Purpose: Plane-parallel ionization chambers were not included for reference dosimetry of photon beams in TG-51 because sufficient data was not available. This work aims to experimentally determine absorbed dose beam quality conversion factors, kQ, for several plane-parallel ionization chambers in clinical megavoltage photon beams to potentially enable their use for reference dosimetry of high-energy photon beams and determine if variation in kQ factors for chambers of the same type is considerable.

Methods: Measurements traceable to the national standard of absorbed dose were carried out at the National Research Council of Canada with 11 different types of plane-parallel ion chamber. In most cases, two chambers of each type were obtained from the major ion chamber manufacturers. Chamber stabilization, leakage currents, ion recombination and polarity behavior, as well as chamber-to-chamber variations were investigated. Absorbed dose-to-water calibration coefficients were measured for the cobalt-60 irradiator and in 6, 10 and 25 MV photon beams from the Elekta Precise linear accelerator to obtain kQ factors.

Results: All chambers investigated gave stable readings within 15 minutes in the cobalt-60 reference field. Leakage currents were negligible (< 0.05% of the chamber reading) for all chambers. Ion recombination corrections were obtained as a function of dose per pulse; the majority of chambers performed as expected. Polarity corrections were less than 0.1% for most chambers. Values of kQ for chambers of the same type differed by less than 0.4% suggesting that chamber-to-chamber variation is not a significant issue.

Conclusions: Although there are differences between kQ factors determined for chambers of the same type, it is generally not significant. Measurements demonstrate the ability to characterize and use plane-parallel ion chambers for reference dosimetry of MV photon beams using the TG-51 protocol. The uncertainty in calibrating a plane-parallel ion chamber is not significantly greater than for a cylindrical chamber.