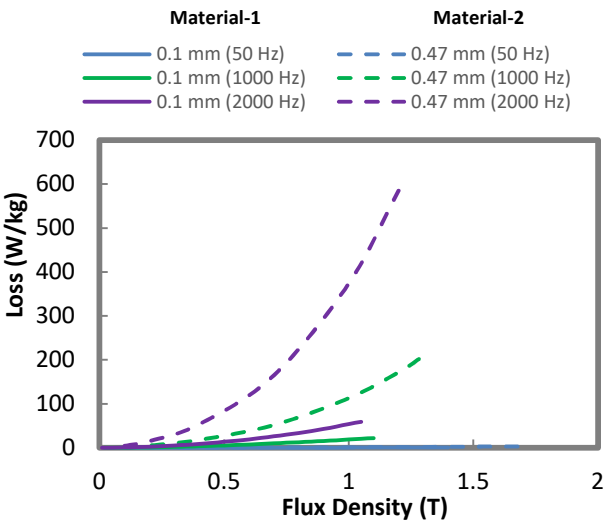
SALIENT FEATURES FOR HIGH SPEED MOTOR DESIGN – PART 2

High Speed Motor

Number of Poles | **Magnet Material** | **Soft Iron Material** | **Sleeve Material**

Soft Iron Material

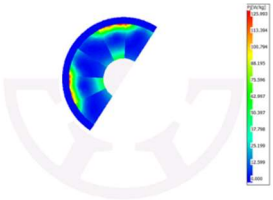


Soft iron material		Material-1	Material-2
Lamination thickness	(mm)	0.10	0.47
Stator back iron hysteresis loss	(W)	1.01	0.87
Stator back iron eddy current loss	(W)	0.45	11.63
Stator tooth hysteresis loss	(W)	1.17	0.91

- Eddy current loss occurs in the stator and rotor iron parts
  - The high operating speed of motor will cause higher switching frequency. The stator teeth sees high frequency for flux density, leads to higher losses.
- Thinner lamination reduces eddy current loop, enhancing resistance to eddy current. This lowers the eddy current loss

Sleeve Material

Material		Epoxy	Stainless steel	Aluminium	Copper
Resistivity	(Ω-m)	1 X 10^{-12}	7.2 X 10^{-7}	3.3 X 10^{-8}	1.724 X 10^{-8}
Loss in sleeve	(W)	0	0.70	11.48	16.78



Epoxy Encapsulation

Copper Sleeve

- For magnet with typical mechanical strength, higher speed of rotation of the rotor results in higher centrifugal forces on the rotating magnet
  - Need of sleeve (0.3 to 0.5 mm thick) on magnet prevent magnet breakage.
- Presence of sleeve leads to
  - Increased effective airgap lowers magnet operating point. This increase the need for higher magnet volume for desired flux which increase magnet cost.
  - Increased cost due to additional component and assembly complexity.
  - High motor speed causes high frequency of flux direction change in sleeve. Hence, increase the eddy current loss in sleeve
  - Sleeve material with high resistivity lower the eddy current loss
- Use of high strength MQ1^{TM} magnet can eliminate the need for sleeve

61 Science Park Road #01-19 The Galen
Singapore Science Park II Singapore 117525
research@magnequench.com
www.mqitechnology.com

Magnequench