A Status Report on the International SAR Inter-Comparison for Wireless Phone Certification

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Abstract

Several national and international organizations have established guidelines for human exposure to radio frequency energy. These include the IEEE C95.1 standard [1] and the recommendations of the National Council on Radiation Protection and Measurements (NCRP) [2], the International Commission on Non-Ionizing Radiation Protection (ICNIRP) [3] and the National Radiation Protection Board (NRPB) in the United Kingdom [4]. While these guidelines have a few subtle differences, their limits in the frequency range used by wireless communications devices are broadly similar. In the USA the Federal Communications Commission (FCC) has promulgated exposure guidelines with which wireless communication devices must comply [5]. The FCC guidelines, were developed to protect workers and the general population from harmful exposure to RF fields and have been promulgated because of FCC legal responsibilities under the National Environmental Policy Act of 1969 (NEPA). The FCC guidelines specify maximum SAR values that are permitted over spatially averaged regions within the body. Specifically, these guidelines require hand-held wireless phones not to exceed an SAR of 1.6W/kg averaged over any one centimeter cube. Other countries have their own specific guidelines.

It is not possible to place probes in the head of a wireless phone user to determine the actual spatial SAR distribution. Instead what is done is to make measurements on absorbing phantom models of various degrees of complexity, and by comparing theory and experiment obtain conservative estimates of the SAR in the human head [6]. The most complex models of the head that are used in this way are based on MRI images, subdivided into volume pixels (voxels) by tissue type, with a specified complex dielectric constant for each voxel. Theoretical analysis of SAR distribution is carried out by modeling the antenna of a source placed close to the head and solving Maxwell's equations by various numerical techniques. The two most important phantom models that are used for

SAR experiment and comparison with theory are (1) a flat phantom, designed to constitute an infinite absorbing half-space adjacent to a standard dipole antenna or wireless phone, and (2) an anthropometric phantom model of the human head and torso. Both phantoms are generally fabricated as thin shells of low-loss material, which is filled with a dielectric liquid whose dielectric properties are an average value for the values measured for the tissues in the head (especially brain tissue).

The University of Maryland and the United States Food and Drug Administration are currently coordinating an international effort to standardize the test procedures used for assessing the SAR values that result from the use of commercial wireless phones. The first phase of this inter-laboratory comparison is currently underway. A flat phantom and mounting assembly, complete with standard dipole antennas for both the 900MHz and 1800MHz wireless phone bands, power meters, couplers and cabling, is currently circulating among the laboratories of the various wireless phone manufacturers who are members of the MMF (the Mobile Manufacturers Forum). Each laboratory will mix its own simulant fluid according to a prescription developed by the IEEE, and whose dielectric properties will be verified by local measurement. Each laboratory will then map the SAR within the phantom on a specified grid, with the results reported as W/kg/W. Each laboratory will also calculate a $1cm^3$ average maximum SAR. The results will be reported back to the University of Maryland/FDA, who will independently be making SAR measurements on identical phantoms, with identical antennas, couplers, cabling, and power meters. The variables among the various laboratories include (a) the E-field probes used within the phantom, (b) their method of calibration, (c) the locally produced simulant fluid, (d) the scanning system, and (e) the measurement electronics. This inter-laboratory comparison will serve to verify the degree of reproducibility that can be obtained in relatively complex exposure assessments of this kind. It will also provide a framework for establishing the measurement procedures required for wireless phone certification.

We will report on the procedures used for independent E-field calibration, simulant fluid verification, and SAR determination, and provide an updated report on the status of the MMF SAR inter-laboratory comparison project. This work follows closely the emerging measurement protocol being developed by an IEEE Standards Coordinating Committee.

References

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