Determination of Field Output Correction Factors in Small Static Photon fields Following TRS-483 CoP

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Background and Objective

This study was inspired by the publication of a new code of practice dedicated for measurements in small static fields. The objectives of this study was to determine field output factor correction factors for a new micro reference class ionization chamber designed for measurement in both standard and small fields.

Methods

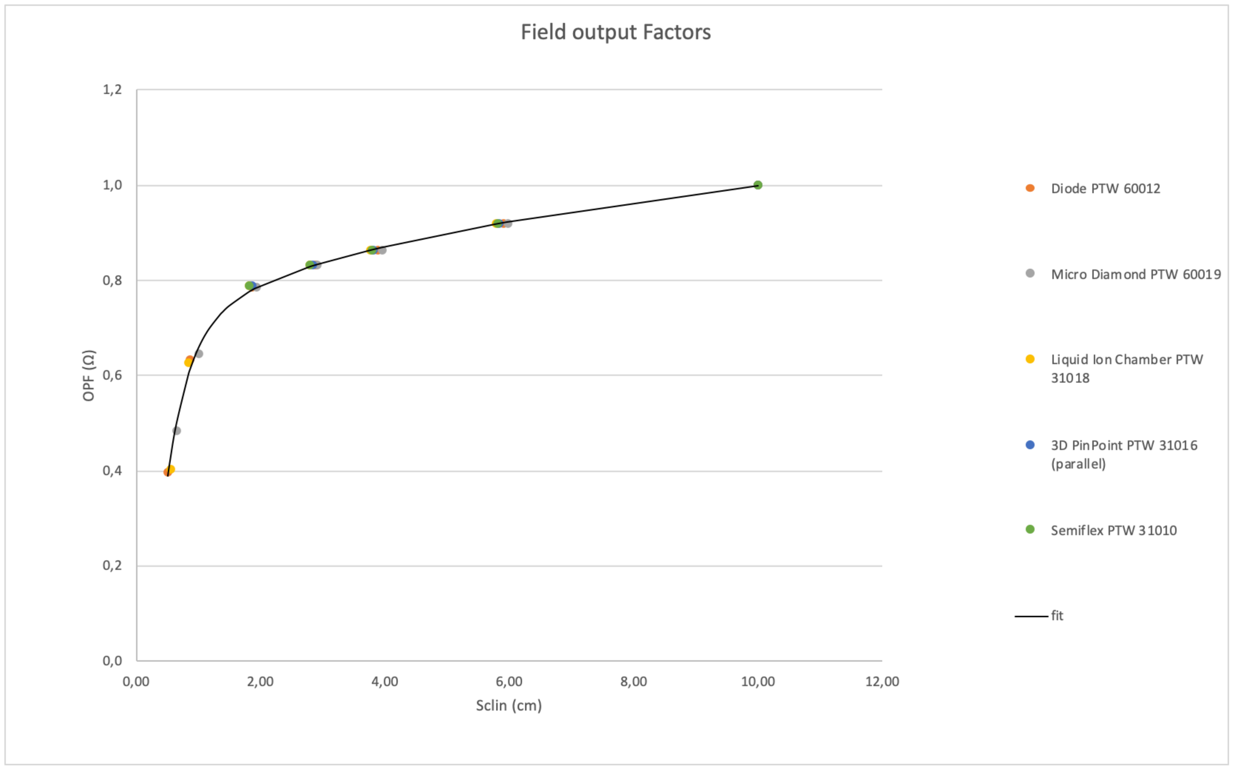
The study was performed in a 6 MV flattened photon beam using two solid state detectors, two air ionization chambers and a liquid ionization chamber. The PTW microDiamond detector was used to measure the lateral beam profiles used to define the equivalent square radiation field sizes (Sclin) from the set fields. The field output factors were measured using the selected detectors and field output factor correction factor data available in the TRS-483 CoP. The acquired field output factor data were then fitted using an analytical function proposed by Sauer and Wilbert. The function's fitting parameters were adjusted to produce the line of best fit for measured field output factors.

$$\mathrm{k}_{Q_{clin},f_{ref}}^{f_{clin},f_{ref}} = \frac{\Omega_{Q_{clin}Q_{ref}}^{f_{clin}f_{ref}}}{\left(\frac{M_{Q_{clin}}^{f_{clin}}}{M_{Q_{ref}}^{f_{ref}}}\right)}$$

The above expression was then used to calculate the corresponding field output correction factors for the new micro reference class ionization chamber (PTW 31021) from its response when it was mounded parallel and perpendicular to the beam axis. Where $\Omega_{Q_{clin}Q_{ref}}^{f_{clin}f_{ref}}$ is the predicted field output factor obtained using the analytical function and $M_{Q_{clin}}^{f_{clin}}$ and $M_{Q_{ref}}^{f_{ref}}$ are the response of the PTW-31021 in the clinical and reference fields respectively.

