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INTERCOMPARISON OF ABSORBED DOSE TO WATER AND AIR-KERMA BASED DOSIMETRY PROTOCOLS FOR PHOTON AND ELECTRON BEAMS

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During the last three decades the International Atomic Energy Agency (IAEA), the American Association of Physicists in Medicine (AAPM) and organizations from various countries have published Codes of Practice (CoP) and dosimetry protocols for the calibration of high-energy photon and electron beams. They are based on the air-kerma or exposure calibration factor of an ionization chamber in a $^{Co}60$ gamma ray beam and formalism for the determination of absorbed dose to water in reference conditions. In recent years, the IAEA (IAEA TRS-398) and the AAPM (AAPM TG-51) have published new external beam dosimetry protocols that are based on the use of an ionization chamber calibrated in terms of absorbed dose to water in a standards laboratory's reference quality beam. These two new protocols follow those by the German Standard DIN, the British IPSM and the IAEA CoP for plane-parallel chambers, which have discussed and implemented the procedures for the determination of absorbed dose-to-water based on standards of absorbed dose-to-water. Since the publication of these protocols and CoPs, many comparisons, theoretical as well as experimental, between them have been published in the literature providing valuable information about the sources of similarities and discrepancies that exist among them. For example, the differences in the basic data for photon and electron beams included in the various IAEA CoPs are very small for the second edition of TRS-277 for photons, TRS-381 for electrons and TRS-398. In these cases the data changes posed by the adoption of TRS-398 are within about ±0.3% for the most commonly used energies. When implementing TRS-398 in these cases, the main difference will arise from the transition from K_{air} to D_w standards. For example, experimental comparison of absorbed doses between TRS-398 and TRS-277 for photons show an average difference of about 0.3% for most commonly used energies with a maximum difference of about 1% at a $TPR_{20,10}$ value of 0.80; for electrons a maximum difference of about 1% is observed between TRS-398 and TRS-381 and about 1.8% between TRS-398 and TRS277 for energies ranging from 6-18 MeV. The comparison of TRS-398 with TG-51 reveals that photon beam dosimetry agrees within about ±0.3% for most commonly used energies. For electron beam dosimetry, comparison of TRS-398 with TG-51 reveals agreement within about ±0.4% for cylindrical chambers for energies above 10 MeV approximately; however, for plane-parallel chambers, differences of almost up to 2% is observed between the two protocols. On the other hand, the agreement for these chambers when cross-calibration procedures are used is excellent. This talk will provide a comprehensive review of intercomparisons of all these protocols. The reasons for the discrepancies between theory and experiments will be discussed terms of the combined effect of small data differences and the influence of $N_{D,w}/N_K$ for the various chamber types.