

Cylindrical Ion Chambers

Victoreen Model 550 Series

- Cylindrical Ion Chambers for use with Model 35040 and Model 530 electrometers
- Wide range of applications in Diagnostic X-Ray and Radiation Oncology suites
- Accommodates energies from 21 keV to 12 MeV (with equilibrium cap)
- The 550 Series offers volumes of 330, 33, 3.3, and 0.33 cm³
- Chamber sensitivities are available for 100, 10, 1, and 0.1 nA/R/s
- These chambers accommodate rates of 0.03, 1.5, 10, or 2300 R/s
- Ion Collection Efficiency information is available for specific frequencies

Introduction

Model 550 Series Cylindrical Ionization Chambers are fully guarded thimble-type probes for use in a variety of applications. Equilibrium caps are available for each probe, extending their energy range up to 12 MeV. Sensitive volumes have been selected such that the nominal coulomb-to-roentgen calibration factors are convenient powers of ten. The cables may be terminated by triax BNC connectors for compatibility with Model 530, Model 35040 electrometers, or coax UHF connectors for compatibility with the older model electrometers.

Applications

The family of Cylindrical Ionization Chambers is designed to meet a wide range of radiation measurement and dosimetry applications required for diagnostic x-ray and radiation therapy in medical facilities.

The 550 Series Ion Chambers offers volumes of 330, 33, 3.3, 0.33 cm³ for scatter, dose and rate measurements and accommodate energies from 21 keV to 12 MeV when used with equilibrium caps.

The selection guide on the next page will assist the user in selecting the appropriate chamber for rates from 0.03 to 2300 R/s and for sensitivities from 100 to 0.1 nA/R/s.



Specifications

Available model(s)

| | 550-3 | 550-4 | 550-5 | 550-6A |
|---|---|-------------------------|--|-------------------------|
| Applications | Scatter, Diagnostic Orthovoltage, Supervoltage | | Teletherapy, Orthovoltage Supervoltage, Diagnostic | |
| Volume | 330 cm ³ | 33 cm ³ | 3.3 cm ³ | 0.33 cm ³ |
| Energy Response | ± 6%, 21 keV to 520 keV without build-up medium | | ± 3%, 42 keV to 520 keV without build-up medium | |
| Sensitivity | 100 nA/R/s | 10 nA/R/s | 1 nA/R/s | 0.1 nA/R/s |
| **Intensity Limit @ 99.5% (Rate) | 0.03 R/s | 1.5 R/s | 10 R/s | 2300 R/s |
| Ion Collection Eff. (Pulse) | 0.3 mR @ 60Hz | 2 mR @ 400 Hz | 6 mR @ 1.3 kHz | 80 mR @ 17kHz |
| Wall Material | Acrylic | Acrylic | Polystyrene | Polystyrene |
| Wall Thickness (density thickness) | 166 mg/cm ² | 166 mg/cm ² | 133 mg/cm ² | 133 mg/cm ² |
| Chamber Diameter | 55.9 mm | 28.2 mm | 15.5 mm | 7 mm |
| Cable Length | 3 m | 3 m | 3 m | 7.5 m |
| Max. Rep. Rate | 60 Hz | 400 Hz | 1.25 kHz | 17 kHz |
| *Stem Scatter-X-Ray | 0.10% | 0.70% | 0.90% | 0.70% |
| *Stem Scatter - ¹³⁷ Cs | 0.10% | 0.20% | 0.20% | 0.20% |
| Distance for 1.5% Geometry Error | 36 cm | 18 cm | 6 cm | 6 cm |
| Leakage | 4 x 10 ⁻¹⁵ A | 4 x 10 ⁻¹⁵ A | 4 x 10 ⁻¹⁵ A | 4 x 10 ⁻¹⁵ A |
| Cable Termination: Triax BNC or Coax UHF. Specify when ordering. | | | | |
| * Stem Scatter is included in calibration. | | | | |
| ** Rates are calculated from chamber geometry. For measurements of rates equal to or greater than those in the above table, the chamber ion collection efficiency should be investigated. | | | | |

