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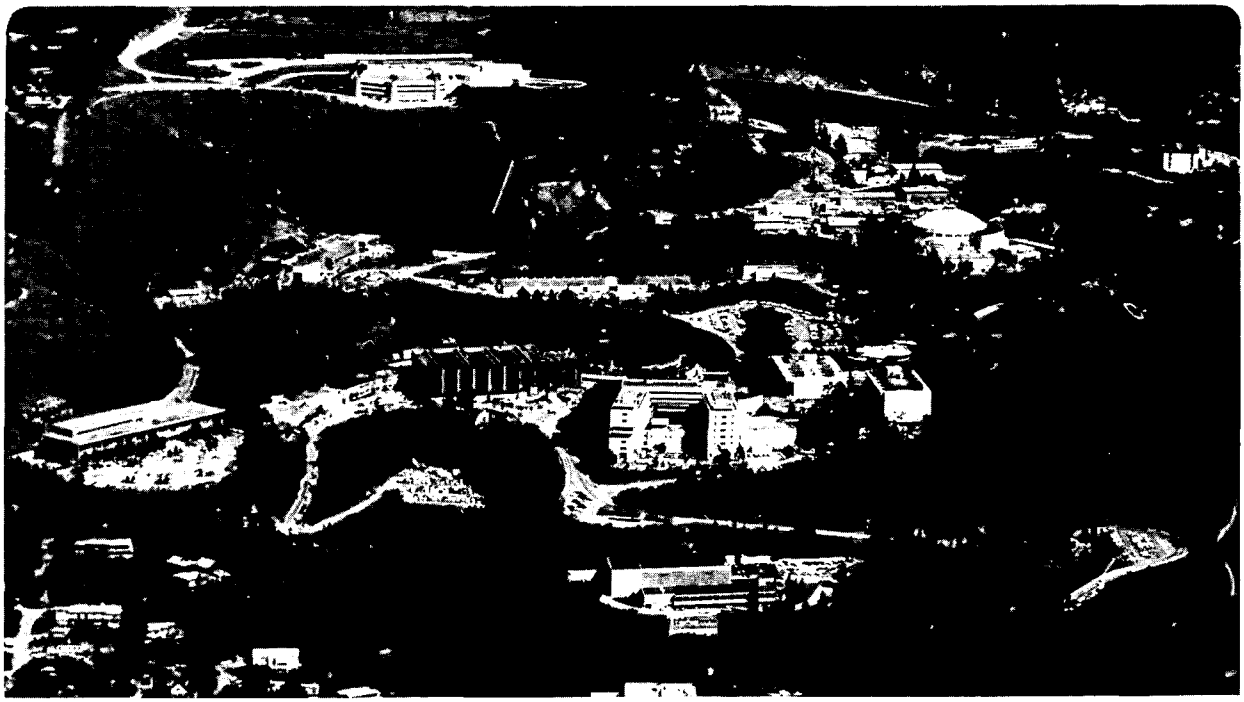

