BROOKHAVEN NATIONAL LABORATORY

MAGNET DIVISION NOTES

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No: 429-16 (RHIC-MD-140)

Task Force: RHIC

Title: Tie Rods in RHIC 130mm Quadrupole

Tie Rods in RHIC 130mm Quadrupole

R.Gupta,S.Kahn,P.A.Thompson

30-MAR-1992

1. End Forces

- Quench Current 8000 Amp.
- Stored Energy 124 kJ/m.
- End Force 124 kN = 27800 lbs.
- Cross Section Area 4 x 5/8" diameter =1.227"
- Elongation (3.4 meter long, 5/8" diam. rods) = 2.5 mm (0.100").
- Max Load per bolt = 6800 lbs.
- Safe Working Load 1/2" NF thread 9,000 lbs.

CONCLUDE: 5/8" diam rod is marginal? due to elongation under magnetic load.
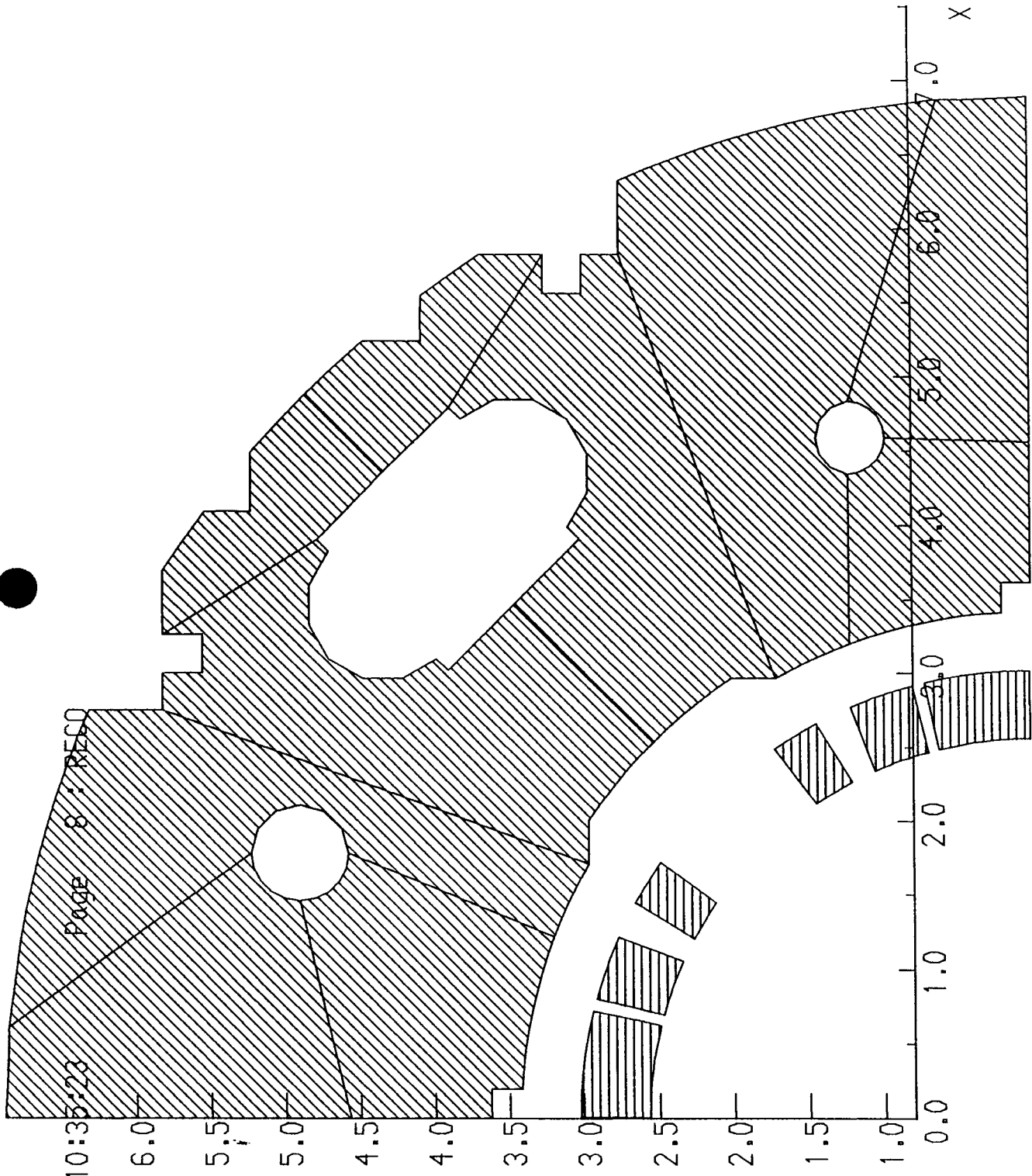
2. Magnetic Effects

Table 2.1 summarizes the magnetic effects of the tierod. The significant effect of adding a non-magnetic tierod is to introduce a b3 term. This can be partially compensated by changing the shear pin from steel to stainless steel in conformity with the dipole design. Additional compensation is obtained by moving the tierod outward $\sim 0.25''$. This is the configuration designated R=5.2. It is shown in Fig. 2.1 and the details of the holes for the pin and the tierod are given in Table 2.2.

