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AN ATTEMPT TO EVALUATE THE EXPOSURE OF OPERATORS OF PORTABLE RADIOS AT 30 MHZ

Reference?

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The high values of electric and magnetic energy density detected near CB antennas[1] have motivated a series of experiments to measure the energy deposition in operators of 30 MHz portable radios. Measurements were performed using simulated human tissue. Since no phanton materials have been developed for the frequency band below 150 MHz[2], an extensive research was conducted to properly simulate human tissue at 30 MHz. The mixtures finally used for the phantoms are as follows (% by weight):

Muscle Tissue

76.570%	H_2O
.153%	NaCl
13.780%	Aluminum Powder
9.495%	Super Stuff (A Jellying Agent)

Fat and Bone

79% Laminac 4110

20.72% Aluminum Powder

.28% Acetylene Black

7cc/2Kg MEK Peroxide

At 30 MHz, the muscle mixture has a relative dielectric constant $\varepsilon_r = 110$ and a conductivity $\sigma = .65\Omega^{-1}/m$, characteristics very close to tissue rich in water.[3] The fat and bone mixture has a dielectric constant $\varepsilon_r = 19$ and a conductivity of $\sigma = .028\Omega^{-1}/m$.

The two phantoms built for the energy deposition tests are shown in Figure 1. One consists of a cylindrical shell of fat and bone tissue 1.25 cm thick filled with muscle mixture. This phantom simulates the human torso. The cylindrical shell of elliptical cross-seciton is 53 cm high and the cross-section diameters are 30 cm and 20 cm long. The weight of the torso is approximately 40 Kg. The phantom resembling a human head is a shell of fat and bone mixture filled with simulated brain tissue. The composition of simulated brain tissue is very similar to that of muscle tissue. The dimensions and thickness of the skull are identical to those of the phantom used at 150 MHz[4].

The energy deposition measurements were performed by using 6W portable (Motorola Handie-Com MH10) radios with a telescopic antenna 80 cm long when fully extended and a helical antenna 40.5 cm long. Methods and procedures of the experiments were completely analogous to those previously used at higher frequencies[4]. Measurements showed no detectable temperature increases due to RF in the phantoms for a one minute exposure. Even when the antennas were positioned very close to the phantom (distance<.1 inch), no appreciable temperature increment was detected at any depth into the phantom. The digital thermometer used in the tests is the Bailey Instrument BAT-8 model, which has a .01°C sensitivity; by monitoring the analog output of the instrument, it is possible to perform readings of .005°C. The tests clearly indicate that the maximum Specific Absorption Rate of RF energy is low in the simulated tissue. A power deposition of 1 mW/gr for 60 sec. causes a temperature increase of approximately .015°C, a level that can be easily detected with the available instrumentation. The temperature measurements show that a deposition rate substantially smaller than 1 mW/gr is caused by the radios used in the tests.

The power densities near the radios and the antennas have been evaluated and are plotted in Figures 2 and 3 for the telescopic and the helical antenna respectively. Since no electric field probe operating below 300 MHz is commercially available, the measurements were performed using the Narda Magnetic Field Probe Model #8631. The probe has the operating frequency range 10 - 300 MHz. The probe sensor consists of three orthogonal wire loops of 4 inch diameter. The data shown in Figures 2 and 3 were collected by placing the sensors in direct contact with the antenna and represent the maximum reading obtained by rotating the probe around its axis as recommended by the manufacturer. As can be seen in Figure 2 for the telescopic antenna, the maximum power density is no greater than 5 mW/cm². This reading is detected at the base of the antenna near a loading coil, contained in the radio case. For the helical antenna, the measured power density of less than 0.6 mW/cm². The large discrepancy between the values of power density presented in (1) and those detected during this work can be explained by the substantial difference between the near field structure of an antenna mounted on a ground plane* and that of the same antenna placed on a small (compared to wavelength) radio case which is hand held.

The deposition measurements performed using both telescopic and helical antennas show that maximum deposition rates well below 1 mW/gr are caused by 6W, 30 MHz portable radios even at spacings between operator and antenna of only .1 inch. No thermal hazard is present for such low deposition rates.

*The measurements reported in (1) were performed using an antenna of a CB mobile unit. However, the antenna was mounted on ground plane[5].