DISCLAIMER

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ENGINEERING NOTE

CODE	SERIAL	PAGE
SL0601	M 5932	1 OF 6

AUTHOR	DEPARTMENT	LOCATION	DATE
EGON HOYER			6/11/82

PROGRAM — PROJECT — JOB

SYNCHROTRON LIGHT FACILITIES — WIGGLER | BEAM LINE VI

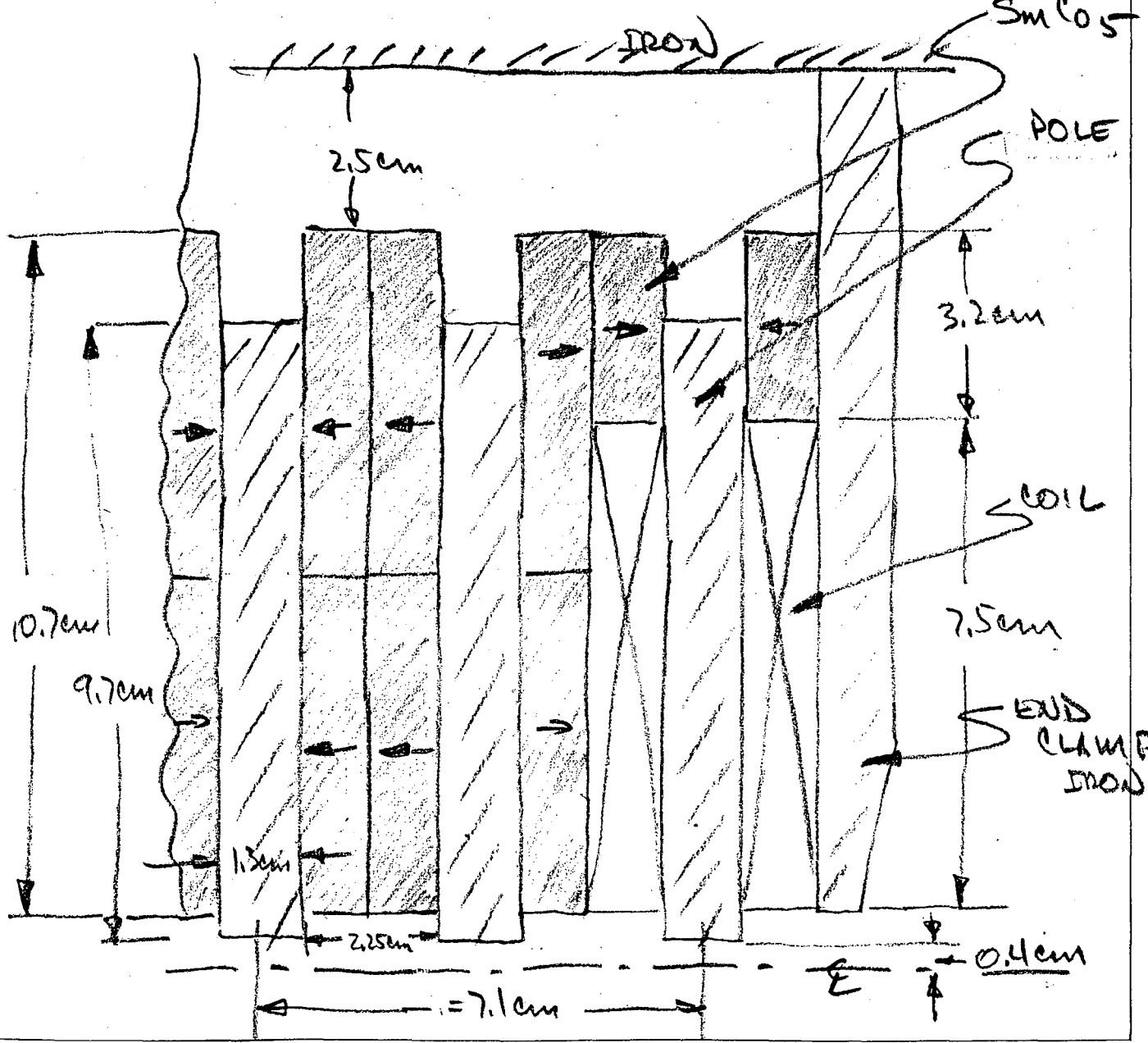
WIGGLER — END CORRECTING POLES

TITLE

CORRECTING COIL DESIGN

GENERAL

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

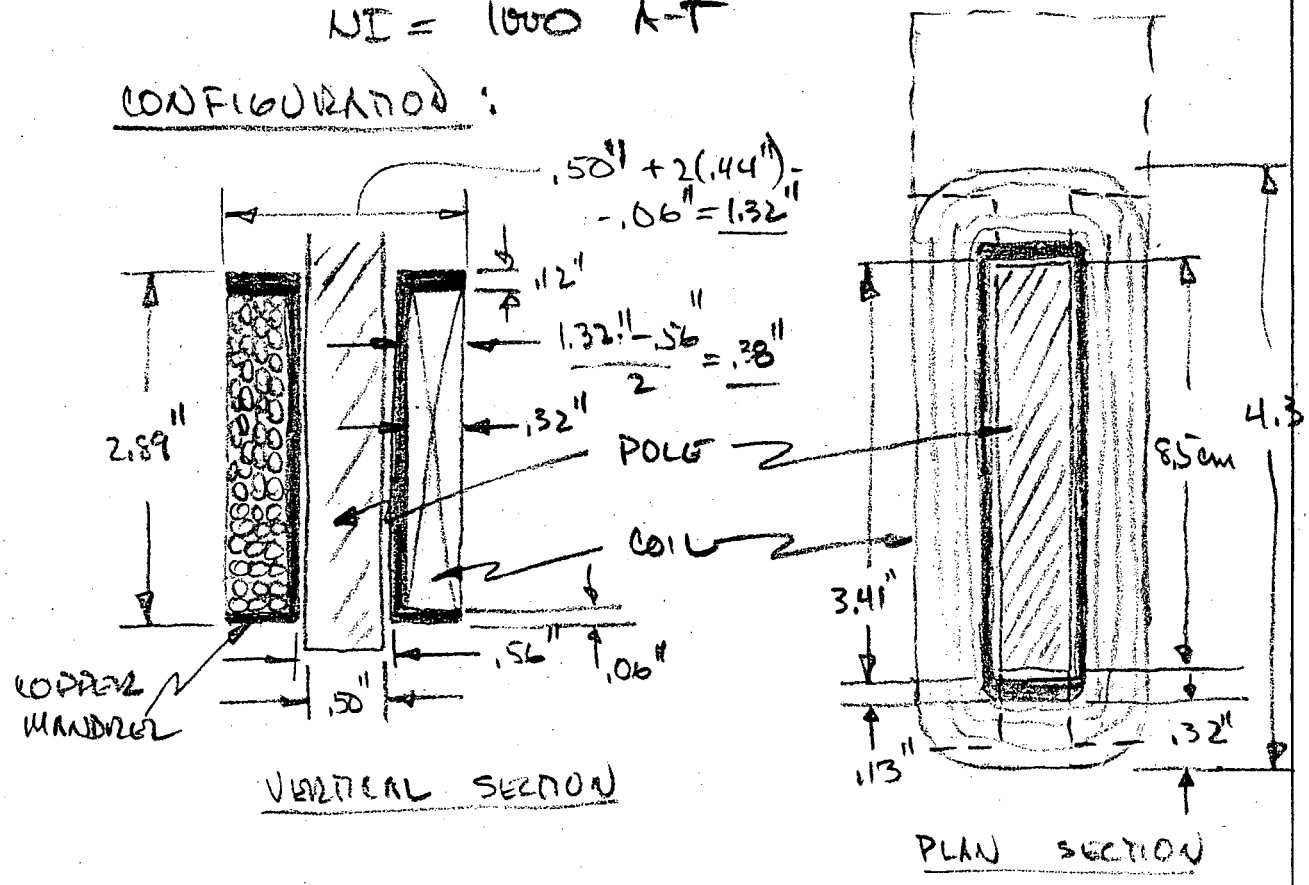


DESIGN

AMPERE TURNS:

NI = 1000 A-T

CONFIGURATION:



VERTICAL SECTION

PLAN SECTION

NO. OF CONDUCTOR LAYERS:

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

CONSIDER: N = 4

CONDUCTOR DIAMETER:

$$d = \frac{.32"}{4} = .08" \longrightarrow \text{USE}$$

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

NO. OF TURNS / LAYER:

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

$$= 32$$

NO. OF TURNS / COIL:

$$N = Mn$$

$$= (32)(4)$$

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

COIL CURRENT:

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

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

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

COIL CONDUCTOR LENGTH:

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

$$\bar{l} = 2\left[3.41 + (.13)(2) + .56 + (.06)(2)\right] + (11)(.32")$$

$$= 9.7"$$

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

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

COIL RESISTANCE:

$$R_c = \frac{\rho l_c}{A} \qquad \rho = 1.75 \times 10^{-6}\ \Omega\text{-in}\ (Cu\ @\ 50^\circ C)$$

$$R_c = \frac{(1.75 \times 10^{-6}\ \Omega\text{-in})(1242'')}{\pi/4\,(.072'')^2}$$

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

COIL POWER:

$$P_c = I^2 R_c$$

$$= (7.8\,A)^2 (.229\,\Omega)$$

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

COIL VOLTAGE:

$$V_c = I R_c$$

$$= (7.8\,A)(.229\,\Omega)$$

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

POWER SUPPLY REQ'TS:

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

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

HEAT TRANSFER:

WATER COOL TO MINIMIZE ΔT THAT THE SWLOS SEES.

