

MAGNETIC FIELD MEASUREMENT FOR LOW VOLTAGE AUTOMATIC CIRCUIT BREAKER

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Abstract: In this paper I present the measurement of the magnetic field around the low voltage automatic circuit breaker in different scenarios. The measurements are taken from two different axes, and will be compared with values obtained from mathematical simulations. The methods that are used are elaborated by the author in his doctoral paper work.

Keywords: electric field, automatic circuit breaker, metra hit,

1. INTRODUCTION

The experiment was making to determine the electric field intensity produced by a low voltage automatic circuit breaker. The result obtained in experiment a used to determine the area with the large value of magnetic field intensity, B , to determine that these experimental values are bigger or small that the magnetic field intensity limit and, they will be compare with experimental values obtained in a simulation environment.

2. DESCRIPTION OF THE EXPERIMENTAL STAND

The experimental stand is compound from a 10 A automatic circuit breaker, an autotransformers used to modified the voltage, a unidirectional electric field meter (Metra Hit FMA1), and a multimeter (DVM345di) with RS232 port which transmit the measured value to a PC.

In figure 1 is presented the position of Magnetic Sensor in Probe Housing of Metra Hit FMA1 field meter.

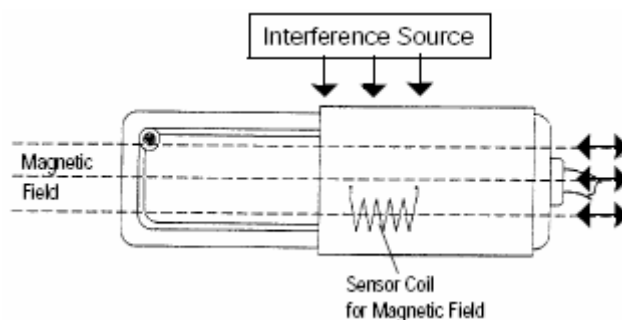


Fig. 1: Position of Magnetic Sensor in Probe Housing

The two scenarios for which are made the measurements are:

- For a constant current of 4 A, and the magnetic field intensity is measured along a two axes AB and E'F', like is presented in figure 2;
- For a constant current of 7 A.

In figure 2 is presented the experimental stand and the axes used to measure the magnetic field intensity.

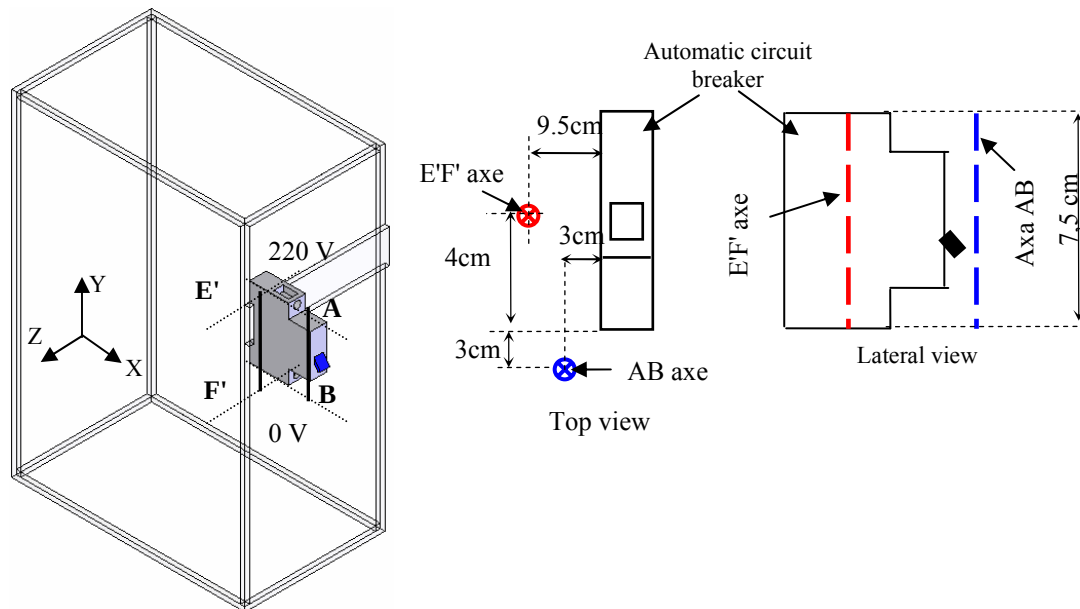


Fig. 2: The representation of axes used to measurement of magnetic field intensity (Isometric, top and lateral view)

The measurement was made after two axes, which are represented in figure 2, and this are:

- AB axe – which is place in front side of the automatic circuit breaker, at about 30 mm from this.
- EF axe – is placed in lateral side of the automatic circuit breaker, at about 9.5 mm from this. The position of this axe is in the neighborhood of the connection slots and of the surface of contact.

The measurement was made for these two axes, over 75 mm long, which is the dimension of automatic circuit breaker. The measurement was made for the three axes X, Y and Z to compound the electric field intensity. By programming the scanning mechanism [1], we obtained 46 point of measurement, at 1.66 mm each over.

3. RESULTS

3.1. Magnetic field intensity variation along AB axe

The resultant magnetic field intensity was compounded from the values measured on the three directions: X, Y and Z. In figure 3 is presented the measurement values of magnetic field intensity B along AB axe for the Cartesian tree directions X, Y and Z, and the resultant values. In figure 4 is presented the same measurement but along E'F' axe.

In figure 5 is presented the variation of magnetic field intensity B along AB axe depending on current intensity value. The graphics a drawing for 4 and 7 A effective value of electric current intensity.

