2}$$

$$= \underline{0.229} \quad \Omega$$

COIL POWER:

$$P_c = I^2 R_c$$

$$= (7.8 \text{ A})^2 (.229 \Omega)$$

$$= \underline{13.9} \quad \text{WATTS}$$

COIL VOLTAGE:

$$V_c = I R_c$$

$$= (7.8 \text{ A}) (.229 \Omega)$$

$$V_c = \underline{1.79 \text{ V}}$$

POWER SUPPLY RESULTS:

$$I_{PS} = 7.8 \text{ AMPS} \rightarrow \underline{8 \text{ AMPS}}$$

$$V_{PS} = (2)(1.79 \text{ V}) = 3.6 \text{ V} \rightarrow \underline{4.0 \text{ VOLTS}}$$

ENGINEERING NOTE

SL 0601

M 5932

5 OF 6

AUTHOR

ECON Hovier

DEPARTMENT

LOCATION

DATE

6/14/82

HEAT TRANSFER:

WATER COOL TO MINIMIZE
 ΔT THAT THE SMOG SEES.
CONDUCTOR - MANHOLE TEMP. DROP:

$$q = K A \frac{\Delta T}{\Delta x} = K S b \Delta T$$

$$q = q' b$$

$$\Delta T = \frac{q'}{K S}$$

$$\Delta T_{CM} = \frac{2q'}{K_E S_R} (1+2+3+\frac{4}{2})$$

$$= \frac{16q'}{K_E S_R}$$

FOR:

$$K_E = .0042 \frac{W}{IN^{\circ}C}$$

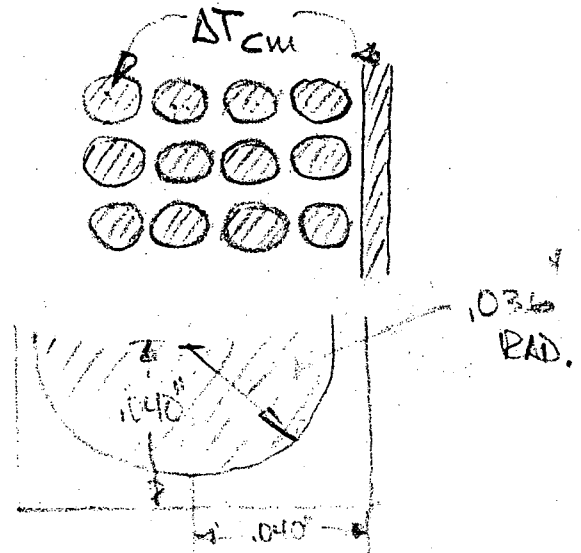
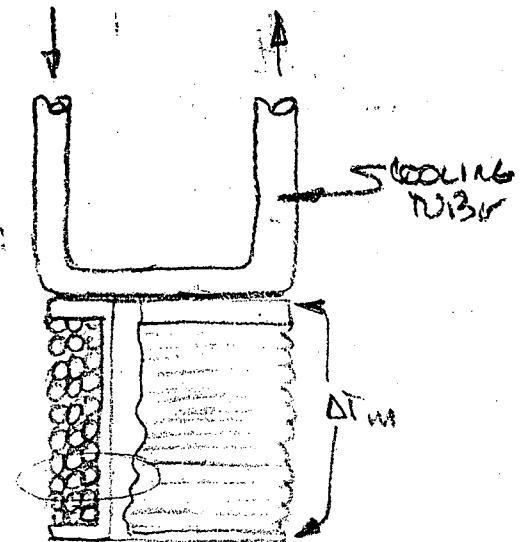
$$q' = \frac{13.9 W}{1242''} = .0112 \frac{W}{IN}$$

$$\Delta T_{CM} = \frac{(16)(.0112 W/IN)}{(.0042 \frac{W}{IN^{\circ}C})(10.0)}$$

$$\Delta T_{CM} = 4.3^{\circ}C$$

MANHOLE TEMP. DROP:

$$\Delta T_M = \frac{W L^2}{2 K \delta}$$



$$S_R = (2 \times 50) = 100$$

ENGINEERING NOTE

CODE

SLO601

SERIAL

W 5932

PAGE

6 OF 6

AUTHOR

Egon Hoyler

DEPARTMENT

LOCATION

DATE

6/4/82

$$m = \frac{q'}{d_{max}}$$

$$= \frac{.0112 \text{ W}}{(1 \text{ W})(.08 \text{ in})} = .140 \text{ W/in}^2$$

$$\Delta T_m = \left(.140 \frac{\text{W}}{\text{in}^2} \right) \left(2.89 \text{ in} \right)^2$$

$$\frac{2 \left(9.71 \frac{\text{W}}{\text{in}^2} \right) \left(.060 \text{ in} \right)}{}$$

$$= 1.0 \text{ } ^\circ\text{C}$$

MANDREL - TUBE TEMPERATURE DROP:

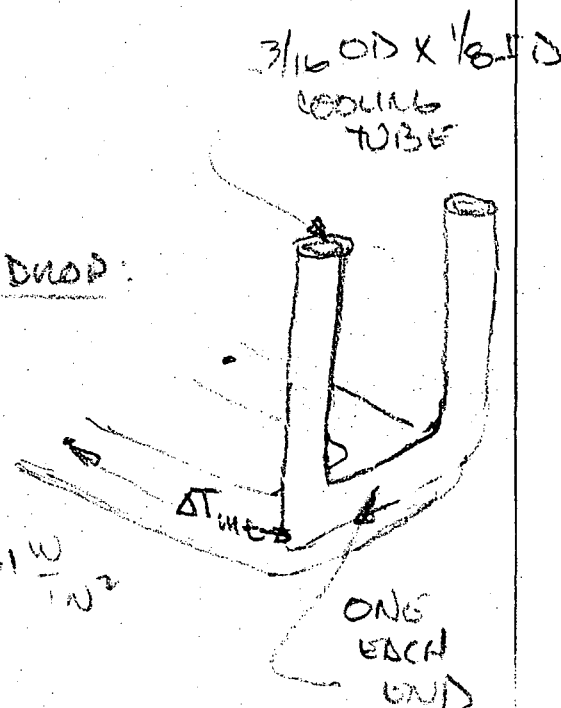
$$\Delta T_{mt} = \frac{m L^2}{2 k \delta}$$

$$m = \frac{P_c}{(C/d)} = \frac{13.9 \text{ W}}{2 [3.41456] (.38 \text{ in})} = 4.61 \frac{\text{W}}{\text{in}^2}$$

$$\Delta T_{mt} = \left(4.61 \frac{\text{W}}{\text{in}^2} \right) \left(2 \text{ in} \right)^2$$

$$\frac{(2) (9.71 \frac{\text{W}}{\text{in}^2}) \left(.126 \text{ in} \right)}{}$$

$$\Delta T_{mt} = 7.9 \text{ } ^\circ\text{C}$$



MAX COIL TEMPERATURE DROP:

$$\Delta T_c = \Delta T_{cm} + \Delta T_m + \Delta T_{mt}$$

$$= 4.3 + 1.0 + 7.9 = 13.2 \text{ } ^\circ\text{C} \quad \text{OK}$$

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

Reference to a company or product name does not imply approval or recommendation of the product by the University of California or the U.S. Department of Energy to the exclusion of others that may be suitable.

TECHNICAL INFORMATION DEPARTMENT
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720