

## MR 2101 - PRECISE IONIZATION CHAMBER 0.6 cm<sup>3</sup> Farmer-type with graphite walls (NE2571 equivalent)



The ionization chamber **MR 2101** exactly corresponds with the construction of its sensitive volume to the widespread design of the chamber NE 2571, developed by Prof. F.T.Farmer.

The construction of the ionization chamber **MR 2101** guarantees full protection of the measured signal beginning with the sensitive volume (so called 'full-guarded' design), and consequently a very important feature of the chamber - the leakage current is as small as only  $\sim 5$  fA. The chamber is equipped with an additional acrylic (PMMA) cap which serves as a build-up layer when measurement is running in the air. The ionization current goes from the chamber through a low-noise triaxial cable.

The ionization chamber is ventilated and this is why there is necessary to introduce correction on changes of the air density - with respect to the changes of environment temperature and atmospheric pressure. For measurement in water a rubber sheath is necessary.

Because of its long-term sensitivity stability and flat energy response, the ionization chamber MR 2101 can be used for Reference Measurement of radiation values in the field of absolute dosimetry. Before all, the transfer of radiation units of the Air-Kerma and Absorbed-Dose to water can be effected from the SSDL to the user's reference beam.

The chamber can also serve for Routine Measurement of the absorbed-dose to water in photon and electron beams of the user - both when Air-Kerma calibration factor  $N_k$  with the prescribed protocol (e.g. IAEA-TRS 277) is used, and when Absorbed-Dose to water factor  $ND_w$  with a far more simple protocol is used.

The ionization chamber MR 2101 along with the electrometer MR 1115-A and with the check source [MR 2802](#) forms a Precise Dosemeter which can be used mostly for reference measurement in the field of absolute dosimetry. All these parts of the Precise Dosemeter have been designed with respect to the demands on "reference-class" equipment following the Standard IEC731 (Medical

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Electrical Equipment. Dosimeters with Ionization Chambers as used in Radiotherapy).

When the measurement is running on reference level - when it is necessary to keep carefully all conditions in order to reach maximum accuracy - the SW-package MR 7111 (Quality Control System for Absolute Dosimetry) can be used. The MR 7111 provides data acquisition in accordance with a programmable measurement protocol. The algorithm of the measurement protocol shows expert-system features; data acquisition is modified in real-time, depending on the course of measured signal and with respect to the expert information stored in the system database. Automated measurement process is accomplished by data processing, including statistical evaluation and storage. Consequently, the configured measuring protocol can be stored and thus, a menu containing user's measurement protocols for given types of periodical tests can be formed. The stored protocol allows mainly:

- to preserve information necessary for exact adjusting of the beam geometry, position and orientation of the ionization chamber (IC), exact list of needed instrumentation etc.
- to ensure correct determination and implementation of all correction factors (e.g. correction on pressure and temperature, correction on IC sensitivity drift, correction on polarization and saturation effects, correction on shift of IC effective point when absorbed-dose to water is measured).
- to control correct data acquisition in accordance with the prescribed measurement protocol, it means to ensure time long enough for IC response stabilization, whenever temperature or bias-voltage changes occur, and to ensure pre-irradiation of the chamber, automated correction on pressure and temperature changes, etc.
- to provide easily the analysis of measurement errors, what is a necessity for all measurements on reference level.

## Technical Data

### Mechanical Features

- Sensitive volume of the MR 2101 is 0.6cm<sup>3</sup> , as usual with the Farmer-type ionization chambers.
- Only high-purity materials are used for the ionization chamber production.
- Chamber construction guarantees full protection of the measured signal beginning with the sensitive volume ('full-guarded' design)
- Chamber is ventilated and therefore, correction on air-density changes - depending on environment temperature and atmospheric pressure - is needed. For measurement in water a rubber sheath is necessary !
- Chamber is equipped with a triaxial connector with bayonet ( BNT) or with thread (TNT), other connector type on request. Electrical Features
- 'Full-guarded' design of the chamber provides excellent value of the leakage current, what is one of the most important chamber parameters. The leakage current is as low as ~5 fA @ 250 V
- Bias voltage: max.  $\pm 500$  V , nominal + 250 V on the central electrode (Detailed information is available in Operating Manual delivered along with ionization chamber) Application Features
- Photon Beams : 50 ÷ 300 kV - Air-Kerma measurement ( without build-up cap ) 0.3 ÷ 1.5 MV, <sup>137</sup>Cs, <sup>60</sup>Co - Air-Kerma measurement ( with build-up cap ) 4 ÷ 40 MV, <sup>137</sup>Cs, <sup>60</sup>Co - Absorbed-Dose to water measurement ( with a sheath )
- Electron Beams : 10 ÷ 40 MeV - Absorbed-Dose to water measurement ( with a sheath ) • Kerma/Dose rate : (0.001 ÷ 10) Gy/min

### Options

- MR 2802 Check Source <sup>90</sup>Sr

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- MR 2802A-1 Adapter for MR 2802 for MR 2101 and other Farmer-type chambers
  - [MR 2911](#) Set of rubber sheaths (3 pcs) for measurement in water
  - MR 2921/b-B-10 Extension low-noise triaxial cable - 10 m / connectors BNT (different cable length or connectors - on request)
  - [MR 293\\*](#) / [b-\\*](#) Cable adapters for connecting IC to electrometers with different connector (3-lug BNT, mQuick, M-PTW, PET, etc.)
  - [MR 5101A-1](#) Adapter for MR 5101 (Standard IAEA design SSDL phantom for calibration absorbed dose-to-water measurement)
  - [MR 5111A-1](#) Adapter for MR 5111 (Photon "Quality Control" water phantom with measurement positions at fixed depths)
  - [MR 5122A-1](#) Adapter for MR 5122 (Universal "Quality Control" water phantom with a positioning arm for depth adjustment)
  - [MR 5151A-1](#) Adapter for MR 5151 (Simple Closed "Quality Control" water phantom)