DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	234011
Document Title:	Redwood Energy Comment - Induction Stoves and EMF Testing
Description:	Comment submitted by staff at the request of Sean Armstrong, Redwood Energy
Filer:	Adrian Ownby
Organization:	Redwood Energy
Submitter Role:	Public
Submission Date:	7/24/2020 1:17:22 PM
Docketed Date:	7/24/2020

Characterizing the Electromagnetic Fields and Testing of Induction Ranges

June 30th, 2020

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Introduction

Induction cooking ranges utilize electromagnetism to generate heat in magnetic cookware. They do this by creating magnetic fields which induce currents in magnetic cookware; these currents then dissipate heat throughout the cookware and heat it to cooking temperature. The magnetic fields that heat the cookware are created when a current is applied to a tightly wound copper coil located beneath the cooking surface (Sweeney et al 2014).

Because magnetism is poorly understood by non-physicists and induction stoves are new to most cooks, this document aims to characterize the electromagnetic fields created by induction stoves, and explain the testing regimen induction stoves are put through before they are sold to the public.

Figure 2: A photo of a single-burner induction range taken at a testing facility (Bay Area Compliance Labs Corp 2015)

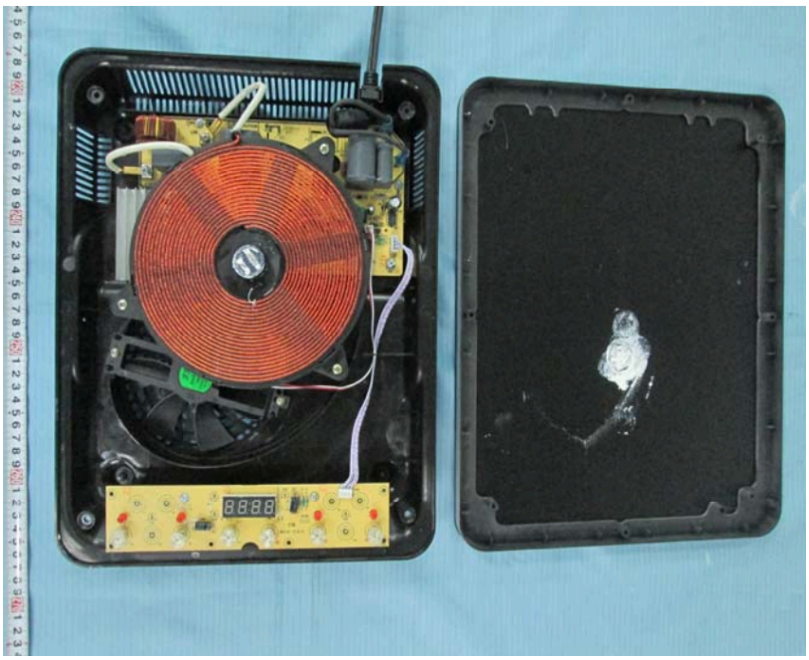

Figure 1: Single-burner induction range with its faceplate removed showing internal components; the copper coil (center) produces the magnetic fields which heat cookware (Bay Area Compliance Labs Corp 2015)

What are the electromagnetic frequencies used in induction ranges?

EMFs are classified into two groups by physicists: ionizing and non-ionizing. Ionizing EMFs are short electromagnetic waves which have high enough energy to disrupt chemical bonds in human tissue and DNA, called "ionizing." Examples of ionizing EMFs are ultraviolet light (sunlight), X-rays, and gamma rays. Non-ionizing EMFs have long wavelengths which do not have enough energy to ionize tissue and DNA. EMFs from Earth's magnetic field, electrical transmission through power lines, cell phones, radio and TV broadcasts, and microwave ovens are all examples of non-ionizing EMFs.

Induction ranges produce electric and magnetic fields just below the radio frequencies regulated by the Federal Communication Commission, and induction stoves are carefully tested to ensure these lower energy radio waves neither interfere or overlap with higher energy communication radio waves. This product testing ensures one can listen to the radio while cooking without static or interference from the range.

The magnetic fields, i.e. EMFs, produced by an induction range for the purpose of heating cookware typically have a frequency between 25 kHz and 50 kHz (Sweeney et al 2014), placing them in the radio frequency (RF) region of the electromagnetic spectrum. Waves in this region of the spectrum are non-ionizing, and do not interact with the human body. (FCC 2020).