Equilibrium caps - model numbers and specific energies

| | 550-3 | 550-4 | 550-5 | 550-6A |
|--|----------|----------|----------|-----------|
| ¹³⁷ Cs, ⁶⁰ Co, 2 MeV | 550-3-26 | 550-4-26 | 550-5-26 | 550-6-25 |
| 4 MeV | 550-3-27 | 550-4-27 | 550-5-27 | 550-5-26* |
| 6 MeV | 550-3-28 | 550-4-28 | 550-5-28 | 550-5-27* |
| 8 MeV | 550-3-29 | 550-4-29 | 550-5-29 | 550-5-28* |
| 10 MeV | 550-3-30 | 550-4-30 | 550-5-30 | 550-5-29* |
| 12 MeV | 550-3-31 | 550-4-31 | 550-5-31 | 550-5-30* |

* Used in conjunction with 550-6-25.

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

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550-ds rev 4 11 mar 03

Farmer-Type Radiation Therapy Waterproof Ionization Chamber Victoreen® Model 580-006-WP



- Stable, reproducible absolute dosimetry measurements
- In-air calibration of brachytherapy sources
- Precision machined thimble for flat energy response
- Hemispherical electrode design, no electrical field distortion
- Rugged **replaceable** PMMA thimble, 0.5 mm thick

Introduction

The Model 580-006-WP Radiation Therapy Ionization Chamber is modeled after the traditional 0.6 cm³ Farmer-type chamber used for absolute dosimetry measurements of medical linear accelerators and ⁶⁰Co machines. Each chamber includes an energy response for M-80, M-100, M-250, and ⁶⁰Co for both linear accelerator and brachytherapy applications as illustrated in the table below. Also supplied with each chamber is a PMMA ⁶⁰Co buildup cap, a convenient low noise one meter cable with triaxial BNC connector and a Victoreen custom carrying case.

Applications

This chamber is equivalent to a 0.6 cm³ acrylic walled chamber with the following published values of k_Q for accelerator photon beams as a function of %dd(10)_x for cylindrical ion chambers commonly used for clinical reference dosimetry.

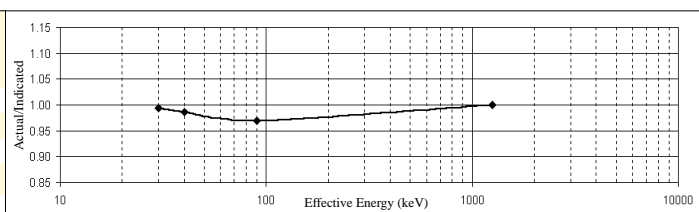
| | %dd(10) _x | | | | | |
|------------|----------------------|-------|-------|-------|-------|-------|
| | 58.0 | 63.0 | 66.0 | 71.0 | 81.0 | 93.0 |
| k_Q | 1.000 | 0.996 | 0.992 | 0.984 | 0.967 | 0.945 |
| k_{ecal} | 0.897 | | | | | |

(See AAPM's TG-51 Protocol for Clinical Reference Dosimetry of High Energy Photon and Electron Beams, Table I, PTW N30001 0.6 cc Farmer.)

Typical Energy Dependence

| NIST technique | kVCP | Added filter | | HVL | Energy | Typical calibration factor (Gy/C) |
|------------------|------|--------------|---------|---------|--------|-----------------------------------|
| | | Al (mm) | Cu (mm) | (mm Al) | keV | |
| M-80 | 80 | 2.6 | 0.0 | 2.97 | 30 | 4.96E+07 |
| M-100 | 100 | 5.0 | 0.0 | 5.02 | 40 | 4.92E+07 |
| M-250 | 250 | 5.0 | 3.2 | 18.5 | 90 | 4.83E+07 |
| ⁶⁰ Co | | | | | 1250 | 4.99E+07* |

* With supplied build-up cap.



