For Discussions on Maximum Field of HTS Solenoid

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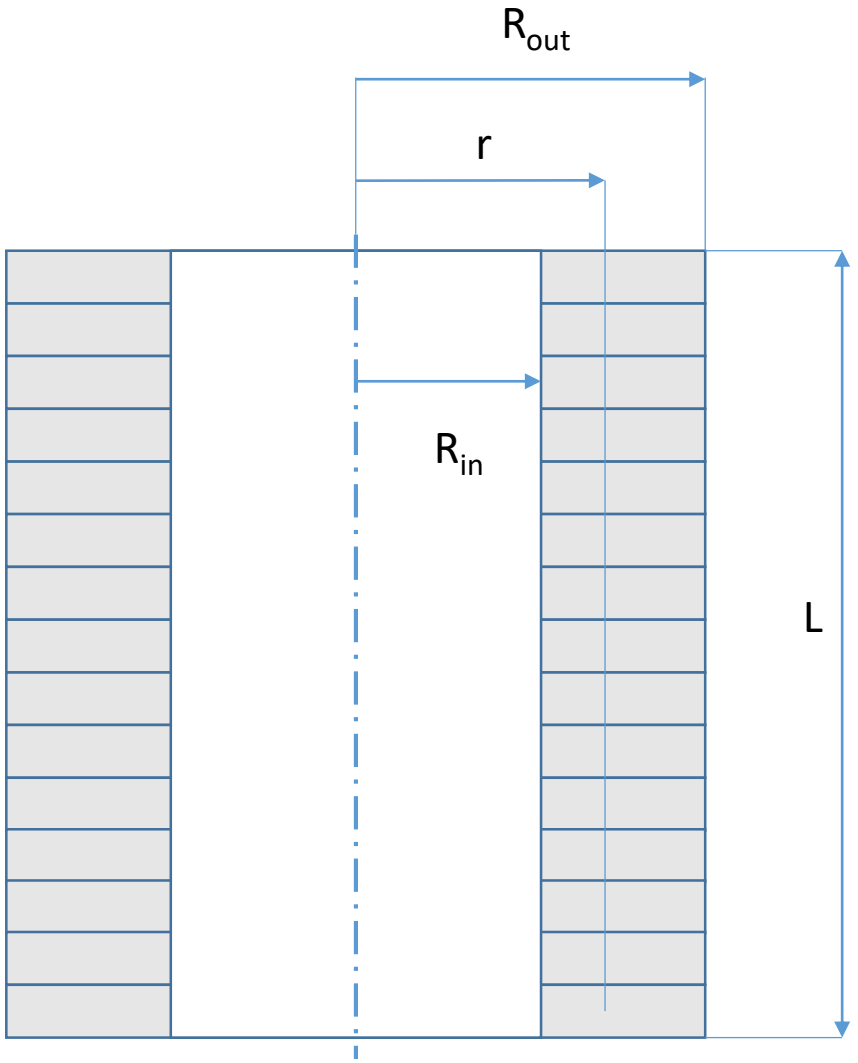
For very long solenoid with constant current density J



Magnetic Flux Density is:

$$B_{bore}=\mu_0 \cdot J \cdot (R_{out}-R_{in}),\ r < R_{in}$$

$$B(r)=\mu_0 \cdot J \cdot (R_{out}-r),\ R_{in} < r < R_{out}$$

JBr stress may be calculated

$$\sigma = J \cdot B(r) \cdot r = \mu_0 \cdot J^2 \cdot (R_{out} - r) \cdot r$$

Its maximum found

If $R_{in} < R_{out}/2$ $\quad$ σ_{max} is at $r = R_{out}/2$ $\quad$ $\sigma_{max} = \mu_0 \cdot J^2 \cdot (R_{out}/2)^2$

And limit of current density defined

$$J_{max} = 2/R_{out} \cdot \sqrt{\sigma_{max}/\mu_0}$$

For smallest possible solenoid with no bore (R_{in}=0) maximum field is

$$B_{max} = 2 \cdot \sqrt{\sigma_{max} \cdot \mu_0}$$

$$B_{bore} = \mu_0 \cdot J \cdot (R_{out} - R_{in}) = \mu_0 \cdot J \cdot R_{out}$$

$$J_{max} = 2/R_{out} \cdot \sqrt{\sigma_{max}/\mu_0}$$

Assuming that stress level of 600 Mpa is not degrading HTS

$$B_{max} \approx 55\ T$$

But is such stress level achievable in the real coil package ???????

Some numbers to get an idea of magnet dimensions and material budget:

- inner radius R_{in} = 26 mm
- tape thickness t = 0.05 mm
- tape width w = 4 mm
- solenoid length L = 500 mm

$$R_{out} = R_{in} / (1 - B_0/B_{max})$$

$$J_{max} = 2/R_{out} \cdot \sqrt{\sigma_{max}/\mu_0}$$

Magnetic Field (T)	Coil Thickness (mm)	Current (A)	Stored Energy (MJ)	Tape Length (km)
27.5	**26**	**168**	**1.1**	**16**
30	**31**	**153**	**1.4**	**21**
35	**46**	**122**	**2.5**	**35**
40	**70**	**91**	**4.7**	**67**
45	**118**	**61**	**10.4**	**157**
50	**264**	**30**	**35.7**	**655**

What to choose !? Let's see presentation of Bernardo.