# Evaluation of the Magnetic Flux Density Surrounding an Air Core Reactor

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**INTRODUCTION**: Air core reactors are commonly used as smoothing reactors, fault limiting reactors, tuning reactors, and so on. The absence of he iron core results in a simple and lightweight construction. Consequently, the magnetic field of an air core reactor is not guided within a material with a high magnetic permeability and causes a large stray field outside the mechanical dimension of the reactor itself. The aim of this work is to have a reliable prediction method of the surrounding magnetic field.

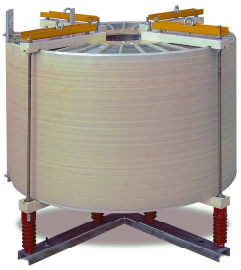

**Figure 1**. Example of air core reactor

**COMPUTATIONAL METHODS**: A parametrized geometry 2D axisymmetric was used with the Magnetic Field interface of the AC/DC Module. The governing equation for Stationary and Frequency Domain study are :

$$\nabla \times (\mu^{-1}\nabla \times \mathbf{A}) = \mathbf{J}_e \quad \text{for Stationary study}$$

$$-\omega^2 \varepsilon_0 \varepsilon_r \mathbf{A} + j\omega\sigma\mathbf{A} + \nabla \times (\mu^{-1}\nabla \times \mathbf{A}) = \mathbf{J}_e \quad \text{Frequency study}$$

The modeling domain is surrounded by a region of Infinite Elements, which are a way to truncate a domain which stretches to infinity. The winding is modeled using the Coil feature with all turn connected in series and excited by current.

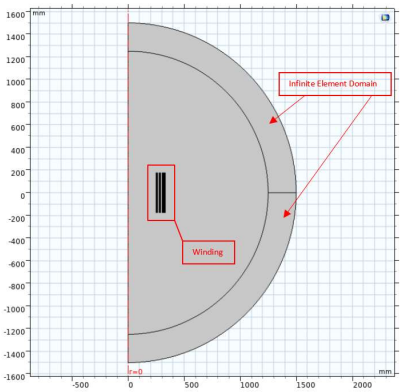


**Figure 2**. 2D axisymmetric geometry

**RESULTS**: The following plots show the magnetic flux density obtained with a DC current of 1500[A] and AC current of 106[A] at 50[Hz]. The Figure 5 shows the values of the flux density at 500mm above the winding (red line of Figure 3 and 4) and the simulated values are compared with the measured values.

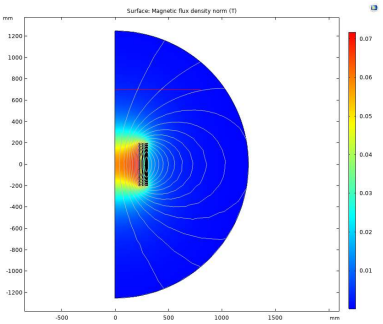

**Figure 3**. Magnetic flux density in DC

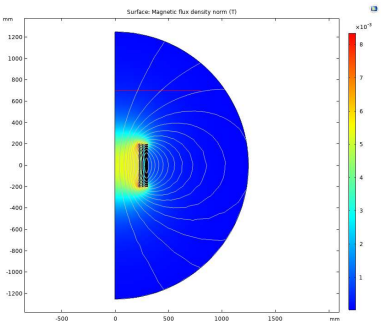

**Figure 4**. Magnetic flux density at 50[Hz]

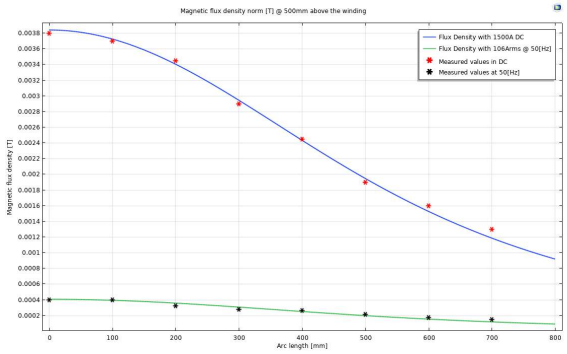


**Figure 5**. Simulated and measured values

**CONCLUSIONS**: The simulation results show a good correlation with the measurements, therefore the model can be used for a future optimization of the winding geometry to obtain the desired values of magnetic flux density.