Features

- Completely waterproof, does not require protective sleeve
- Pure aluminum electrode 1 mm in diameter, 20.0 mm long
- Fully guarded up to the collection volume
- Vented to air
- Compatible with existing phantoms

Specifications

Volume 0.61 cm³

Sensitivity 2.0 x 10⁻⁸ CGy⁻¹

Leakage < 4 x 10⁻¹⁵ A

Optimum polarizing voltage + 300 VDC

Maximum polarizing voltage 500 VDC

Minimum exposure 0.04 Gy

Ion collection time

300 V: 0.14 ms

400 V: 0.11 ms

500 V: 0.09 ms

Wall material PMMA (C₅H₈O₂)_n acrylic with graphite layer

Wall density 1.19 g/cm³ (PMMA), 1.78 g/cm³ (C)

Wall thickness 0.203 mm (PMMA), 0.279 mm (C)

Wall area material density 73.8 mg/cm²

Electrode Pure aluminum, 1 mm Ø, 20.0 mm long

Cable 1.6 m with triaxial BNC connector

Cable leakage < 10⁻¹² CGy⁻¹ cm⁻¹

Temperature range + 10° to + 40°C

Relative humidity 20 to 75%

Buildup cap PMMA for ¹³⁷Cs - ⁶⁰Co

Weight 4.4 oz (125 gm)

Case Custom foam lined

Vent tubing material Polyethylene-lined ethyl vinyl acetate tubing

Saturation behavior

Maximum dose rate at continuous irradiation

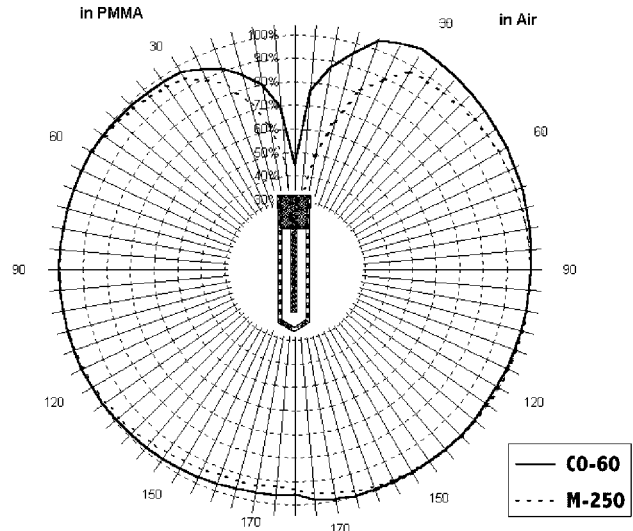
| Polarizing voltage | 99% saturation | 99.5% saturation |
|--------------------|------------------------|-----------------------|
| 300 V | 6.0 Gys ⁻¹ | 3.0 Gys ⁻¹ |
| 400 V | 10.7 Gys ⁻¹ | 5.3 Gys ⁻¹ |
| 500 V | 16.6 Gys ⁻¹ | 8.3 Gys ⁻¹ |

Saturation behavior (continued)

Maximum dose rate per irradiation pulse

| Polarizing voltage | 99.0% saturation | 99.5% saturation |
|--------------------|------------------|------------------|
| 300 V | 0.6 mGy | 0.3 mGy |
| 400 V | 0.8 mGy | 0.4 mGy |
| 500 V | 1.0 mGy | 0.5 mGy |

Directional dependence



Optional accessories

Check Source, ⁹⁰Sr, 33 MBq (892 µCi) (Model 30-657)

Extension Cable, 33 ft (10 m), Triax BNC plug to BNC jack (Model 86133)

Acrylic Buildup Caps (M11x1 Thread): available upon request

Waterproof Kit (Model 580-006-1)

Available model(s)

