Evaluation of Magnetic Fields Generated by Induction Hob Under Assumed Actual Usage Conditions

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Abstract

Assuming the actual usage, the magnetic fields generated by a household induction hob were measured and these measurements were confirmed to be in conformance with the ICNIRP magnetic field reference level. The measurement method was in accordance with IEC 62233. The spatial distribution around an induction hob user was roughly determined by scanning three measurement planes at different distances from the hob and parallel or perpendicular to the hob’s front. Moreover, measurements were taken with different metallic material types and sizes of cooking pots as well as under the conditions of various position gaps between the centers of the pot bottom and the coil used for magnetic field generation in the hob. As a result, it was confirmed that all measurement results in this study were lower than the magnetic field strength reference levels for general public exposure provided in the ICNIRP 2010 guidelines.

Introduction

Induction hob has become increasingly popular in regular households due to its convenience and high level of fire safety. Several researches have published the reports on the magnetic fields generated by induction hob. In our study, the conformance with the magnetic field reference levels for general public exposure provided in the ICNIRP 2010 guidelines was verified regarding magnetic fields measured under the actual usage conditions by changing standing positions of a hob user, pot materials and sizes, and gaps between the centers of the pot bottom and the coil.

Methods

Measurements were conducted for a common induction hob model made by Japanese manufacturer. The measuring instrument used was the ELT-400 from Narda S.T.S. This instrument performs a time-domain evaluation of the exposure level of the measured low-frequency magnetic field (10 Hz - 400 kHz), so it implements the measurement that complies with IEC 62233.

Measurement Target / Instrument

Sensor (Narda S.T.S ELT-400)
- 3-D coil magnetometer
- Mode : ICNIRP 2010 Gen.Pub
- Probe : 100 mm²
- Detec : RMS
- Range : L2W
- Frequency range : 10 Hz - 400 kHz

Evaluation Methods

The evaluation of measurements obtained was performed by calculating their ratio (%) to the corresponding reference levels of ICNIRP guideline using Formula 1.

1. Spatial distribution around the user (Fig2)

- Measurement of the spatial distribution of magnetic fields around the induction hob user was conducted by scanning with 100 mm intervals on the three measurement planes as shown in Fig2.
- Measurement was conducted using an iron pot with a diameter of 180 mm at a maximum output of 3 kW. The maximum output was confirmed by checking the electric current flowing through power cord.

2. Material and size of pot

- Measurements were conducted for iron and aluminum pots of five different diameters under the condition of maximum output of 3 kW for the iron pot and 2.5 kW for the aluminum pot.
- According to IEC 62233, the maximum value of measurements obtained along vertical axis from 500 mm below to 1,000 mm above the countertop at a distance of 300 mm from the front of the hob was determined.

3. Position gap between the centers of pot bottom and coil

- Measurements were conducted by changing the gap between the centers of pot bottom and coil in the range of 0-90 mm to back direction of hob, using an iron pot of 180 mm in diameter.
- The power output and measurement positions were the same as described in 2.

Conclusion

Assuming the actual usage, the magnetic fields generated by a common induction hob were measured. The spatial distribution of magnetic field intensity around the user, differences due to the material and size of pot as well as the gap between the centers of pot bottom and coil were shown. Measurements were evaluated by calculating their ratios to the corresponding reference levels of ICNIRP guideline resulting in confirmation of conformance with the ICNIRP guideline.

Figure 1  Measurement set-up.

Figure 2  Spatial distribution of magnetic fields generated by Induction hob.

Figure 3  Changes in the ratios of measurement values and the positions of maximum value by the diameter of pot.

Figure 4  Changes in the ratios of measurement values and the power cord currents by the gap between the centers of pot bottom and coil.