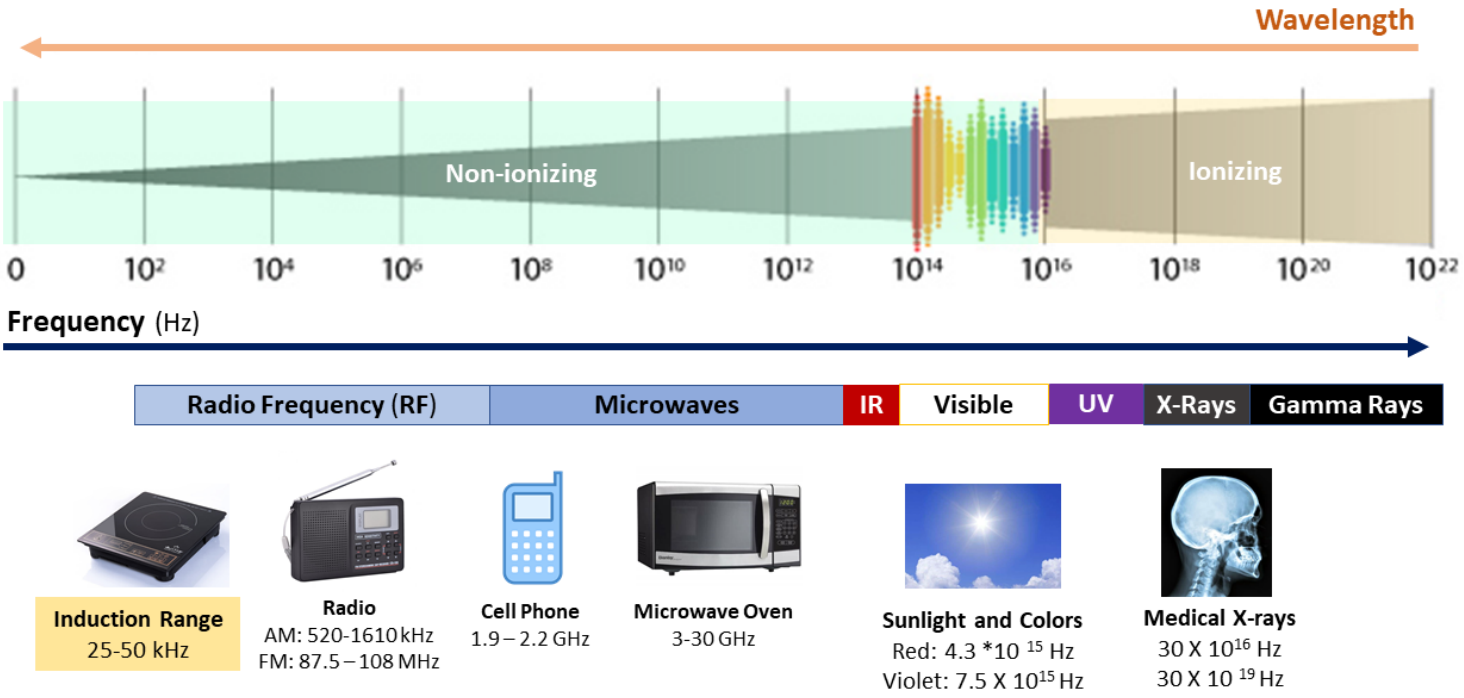

Figure 3: The spectrum of electromagnetic radiation showing the location of induction cooking range EMFs compared with other sources of EMFs (Modified from National Institute of Environmental Health Sciences).

How are induction cooking ranges certified for electromagnetic emissions?

FCC Certification

The Federal Communications Commission (FCC) regulates EMF emissions from electronic products manufactured or sold in the United States to ensure that electronics do not cause radio communications interference. Part 18 of the FCC rules sets forth standards for EMF strength for a variety of electronic equipment ranging from industrial, scientific, and medical equipment to consumer electronics.

Induction ranges are tested using FCC Measurement Procedure 5 (MP-5). FCC Office of Science and Technology (OST) established Measurement Procedure 5 (MP-5) to standardize testing of EMF emissions from electronic equipment based on Part 18 of the FCC rules and ensure that EMFs from electronics sold in the US are within acceptable limits. All equipment that is manufactured or sold in the US must demonstrate conformity to FCC rule 18.305 for radiated field strengths, which states that radiated fields below 90kHz should not surpass 1,500 microvolts per meter, and those on or above 90 kHz should not exceed 300 microvolts per meter measured at 30 feet (FCC 1987a). The test procedure involves using a radio antenna in an "anechoic" (EMF-proof) chamber to measure EMF emissions from a piece of electronic equipment (FCC 1987b). The testing

occurs in various certification laboratories around the world depending on where the induction range was manufactured. A diagram of the test set up for MP-5 is illustrated in Figure 4 and an actual photograph of an induction range test from a testing document is shown in Figure 5.

