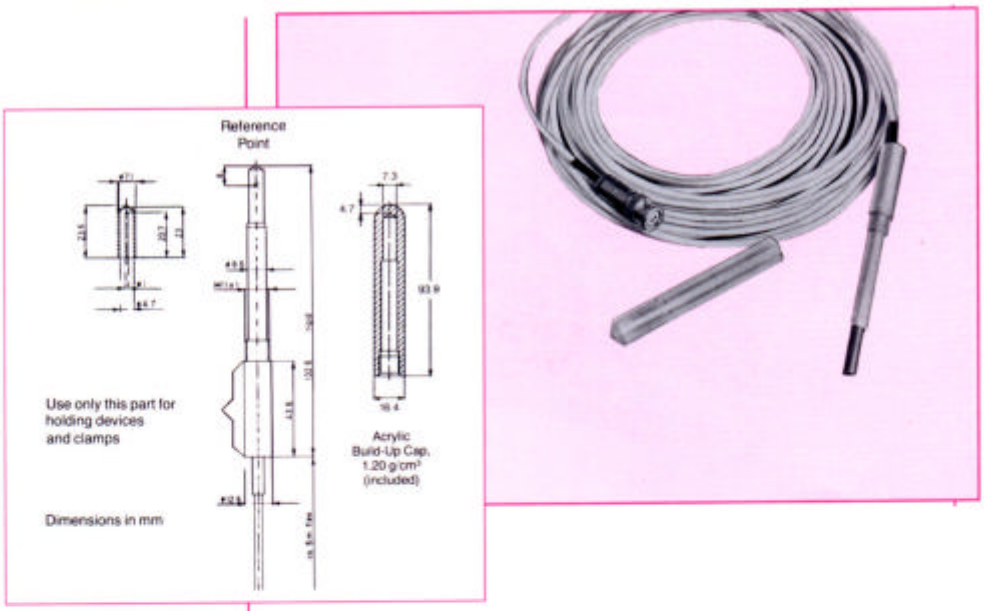
PRECISION IONIZATION CHAMBERS

REPLACEMENT-FREE X-RAY CHAMBER*



- Simplifies or eliminates calculations of replacement factors in water and plastic phantoms
- Same physical dimensions as 0.6 cm^3 chamber

This Farmer-type ion chamber has a unity replacement factor for high-energy x-rays.[1] By careful design of the air gap, wall, center electrode dimensions and densities, the overall chamber density is substantially equal to that of water. The dimensional relationships were obtained by weighting the normal radiation path lengths through the chamber with the density of the chamber material.[2] The phantom material displaced by the chamber is, therefore, compensated for by the total chamber material. Since the replacement is assumed to be proportional to the net amount of material displaced by the ion chamber, the chamber is replacement-free. This principle has been tested for ^{60}Co gammas and high-energy x-rays of 6–25MV.[3,4]

In the application of the AAPM protocol for x-ray calibration, the replacement correction is a multiplication factor which is energy- and chamber-dependent. It is to be applied if the chamber is used when the dose gradient has a non-zero slope, i.e., on the descending portion of the depth-dose curve.[1] If used where the dose gradient is zero, the factor is unity.

In a water phantom, the replacement-free chamber removes the confusion of when to use a replacement factor and what value to use since the factor is always unity. In a plastic phantom, the AAPM replacement factor will apply if the chamber is used where the dose gradient has a non-zero slope. At d_{max}, however, the factor will again be unity.

SPECIFICATIONS

Volume: 0.4 cm^3. **Leakage:** ±4 x 10^{-15} A.

Sensitivity: 1.3 x 10^{-10} A R^{-1}s.

Polarizing Voltage: Max. 500V.

Smallest Exposure: 4R.

Stem Effect: < 1%.

Cable Leakage: 10^{-14} $AR^{-1}s$ cm^{-1}.

Wall Material: Acrylic. 1.2mm.

Weight Per Unit Area: 140 mg/cm^2.

Maximum Dose at 99%: +300V: 200 R/sec, +500V: 5000R/sec.

Maximum Dose Pulsed at 99%: +300V: 120 mR. +500V: 200 mR/sec.

Range of Temperature: +10 to +40°C.

Rel. Air Humidity: ≤ 75%.

Cable Length: 10 meters.

30-361FW Ion Chamber with acrylic build-up cap and 10-meter cable, Triax BNC termination.....

30-357FW Extension Cable, 30-ft. Triax, male/female .....

References:

1) AAPM. (1983). "A Protocol for the Determination of Absorbed Dose from High-Energy Photon and Electron Beams." Med. Phys. 10, Nov/Dec.

2) P. Shapiro et al. (1976). *Med Phys. 3(2)*:87-90.

3) R.H. Stark et al. (1979). *Med Phys. 6(4)*:332.

4) S.H. Mahood and P.R. Almond. (1983). *Med Phys. 10(4)*:539.

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