

Wide Energy Hemispherical Build-up Caps For use with MOSFET Dosimeters

Hemispherical Build-up Caps

MOSFETs are known to be highly accurate dosimeters that offer a wide range of measurement options, as one MOSFET can be used for all energies and modalities. MOSFET dosimeters have only 0.8mm inherent build-up, which allows for flexibility in measuring surface dose as well as dose at Dmax. In order to measure dose at Dmax, build-up is required. Measuring accurate dose at depth is of primary concern for the physics community when performing patient dosimetry. Precise dose measurement verifies that the target volume area has been treated with the appropriate dose, while sparing surrounding tissue and organs. Current tissue-equivalent build-up caps require a different size for each energy. Best Medical Canada offers a custom designed Build-up Cap for use with MOSFET Dosimeters, which allows for depth dose measurements over a wide range of energies.

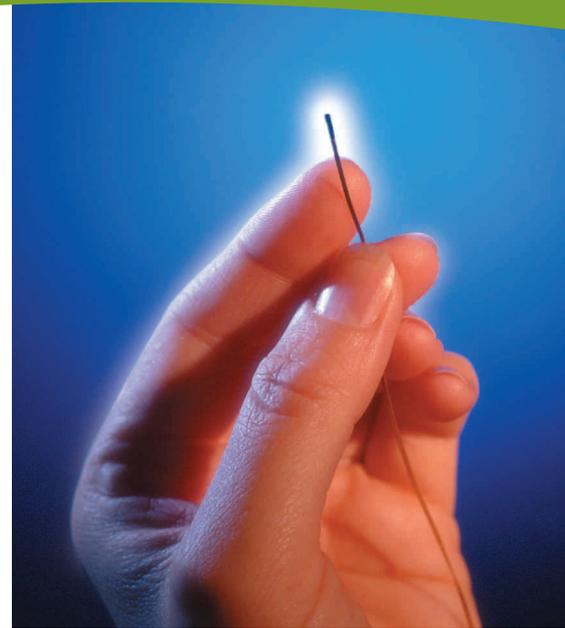
Full Photon Range & 15MeV - 18MeV Electrons Brass Build-up Caps - 0.635cm Radius (TN-RD-56-0.63)

In order to maintain the isotropic characteristics of the MOSFET dosimeter ($\pm 2\%$ for 360°) and allow for one calibration factor for all energies and modalities, it is recommended that a hemispherical build-up cap be used. This small brass hemisphere is specially grooved for precise placement of the MOSFET and maintains the characteristics which distinguish these devices from other types of dosimeters.

The new brass build-up cap is very lightweight (only 4g) and small (radius: 0.635cm), which makes it ideal for placement on patients.

This build-up cap may be affixed to the MOSFET for the duration of its life, i.e. 200 doses. Using just one build-up cap for all Photons and some Electr on energies makes the dosimeters easier for therapists to use and saves on patient set-up time, as only one dosimeter is required for all energies. Additionally, this method saves time spent on switching between different sizes of build-up for each treatment, e.g. IMRT with multiple energies¹.

1. R. Varadhan, J. Miller, B. Garrity, M. Weber "In vivo prostate IMRT dosimetry with MOSFET detectors using brass buildup caps" – Journal of Applied Clinical Medical Physics, Vol 7, No 4, p. 1-11 (2006)





Why Brass?

Brass is a metal alloy containing mainly copper and zinc compounds. Due to its high density (8.5g/cm^3) and to its high Z number ($Z \sim 30$), it provides the minimal amount of metal needed to achieve full buildup at D_{max} for a range of photon energies (4, 6, 10 and 18MV) and some electron energies (15- 18MeV)* at a very practical size.

The use of MOSFET Dosimeters under full build-up enables dose sampling at the charged particle equilibrium region, where the radiation response is maximum.

MOSFET Correction Factors (CR) Under Brass Build-up Caps

To directly correct for dose readings at D_{max} , the system's software allows for Correction Factor (CR) values to be entered which then convert MOSFET response to dose.

These CRs vary between 0.8 and 1.1 and are Linac and calibration set-up dependent. They must be determined for any new MOSFET/Cap combination. These CRs may be stored in the system's software dose measurement template.

For example, two sets of CRs were obtained with a Siemens Mevatron Linac at 6 and 18MV photon energies, with a nominal dose of 200 cGy at D_{max} in water and $10 \times 10 \text{ cm}^2$ field size (100cm Source Axis Distance): See Table 1.

Handling and Cleaning

Brass build-up caps are easily attached to the MOSFET. Circular adhesive patches are provided with the caps to fasten the MOSFET dosimeter to the build-up cap for the duration of the lifetime of the dosimeter. The cap/MOSFET is then adhered to the patient's skin using paper tape.

Cleaning - use rubbing alcohol or alcohol swabs, which are usually found in any hospital/clinic environment.

Note: For low electron energies, It is suggested that no build-up is used. However, if desired, one can use the 1.5cm radius tissue equivalent build-up cap. (model TN-RD-55-1.5).

Table 1: Typical Correction Factors for Brass Build-up Caps (TN-RD-56-0.63)

Energy	Correction Factor (CR)
6 MV	1.10
18 MV	0.84

Note: The Correction Factor "CR" is the value used in the system software, along with the Calibration Factor "CF" to convert MOSFET response to dose. (Please refer to Operators' Manuals for further details).

