# Information on PTW Markus Chambers Type 23343 and Type 34045

## 1. General Features

One of the most widespread plane-parallel chambers used for dosimetry in high energy electron beams is the Classic Markus chamber type PTW 23343. This chamber is being produced since more than 30 years according to the original design of Prof. Markus, Goettingen, Germany. Many measurements of the features of this chamber have been made in the past, and the results of these investigations have lead to the design of successor models such as the Advanced Markus chamber type PTW 34045 and the Roos chamber type PTW 34001.

From today's point of view, these new designs are superior to the original Classic Markus design, and the latest dosimetry protocols explicitly refer to plane-parallel chambers with wide guard rings, excluding the Classic Markus chamber with its narrow guard ring design. PTW-Freiburg therefore recommends the use of either the Advanced Markus chamber or the Roos chamber for absolute electron dosimetry.

Nevertheless, PTW-Freiburg will continue the production, delivery and support of Classic Markus chambers because this chamber type is well established all over the world, and because most of the drawbacks of this chamber design can be compensated by appropriate corrections. Disadvantages of the Classic Markus chamber are:

- At electron energies below approx. 8 MeV a perturbation correction factor is to be applied due to the narrow guard ring design. Perturbation correction factors for the Classic Markus chamber depending on energy are published for instance in IAEA TRS 381.
- Markus chambers show a polarity effect of up to approx. 1 % dependent upon electron energy. For most Markus chambers the maximum of this effect is located around 8 MeV. The user must take this effect into account by performing polarity effect measurements in his beams.
- Classic Markus chambers show chamber-to-chamber variations due to the manufacturing process applied for this chamber design. Each Classic Markus chamber should therefore be checked individually.

It should be noted that the Advanced Markus chamber and the Roos chamber do not show the effects of the Classic Markus chamber as listed above, except for the polarity effect which is the same for the Classic Markus chamber and for the Advanced Markus chamber.

**Fig. 1:** The Classic Markus chamber

## 2. Positioning in a Water Phantom

For absolute and relative dosimetry it is essential to position the Classic or Advanced Markus chamber correctly at the desired measuring depth z in water.

According to the dosimetry protocols, the effective point of measurement has to be positioned at the desired measuring depth. The measuring depth is considered as the sum of the water-equivalent thicknesses of all material layers in front of the effective point of measurement. For plane-parallel chambers the effective point of measurement coincides by definition with the reference point, which is a point on the chamber axis at the inner surface of the entrance foil.

When used in water, Classic and Advanced Markus chambers must be used with a protection cap, screwed onto the chamber until the lines on the cap and the chamber body match each other.

When a Classic or Advanced Markus chamber is used with the protective cap, the following material layers are located upstream from the measuring volume (from the reference point):

0.87 mm of PMMA
0.40 mm of air
0.03 mm of PE

1.30 mm total thickness

The sum of the area densities of these 3 materials is 106 mg/cm², corresponding to a water-equivalent thickness of 1.06 mm.

The real (physical) effective point of measurement is therefore 1.06 mm below the surface of the protective cap. This point has to be positioned at the desired measuring depth z. Figure 2 shows the geometrical situation for z = 10 mm.

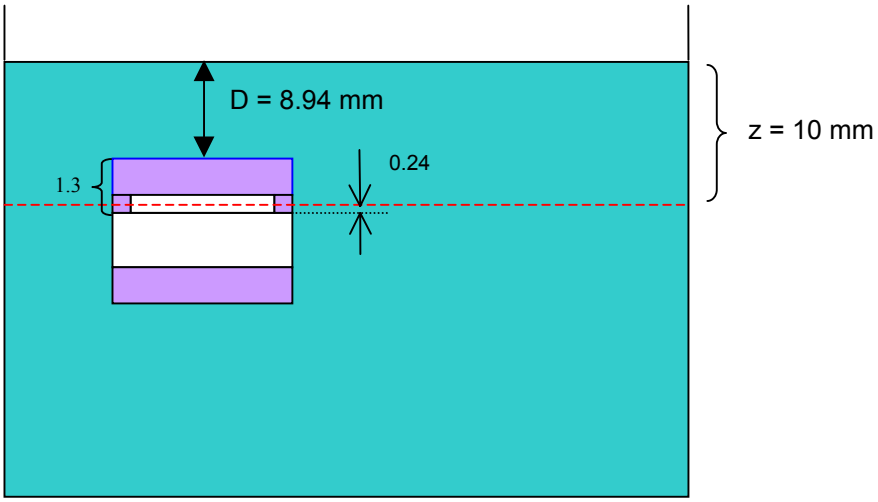


**Fig. 2:** The Classic or Advanced Markus chamber positioned at water depth z = 10 mm.



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