AbstractID: 7323 Title: Calorimetric measurements of the efficiency of a transmit-receive head coil for the optimization of MR head examinations within SAR safety levels.

Purpose: To determine the efficiency (i.e. the ratio of the actual SAR over scanner reported SAR) of a transmit-receive (TR) head coil, over clinically-relevant ranges of transmitted RF power and patient weight, aiding in the optimization of parameters for head examinations requiring careful SAR monitoring.

Methods and Materials: Temperature increases due to the deposition of RF energy during MRI scanning were measured on a clinical 1.5T Siemens MAGNETOM Avanto (revision B13 software). The calorimetric tests employed a 4-liter cylindrical head phantom placed inside a standard TR head coil. The phantom and the ambient temperatures, T and T_A, were recorded simultaneously using MR-compatible temperature probes. A spin echo imaging sequence with 4-echoes, TR/TE1/TE2/TE3/TE4 100/20/40/60/80ms, 256×256 matrix, a single 3mm-slice, and 70 signal averages to prolong the scan time to 30min was used. The measurements were repeated for five transmitter reference voltages, 117, 105, 93, 84, and 58.5V. The scanner's SAR estimates S were recorded for patient weights between 50 and 150kg. The temperature measurement continued after scanning to allow determination of the cooling constant k. Data were analyzed using Newton's Law of Cooling: $dT/dt = -k(T-T_A)+eS/c$, where e is the coil efficiency, c is the heat capacity of water. First k and subsequently e were determined by fitting the measured temperature history to the corresponding solutions of that equation.

Results: For higher reference voltages, 117 and 105V, the efficiencies were found to increase with patient weight, from 0.6 to 0.88 for weights 50-150kg. Conversely, for lower reference voltages, the efficiencies become weight-independent and are about 0.5, 0.4, and 0.2 for 95, 84, and 58.5V, correspondingly.

Conclusions: The observed efficiencies indicate somewhat conservative SAR estimates, especially for the low range of transmitted RF power. Therefore these measurements provide a useful refinement to the model-dependent SAR estimate displayed by the MRI system.