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The Influence of Different Flux Patterns on Magnetic Losses in Electric Machine Cores

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Abstract : The finite element analysis of magnetic fields in electromagnetic devices shows that the machine cores experience different flux patterns including alternating and rotating fields. The rotating fields are generated in different configurations range between circular and elliptical with different ratios between the major and minor axis of the flux locus. Experimental measurements on electrical steel exposed to different flux patterns disclose different magnetic losses in the samples under test. Consequently, electric machines require special attention during the cores loss calculation process to consider the flux patterns. In this study, a circular rotational single sheet tester is employed to measure the core losses in electric steel sample of M36G29. The sample was exposed to alternating field, circular field, and elliptical fields with axis ratios of 0.2, 0.4, 0.6 and 0.8. The measured data was implemented on 6-4 switched reluctance motor at three different frequencies of interest to the industry as 60 Hz, 400 Hz, and 1 kHz. The results disclose a high margin of error that may occur during the loss calculations if the flux patterns issue is neglected. The error in different parts of the machine associated with considering the flux patterns can be around 50%, 10%, and 2% at 60Hz, 400Hz, and 1 kHz, respectively. The future work will focus on the optimization of machine geometrical shape which has a primary effect on the flux pattern in order to minimize the magnetic losses in machine cores.

Keywords : alternating core losses, electric machines, finite element analysis, rotational core losses
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