



Conservativeness of mobile phone SAR measurements

A recent publication¹ has called into question the methodology of SAR testing, despite its widespread adoption and acceptance. This recent paper is at odds with the results of several studies that have confirmed that SAR testing results are conservative for the general population, including children. While it is for the scientific community to clarify on detailed technical issues² and to explain the meaning of some of the inconsistent arguments³ made in this particular publication, the Mobile Manufacturers Forum would like to point out the following:

SAR compliance testing of mobile phones is carried out using the standardized protocol described in IEC 62209-1, IEC 62209-2 and IEEE 1528. The International Electrotechnical Commission (IEC) is the world's leading organization that develops and publishes international standards for all electrical, electronics and related technologies. The IEC standards are developed by nominated experts of national committees - from research labs, governmental agencies, academia, industry, commerce, and consumer groups.

The key element in the SAR compliance measurement of mobile phones is the SAM (**S**pecific **A**nthropomorphic **M**annequin) head phantom. SAM was defined as the standard head phantom allowing a conservative SAR assessment covering vast majority of human population, independent of age. The conservativeness of SAM phantom has been confirmed by large scale international inter-laboratory computational and measurement studies.

SAM is considered a representative Head SAR model for the vast majority of users

The standard setting body IEEE International Committee on Electromagnetic Safety designed a standardized and conservative head model as stated in the IEEE 1528-2003 standard.

'The use of the Specific Anthropomorphic Mannequin (SAM) phantom and handset test positions in standardized measurement procedures will reduce lab-to-lab variability. the combination of higher tissue

¹ Gandhi et al, 'Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children', *Electromagnetic Biology and Medicine*, Early Online, 1-18, 2011

² Ibid., e.g. the wrong quote on page 1: '*The SAR for a 10-year old is up to 153% higher than the SAR for the SAM model.*'

³ Ibid., e.g. on page 1: '*Radiofrequency (RF) exposure to a head smaller than SAM will absorb a relatively higher SAR.*'



*conductivities, a large head size, a thin ear spacer, and the exclusion of a hand holding the handset were chosen to provide a conservative estimate of the peak spatial-average SAR associated for the operating configurations expected by typical wireless handset users.'*⁴

The selections of a thin ear and a flat cheek of the SAM head model brings the antenna closer to the head liquid which increases SAR. As the head liquid with conservative dielectric properties was chosen⁵ (not an average of the head tissues as stated in the Gandhi et al paper¹), the current SAR testing method in SAM head provides overestimated SAR results in real human heads. Research has confirmed that SAR testing results are conservative for the general population, including children. A study⁶ conducted by an international task force of 14 experts from government, academic, and industrial research institutions which compared numerically calculated SAR using SAM and MRI based models of normal adult and child heads found:

*'(...) SAM produced a higher SAR in the head than the anatomically correct head models. Also the larger (adult) head produced a statistically significant higher peak SAR for both the 1- and 10-g averages than did the smaller (child) head for all conditions of frequency and position.'*⁶

SAM conservatively measures Head-SAR regardless of a user's age

Moreover, research studies from Switzerland and France have also shown that SAM is a reliable model for measuring adults' and children's head SAR:

*'The peak spatial specific absorption rate (SAR) assessed with the standardized specific anthropometric mannequin head phantom has been shown to yield a conservative exposure estimate for both adults and children using mobile phones. (...) This study, however, confirms previous findings saying that there are no age-dependent changes of the peak spatial SAR when averaged over the entire head.'*⁷

'This paper deals with (...) SAR induced in different heads models. In particular, the exposure of children will be analyzed. (...) The specific

⁴ IEEE 1528-2003, Page 30, Section 5, Phantom Models

⁵ Drossos et al. 'The dependence of electromagnetic energy absorption upon human head tissue composition in the frequency range of 300-3000 MHz', IEEE Trans. MTT vol. 48, issue 11, part 2, pp: 1988 – 1995. 2000

⁶ Beard et al, 'Comparisons of computed mobile phone induced SAR in the SAM phantom to that in anatomically correct models of the human head', IEEE Trans. Electromagn. Compat., Vol 48, No. 2, pp. 397-407, May 2006; following quote from abstract

⁷ Christ et al, 'Age-dependent tissue-specific exposure of cell phone users', Phys Med Biol. 2010 Apr 7;55(7):1767-83. Epub 2010 Mar 5.



*anthropomorphic mannequin (SAM) homogeneous head model (...) always overestimates adult and child head exposure.*⁸

Both SAM and computational methods have its rightful place in SAR compliance testing

Finally, research addressing the effects of dielectric property differences in children and adults on SAR has shown that:

*"It is the matter of reassurance that the dosimetric studies so far have not shown any significant differences in the calculated SAR values due to higher conductivity values for younger tissues."*⁹

Furthermore, a study on numerical and experimental comparisons of the SAR in human head phantoms has concluded that:

*'The numerical and experimental results compare well and confirm that the applied SAR assessment methods constitute a conservative approach.'*¹⁰

Therefore, SAM is considered a representative model of Head-SAR for the vast majority of user and is regarded conservative enough to reflect all age groups. These conclusions have been arrived at as a result of numerous independent studies. It is also important to recall that all mobile phone models are tested to make sure they meet national and international exposure limits for exposure to radiofrequency emissions, before they can be sold in each market.

For more information on SAR issues, please refer to www.sartick.com

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⁸ Hadjem A. et al, 'Analysis of Power Absorbed by Children's Head as a Result of New Usages of Mobile Phone', IEEE Trans. Electromagn. Compat., Vol 52, No. 4, pp. 812-819, Nov 2010

⁹ Peyman A. et al, Dielectric properties of tissues; variation with age and their relevance in exposure of children to electromagnetic fields; stage of knowledge', Prog Biophys Mol Bio. 2011 Sep 3; [Epub ahead of print]

¹⁰ Christ A, et al, 'A Numerical and Experimental Comparison of Human Head Phantoms for Compliance Testing of Mobile Telephone Equipment', Bioelectromagnetics vol. 26, pp.125-137, 2005