

How water equivalent are water-equivalent solid materials for output calibration of photon and electron beams?

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The water equivalency of five “water-equivalent” solid phantom materials was evaluated in terms of output calibration and energy characterization over a range of energies for both photon (Co-60 to 24 MV) and electron (6–20 MeV) beams. Evaluations compared absorbed doses calculated from ionization measurements using the same dosimeter in the solid phantom materials and in natural water (H₂O). Ionization measurements were taken at various calibration depths. The Radiological Physics Center’s standard dosimetry system, a Farmer-type ion chamber in a water phantom, was used. Complying with the TG-21 calibration protocol, absorbed doses were calculated using eight measurement and calculational techniques for photons and five for electrons. Results of repeat measurements taken over a period of 2 1/2 years were reproducible to within a $\pm 0.3\%$ spread. Results showed that various combinations of measurement techniques and solid phantom materials caused a spread of 3%–4% in the calculation of dose relative to the dose determined from measurements in water for all beam energies on both modalities. An energy dependence of the dose ratios was observed for both photons and electrons.

INDEXING TERMS: CALIBRATION STANDARDS, ELECTRON DOSIMETRY, IONIZATION, PHANTOMS, TISSUE—EQUIVALENT MATERIALS, WATER, X—RAY DOSIMETRY