Fermilab

Revision 1.0

Particle Physics Division
Engineering and Technical Teams

1/21/1999

Mechanical Support Engineering Note

Number: MD-ENG-159 Date: May 16, 2008

Project: E907 Project Internal Reference:

Title: JGG Coil Connection Bar calculations

Author(s): Jim Kilmer

Reviewer(s): D. Posner 5/16/08

Key Words: Jolly Green Giant

Abstract/Summary:
This note contains the calculations for sizing the shorting bars that connect the new JGG turns into full coils.

Applicable Codes:

None.

Jolly Green Giant Coil Connections
May 16, 2008
Jim Kilmer

This engineeering note shows calculations for the connection bars needed to connect all of the turns in the pancakes into a coil. The nominal current for the magnet is 2276 amps and all orf the turns must be put in series. The connecting bars will be made out of 6061-T6 material because that is common at the lab. The resistivity and themal conductivity data come from **Metals Handbook Desk Addition, Boyar and Gall, editiors, American Society for Metals, Metals Park, Ohio, 44073, copyright 1985**.

The longest bar needed is 6 inches long. Use as a minimum a cross section of 4 inches by .25 inches thick.

$A := 4 \cdot in \cdot .25 \cdot in$

$A = 6.452 \times 10^{-4}\, m^2$

$l := 6 \cdot in$

$\sigma := 40 \cdot 10^{-9} \cdot \Omega \cdot m$ Reisistivity give on page 6.31 of the reference.

$R := \frac{\sigma \cdot l}{A}$

$R = 9.449 \times 10^{-6}\, \Omega$

$I := 2276 \cdot amp$

$P := I^2 \cdot R$

$P = 48.947\, W$ Power dissipated in the shorting bar.

Now estimate the maximum temperature in the bar. Both ends of the bar are connected by welding to a water-cooled coil turn so the temperature is fixed at the water temperature. Find the increase.

$k := 167 \cdot \frac{W}{m \cdot K}$ From the reference page 6.31.

$dt := \frac{P \cdot \frac{l}{2}}{k \cdot A}$

$dt = 34.617\, K$ This means the rise in temperature at the center of the bar is 34 degrees K, so a 4 inch by .25 inch bar should work. We will also put klixon temperature switches on all of the connections.