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Key Data for Ionizing-Radiation Dosimetry: Measurement Standards and Applications

International Commission on Radiation Units and Measurements (ICRU) Report 90, Key Data for Ionizing-Radiation Dosimetry: Measurement Standards and Applications, is the result of a specific request by the Consultative Committee on Ionizing Radiation and has strong links with previous ICRU reports on stopping powers of electrons and positrons, protons, and heavier ions.

The Report begins with a brief introduction on the need for recommendations on key data, reasons for reevaluating the data, and the Report's relation to earlier ICRU reports. Section 2 gives a brief summary of the definitions of the quantities required in this Report. Although most of the definitions and relationships between the quantities are well established, there continue to be new developments, such as the recognition that the conventional relationship between exposure and air kerma is only approximate. Many of the key data play important roles in the realization of primary standards, so Section 3 reviews the primary standards for air kerma and absorbed dose to water and shows how the key data enter the measurement equations. An important quantity, not only for measurement standards but also for Monte Carlo calculations, is the charged-particle stopping power. Section 4 briefly reviews the theory of charged-particle stopping power in which the mean excitation energy and the density-effect correction are the non-trivial quantities; the review is not intended to be in-depth, but rather to provide a sufficient understanding of the methods used in this Report that mainly extend those used in ICRU Report 37, Stopping Powers for Electrons and Positrons (1984); ICRU Report 49, Stopping Powers and Ranges for Protons and Alpha Particles (1993); and ICRU Report 73, Stopping Ions Heavier than Helium (2005). Section 5 summarizes the key data and, when appropriate, gives recommended values and associated uncertainties. Section 6 provides an overview of the theories used to calculate photon cross sections and the resulting attenuation and mass energy-absorption coefficients that play an important role in radiation dosimetry, and includes comparisons with relevant measurements. Section 7 reviews the main impacts that the changes recommended in this Report will have on radiation dosimetry. Tables of pertinent charged-particle stopping powers, incorporating the recommendations made here, are given in the Appendix.

The Report is available from Oxford University Press http://jicru.oxfordjournals.org in both soft- and hardcopy formats. For additional information contact David A. Schauer, ScD, CHP at icru@icru.org, 301.657.2652 (x31) or 301.907.8768 (fax).