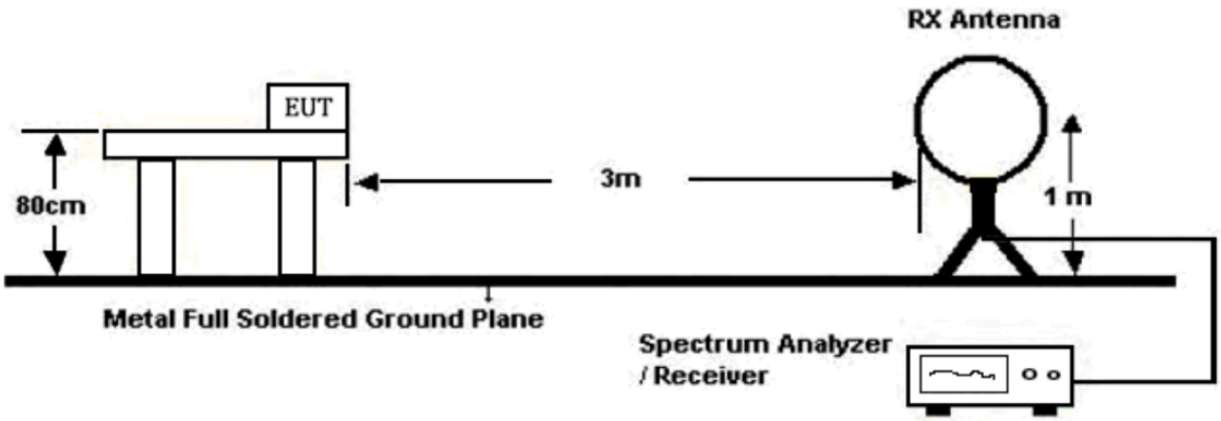

Figure 4: Diagram of an experimental set up used to test radiated emissions from induction stoves in accordance with FCC Rule 18.305.

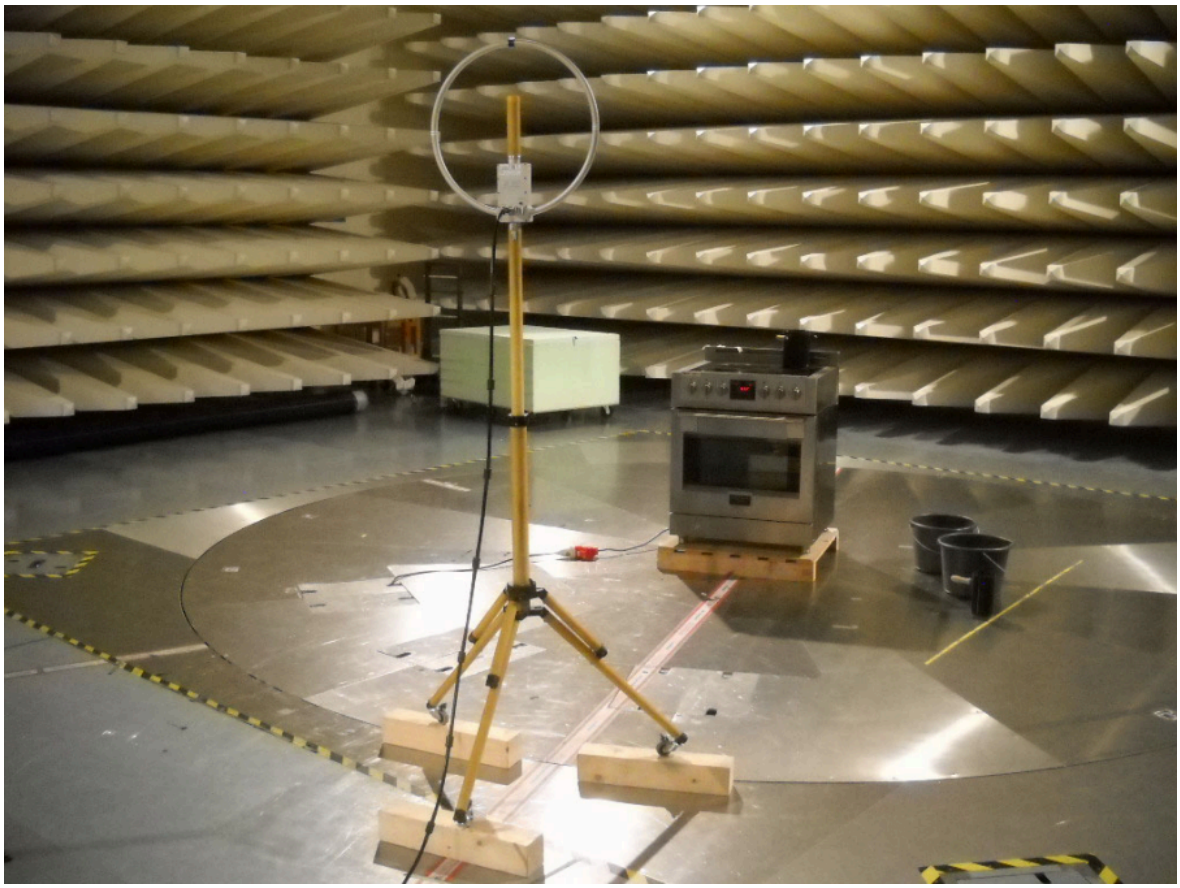

Figure 5: An example of a radiated emissions test showing anechoic chamber and loop antenna (VDE Testing and Certification Institute 2016).

References

FCC. (1987a). *47 CFR § 18.305 - Field strength limits.*

FCC. (1987b). *Methods of measurement of radio noise emissions from industrial, scientific, and medical equipment.*

FCC. (2020). *RF Safety FAQ*.

Sweeney, M., Dols, J., Fortenbery, B., and Sharp, F. (2014). *Induction Cooking Technology Design and Assessment*.

Acknowledgements

Redwood Energy would like to thank Dr. Will Gannett, Professor of Physics at Humboldt State University for his involvement in this research.