580-006-WP Farmer-Type Radiation Therapy Waterproof Ionization Chamber

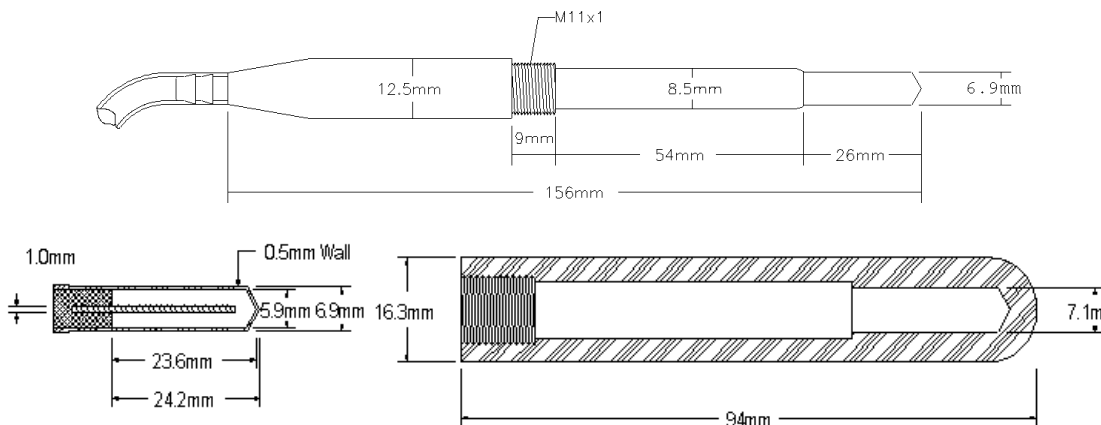
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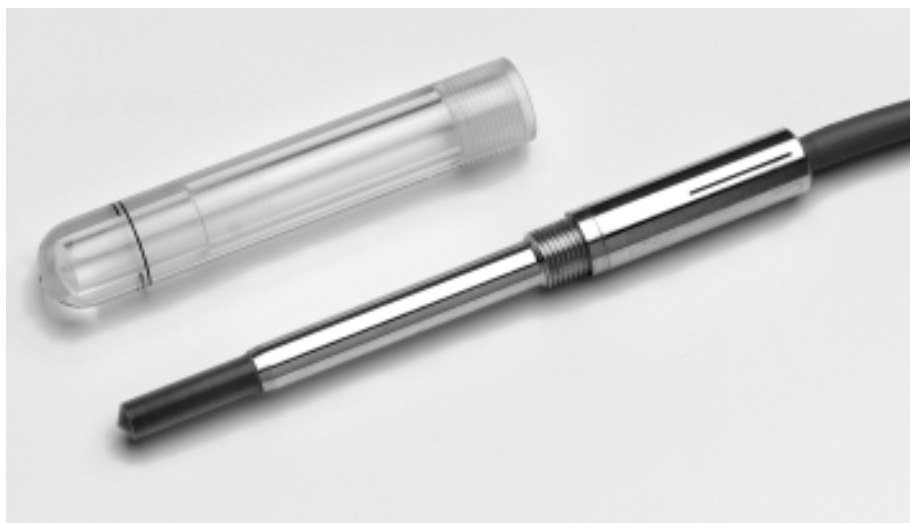
580-006-wp-ds rev 5 26 mar 03



Farmer-Type Ionization Chamber, 0.6 cm³, Waterproof Model 30-351



Radiation Oncology



- Completely waterproof, does not require protective sleeve
- Can be safely used in water phantoms and solid state phantoms
- Open volume, vented at connector
- Fully guarded up to the measuring volume
- Touchable parts free of high voltage
- Extension cables up to 100 meters in length are available

The waterproof 0.6 cm³ ionization chamber (Model 30-351) is designed for absolute dosimetry in radiation therapy. Since the chamber is waterproof, it may be used in water phantoms and does not require a protective sleeve. It is rugged in construction and has a PMMA/graphite thimble and an aluminum electrode. This chamber includes a 3.3 ft (1 m) cable, BNC Triax connector, and a PMMA buildup cap.