CONDUCTION - MANDREL TEMP. DROP:

$$q = KA\frac{\Delta T}{\Delta X} = KS_b\Delta T$$

$$q = q' b$$

$$\Delta T = \frac{q'}{KS}$$

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

$$= \frac{16\,q'}{K_E S_\lambda}$$

FOR:

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

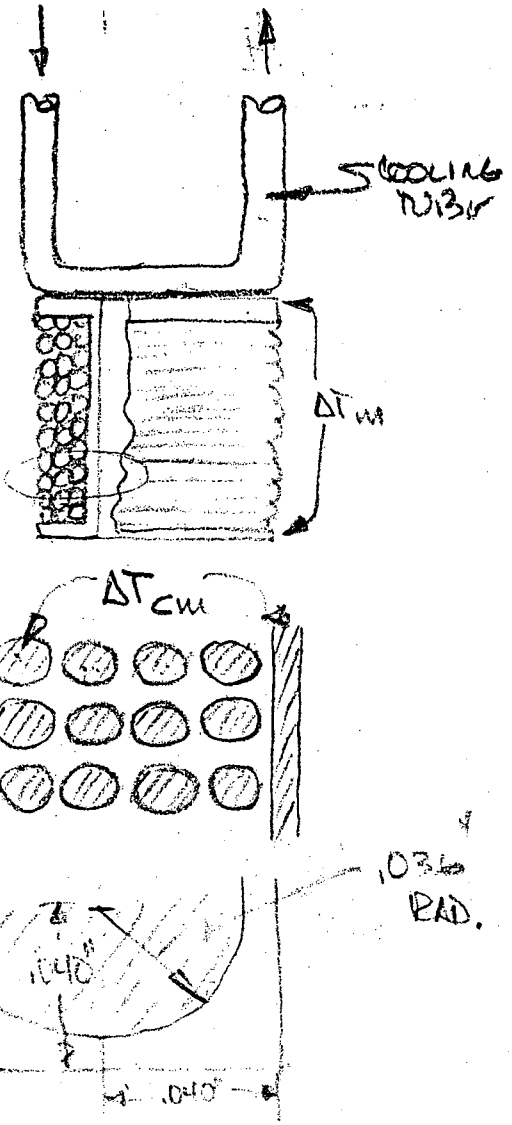
$$q' = \frac{13.9\ W}{1242''} = .0112\ \frac{W}{IN}$$

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

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

MANDREL TEMP. DROP:

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

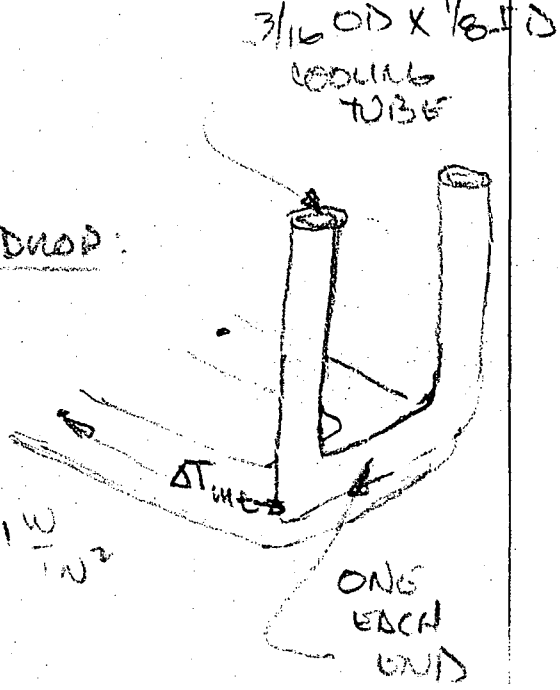


$$W = \frac{q'}{d_{max}}$$

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

$$\Delta T_m = \frac{\left(.140\ \frac{W}{in^2}\right)\left(2.89"\right)^2}{2\left(9.71\ \frac{W}{in\,°C}\right)(.060")}$$

$$= 1.0\ °C$$



MANDREL - TUBE TEMPERATURE DROP:

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

$$W = \frac{P_c}{(c)d} = \frac{13.9\,W}{2[3.41+.56](1.8")} = 4.61\ W/in^2$$

$$\Delta T_{mt} = \frac{\left(4.61\ \frac{W}{in^2}\right)\left(2"\right)^2}{(2)(9.71\ \frac{W}{in})(.120")}$$

$$\Delta T_{mt} = 7.9\ °C$$

MAX COIL TEMPERATURE DROP:

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

$$= 4.3 + 1.0 + 7.9 = 13.2°C \quad \text{OK}\checkmark$$

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