EDDY-CURRENT FORCES ON THE DIPOLE BORE TUBE DURING A QUENCH.

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This supercedes an earlier report on the same subject [1].

The pressures resulting from eddy currents in the bore-tube plating are presented for both perfect and zero heat transfer, from the outside of the bore tube, for two Kohler-plot lines, and for plating thicknesses of from 2 to 6 mils.

The time constants for penetration of the heat through the stainless steel and around the circumference are short, and so a uniform temperature throughout the bore tube is assumed. The heat capacity of the stainless steel is accounted for in the zero-heat-transfer case.

An RRR of 1000 was assumed, and the variation of RR with temperature at zero field was accounted for (NBS data). The two Kohler-plot lines used correspond to measurements on 4- and 8-mil platings [2].

For the perfect heat transfer condition, the pressure is proportional to $B\dot{B}$ and the thickness. For the zero heat transfer condition the pressure vs. thickness relationship is non-linear, and the peak pressure occurs at an earlier time than the $B\dot{B}$ maximum.

The field vs. time relationship is one calculated using the QUENCH program [3], and has a maximum $B\dot{B}$ of 84 sq. teslas/sec. Measurements on magnet D00002 [4] indicate values as high as 150.

The pressures presented are the x-components at the midplane, theta=0. The y-component is zero. The x-component varies as cosine theta.

REFERENCES

1. Meuser, R. B., SSC-N-214.
2. Meuser, R. B., SSC-N-444.
3. Hassenzahl, W., personal communication.
4. Tompkins, J., personal communication.

Kohler-plot data for thickness of (mils)	Heat-transfer mode	Plating thickness (mils)	Max. pressure at $\theta = 0$ (psi)	...at time (sec)	...and temp. (K)
8	zero	2	53.8	0.26	20.2
		4	95.7	0.25	22.5
		6	131.5	0.25	25.4
8	perfect	2	59.9	0.30	4.35
		4	119.7	0.30	4.35
		6	179.6	0.30	4.35
4	zero	2	93.1	0.25	22.3
		4	156.4	0.25	27.5
		6	214.2	0.25	30.4
4	perfect	2	113.2	0.30	4.35
		4	226.5	0.30	4.35
		6	339.7	0.30	4.35