Table 2.1: b3 vs current as function of configuration

Current(A)	Pin=Fe Tie=Fe	Pin=SS Tie=FE	Pin=Fe Tie=SS	Pin=SS Tie=SS	R=5.2
1	-0.003	-0.007			-0.004
1000	-0.001	-0.006	0.004	0.000	-0.003
2000	-0.001	-0.006		0.001	-0.003
3000	-0.003	-0.011	0.012	0.004	-0.003
4000	-0.002	-0.026		0.008	-0.006
5000	-0.006	-0.066	0.137	0.074	-0.012
6000	+0.006	-0.320		0.445	+0.062
7000	+0.006	-0.750	2.241	1.426	+0.082
8000	+0.004	-1.775		2.438	+0.283
9000	+0.004	-2.476	5.013	2.363	+0.178

R=5.2 uses SS pins and tie rods with the

tie rods at a radius of 5.2"

Figure 2.1: QRI (130 mm) Quadrupole Cross Section

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Y [INCH]

X

VF

ELEM=QUAD SYMM=XY SOLN=AT SCALE=1.0 FIEL=MAGN
Mesh   8592 Elements   58 Regions   2 Symmetry pairs

Table 2.2: Tie Rod and Pin Holes

Element	Diam(inch)	x(inch)	y(inch)
PIN	0.50	4.59	1.22
TieRod	0.65	1.79	4.91
Pin is assumed to be Stainless Steel			
Diameters are hole diameters			
x,y are center locations			

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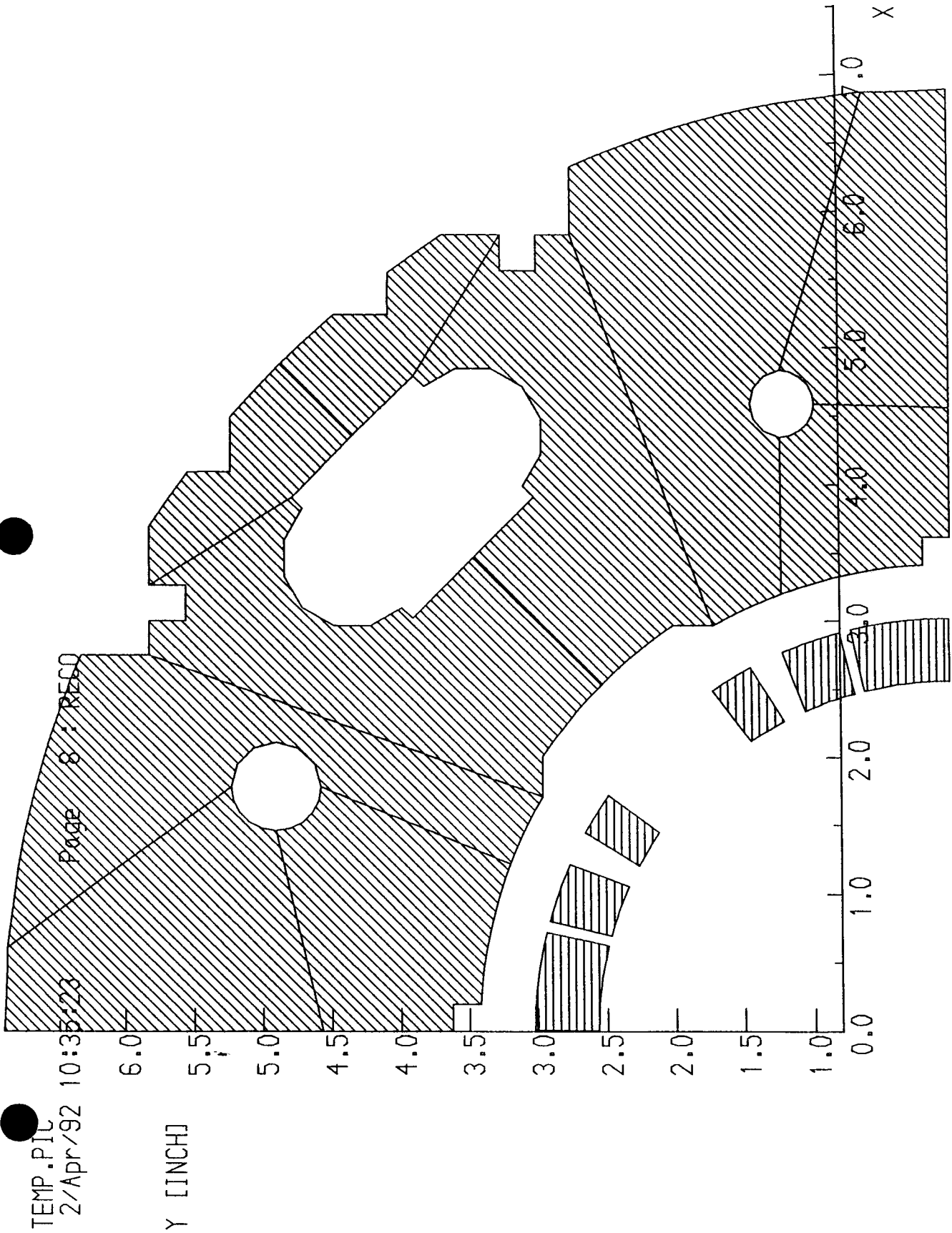
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