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How do I find the quality conversion factor, k_Q, for a chamber not listed in TG-51?

With the recent rapid increases in advanced-technology treatments (such as IMRT and stereotactic radiosurgery), the use of small thimble chambers (≤ 0.3cc) is on the rise. Most of these chambers are not listed in the TG51 report. Consequently, the RPC has received a number of phone calls regarding k_Q values for these chambers. Some physicists follow the TG51 guidelines and find an equivalent chamber listed in TG51. Others go a step further and perform comparison measurements to determine or verify the value of k_Q. Some of these physicists have reported up to 1.5% discrepancy between their measurements and the k_Q value based on equivalency. The following are the RPC's recommendations on this issue.

Following the TG51 guidelines, one should determine the closest equivalent ion chamber listed in the protocol. The following may help in that direction. A cylindrical chamber is expected to be equivalent to a listed chamber if the thimble wall material, wall thickness and diameter; and the central electrode material are the same. The length of the thimble is less important.

Determination of k_Q through comparison measurements with a chamber listed in TG51 is important in two ways: (i) it serves as a cross-check of the k_Q value based on chamber equivalency, and (ii) it provides a k_Q value for those chambers whose equivalency is difficult to establish. The following tips may help reduce the uncertainty in determining k_Q from comparison measurements:

- It is important to avoid the use of plastic phantoms for comparison measurements. Liquid water should be used instead.

- P_{pol} for most cylindrical chambers is expected to be in the range 0.999-1.001, implying ≤ 0.1% correction. A different value should signal a warning that repeat measurements are needed.

- The measurement of P_{ion} with good precision is not a trivial undertaking. We recommend an initial exposure of ~300 mu, followed by 3 or more repeat readings to ensure non-trending data, for each bias setting. To measure both P_{ion} and P_{pol}, this routine is recommended at the following bias settings: full, half, reverse, and back to full. The repeat at full bias serves to determine the magnitude of drift in the beam output.

- As is well understood, it is important to set the axis of each cylindrical chamber to exactly the same depth below the water surface. A small error in depth has less impact at d_{max} than at 10 cm, but many physicists are more comfortable making measurements like these at 10 cm.

Previous issues of this Newsletter and answers to many questions can be found at our FAQ page.