All detectors were irradiated under identical conditions using the same set up and the measurements were repeated three times.

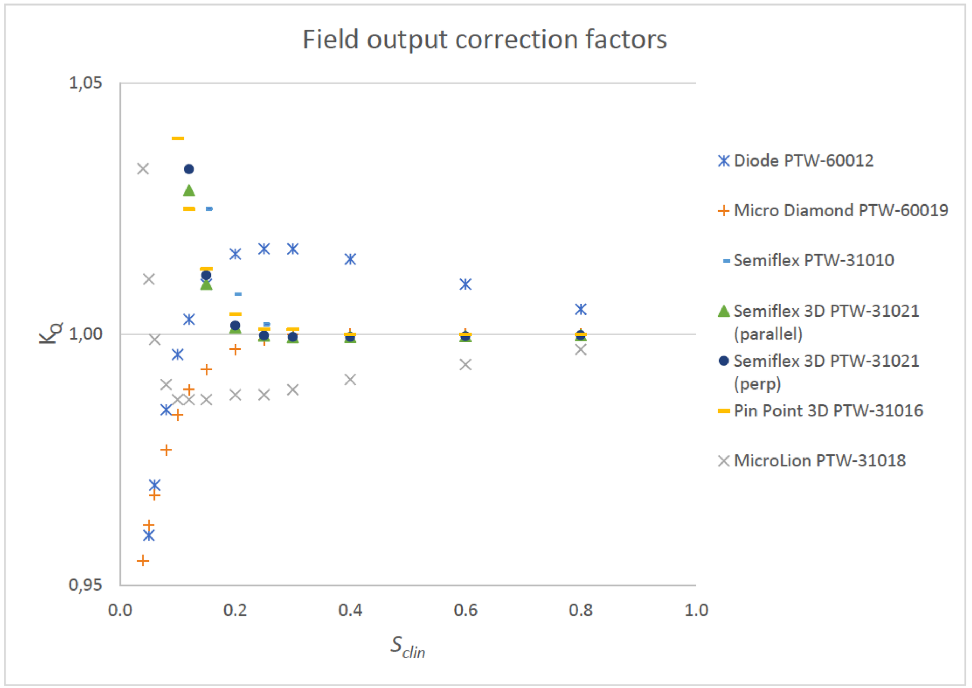
Results and Discussion



Field output factors measured in small static fields using a relatively large selection of detectors. The field output factors were fitted to an analytical function as proposed by Sauer and Wilbert to produce the line of best fit represented by the solid black line.

$$\Omega(S) = P_{\infty}\frac{S^n}{l^n + S^n} + S_{\infty}(1 - e^{-bs})$$

The fitting parameters that produced the best fit for the analytical function were: $P\infty$ = 0.741, $S\infty$ = 0.41, l = 0.517, n = 2.433 and b = 0.099.



Field output factor correction factors for the detectors used for small field output factor measurements as a function of the equivalent square field (*Sclin*). The field output factor correction factors determined for the PTW-31021 in the perpendicular and parallel orientation are also shown.

Conclusions

- The field output factor correction factors for PTW-31021 were found to be in good agreement with the data published in TRS-483 when comparing chamber sensitive volume to field output factor correction factor.
- The PTW-31021 was found to be unusable in square field sizes smaller then 1.2 cm x 1.2 cm

References

H. Palmans, P. Andreo, M. S. Huq, J. Seuntjens, K. E. Christaki, A. Meghzifene, *Dosimetry of small static fields used in external photon beam radiotherapy: Summary of TRS-483, the IAEA–AAPM international Code of Practice for reference and relative dose determination.* Med. Phys. 2018, 45