By analyzing the values measured along AB axes for the magnetic field intensity we can conclude the followings:

- Y axe component has very low and uniform values in compared with the X and Z directions, for both values of electric current intensity. The medium value is $0.487 \mu\text{T}$ for 4A and by $0.779 \mu\text{T}$ for 7A.
- Z axe component has the biggest medium value, but not and the maximum value, for the both value of electric current intensity;
- The X component has the large variation and the maximum local value of magnetic field intensity.
- For the tow values of electric current intensity, by 4 and 7 A, the resultant value of magnetic field intensity is maximum at 5153 mm of bottom side of breaker, how is the area between contact surface and iron grids.
- The most favorable area for testing and monitoring the variation of magnetic field intensity is between points 25 and 40, in the area of iron grid of arc blow-out chamber.

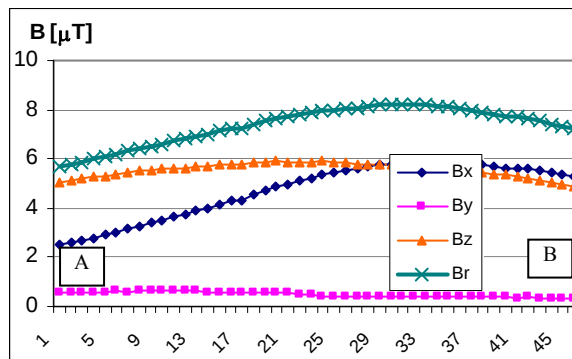


Fig. 3: The magnetic field intensity measured on AB axe for the three directions, and resultant, for a 4 A current at 220 V voltages.

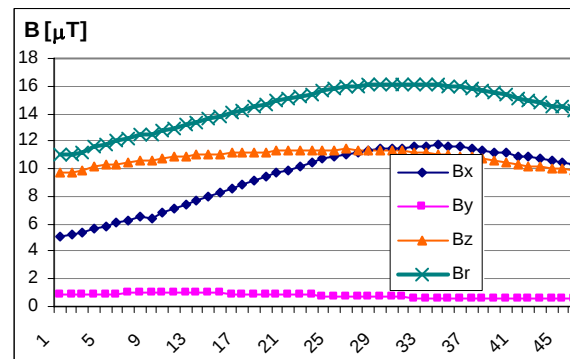


Fig. 4: The magnetic field intensity measured on AB axe for the three directions, and resultant, for a 7 A current at 220 V voltages.

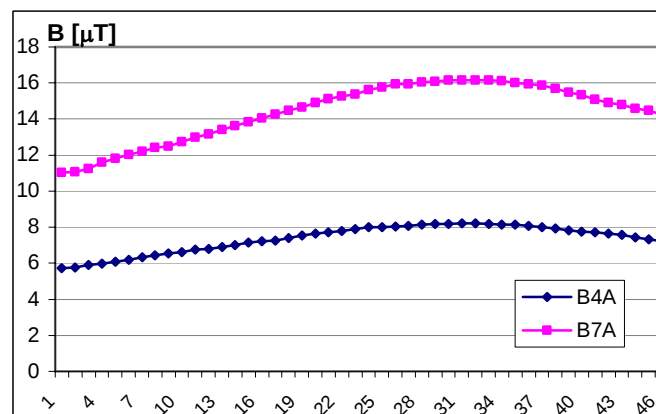


Fig. 5: Magnetic field intensity variations on AB axe depending of current value.

3.1. Magnetic field intensity variation along EF axe

In figure 6 is presented the variation of magnetic field intensity (effective values) along E'F' axe depending the electric current intensity value.

By analyzing the values measured along E'F' axes for the magnetic field intensity we can conclude the followings:

- For the both value of electric current intensity, the values for magnetic field intensity have an ascending trend from E' point to F' point.
- The maximum value of magnetic field intensity is obtained at 38 and 39 point of measurement, in the right of fixed contact borne.

- The magnetic field intensity is direct proportional with the value of electric current intensity passing through switchgear.
- The entire axe E'F' can be used to testing and monitoring the variation of magnetic field intensity.

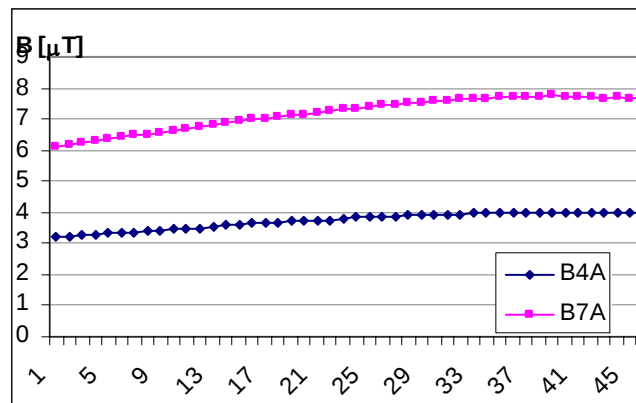


Fig. 6: Magnetic field intensity variations on E'F' axe depending of current value.

4. CONCLUSIONS

By studying the results of measurements of magnetic field intensity around the switchgear we can conclude:

- On AB axe at the grown of electric current intensity the value of magnetic field intensity grown.
- The maximum value of magnetic field intensity is obtained in the end area of iron grid of arc blow-out chamber.
- On E'F' axe at the grown of electric current intensity the value of magnetic field intensity grown.
- The maximum value of magnetic field intensity is obtained in the area of fixed contact connexion borne.
- The both axes, AB and E'F' can be used to testing and monitoring the influence of electric current intensity values on magnetic field intensity value.

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