Ionization versus polarizing potential (0-1000 volts) measurements (SD< 0.05%) were made on 6 MV photons and 16 MeV electrons, representing low and high ion-collection efficiency situations. Measurements for a variety of ion chambers suggest that P_{ion}, measured by the conventional Boag two-voltage technique, over-estimates the true saturation charge (Q_{sat}). We also verified similar findings, recently reported for ^{60}Co, by Zankowski and Podgorsak[a]. Their semi-empirical model, incorporating contributions from initial recombination, general recombination, ion diffusion and charge multiplication, produces excellent fits to our measured data for pulsed photon and electron beams. Results suggest that for a 0.6 cm^3 Farmer type chamber, P_{ion} determined by the Boag technique over-estimates Q_{sat} by 0.3 to 0.5 % for both continuous (^{60}Co) or pulsed (non-scanned) electron or photon beams.

Based on their ^{60}Co data Zankowski and Podgorsak[a] recommended that a complete ionization vs. polarizing potential curve be measured to determine Q_{sat} or alternatively, that the Boag technique be used for polarizing potentials below 100 Volts. Our results indicate that the over-estimation correction has a narrow range independent of dose rate or modality. This suggests that we may continue to measure P_{ion}, using the Boag technique, with voltages near 300 Volts to minimize P_{ion}, and that the over-estimation correction may be determined for classes of ion chambers.

[a] Zankowski C. and Podgorsak E. “Determination of saturation charge and collection efficiency for ionization chambers in continuous beams”, accepted for publication by Medical Physics, 1998.

This work was supported by PHS grant CA10953 awarded by the NCI, DHHS.