# Static Force Characteristic of E-type Single Phase AC Electromagnets

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*Abstract*— In this paper, we propose an approach for the determination of static force characteristic of E-type single phase AC electromagnet using 2D numerical models developed in QuickField and FEMM software. The magnetic attraction force is estimated using Maxwell stress tensor method. The results obtained with numerical models were validated by an analytical method combined with experimental data. The numerical model is an AC magnetics problem coupled with the coil electric circuit. Necessary experimental data are electromagnet coil current values at different air gaps for a known voltage. Also, the ohmic resistance of the coil, the number of turns and wire diameter are known. The numerical results for attraction force obtained in QuickField agree well with those obtained by analytical method combined with experimental data. The correspondent numerical values obtained in FEMM do not match with them, although the air gap magnetic flux density values are practically identical to those obtained in QuickField. More specifically, the numerical values obtained in FEMM for attractive force are half of QuickField values. Considering the distribution of magnetic flux density on polar surfaces and using Maxwell formula in its integral form for calculating the force, it was proved that the numerical values of force are in very good conformity with those obtained in QuickField. The authors point out that in software FEMM the AC force is wrongly calculated based on Maxwell stress tensor method although in DC this calculation is correct.