# AbstractID: 2906 Title: Detailed characterization of the water-equivalent material Virtual Water in high-energy photon and electron beams

**Purpose**
In reference dosimetry for high-energy photon and electron beams a solid phantom offers a number of advantages over water as the reference material including ease of use and positioning reliability. This paper describes the characterization of the material Virtual Water (manufactured by Med-Cal).

**Methods and Materials**
Ionization measurements were made in Co-60, 6 & 10 MV photons and five electron beams (4-22 MeV). Two techniques were used: i) substitution - Virtual Water slabs displaced water in a water phantom, and ii) direct comparison of ionization measurements in a water and Virtual Water (VW) phantom. Two formulations of Virtual Water were evaluated, having different densities.

**Results**
Neither formulation showed exact water equivalence in photon beams – the water/VW ratio varied with the depth of measurement with a difference of over 1% at 10 cm depth. However, by using a density (range) scaling factor very good agreement (< 0.2%) between water and VW at all depths was obtained. In the case of the electron beams a range-scaling factor was also required to match the shapes of the depth dose curves in water and Virtual Water. However, there remained a difference in the measured fluence in the two phantoms after this scaling factor had been applied. For measurements around the peak of the depth-dose curve this difference amounted to 0.4%.

**Conclusion**
The level of water equivalence for Virtual Water is among the best reported for epoxy-resin based materials. The low overall uncertainty on the fluence ratio - estimated to be 0.18% - opens up the possibility of performing dosimetry in a solid phantom with an accuracy approaching that of measurements in water. This is particularly of interest for low energy electron beams (< 6 MeV) where positioning errors in a water phantom can contribute significantly to the overall uncertainty.