Specifications

Volume 0.6 cm³

Response $2 \cdot 10^{-8}$ C/Gy

Leakage $\pm 4 \cdot 10^{-15}$ A

Polarizing voltage Maximum 500 V

Cable length 3.3 ft (1 m)

Cable leakage 10^{-12} C/(Gy • cm)

Wall material PMMA (C₅H₈O₂), Graphite (C)

Wall density 1.19 gm/cm³ (PMMA), 1.85 gm/cm³ (C)

Wall thickness 0.335 mm PMMA, 0.09 mm C

Area density 56.5 mg/cm²

Electrode Aluminum, 1.1 mm Ø, 21.2 mm long

Nominal useful range 30 keV to 50 MeV

Range of temperature 10° to 40°C

Range of relative humidity 10% to 80%

Ion collection time

300 V: 0.18 ms

400 V: 0.14 ms

500 V: 0.11 ms

Saturation behavior

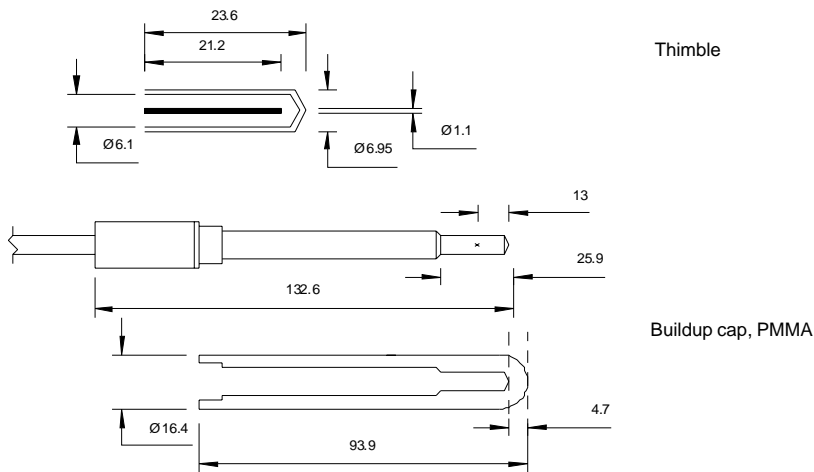
| Saturation behavior | Polarizing voltage | 99.0% saturation | 99.5% saturation |
|---|--------------------|------------------|------------------|
| Maximum dose rate at continuous irradiation | 300 V | 5.70 Gy/s | 2.80 Gy/s |
| | 400 V | 10.00 Gy/s | 5.00 Gy/s |
| | 500 V | 16.00 Gy/s | 7.80 Gy/s |
| Maximum dose rate per irradiation pulse | 300 V | 0.69 mGy | 0.34 mGy |
| | 400 V | 0.91 mGy | 0.46 mGy |
| | 500 V | 1.14 mGy | 0.57 mGy |

See next page for more specifications.

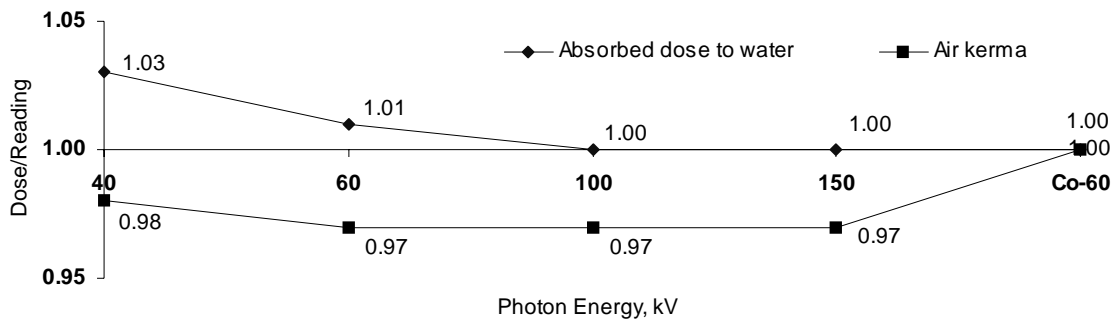
Specifications (continued)

Diagram

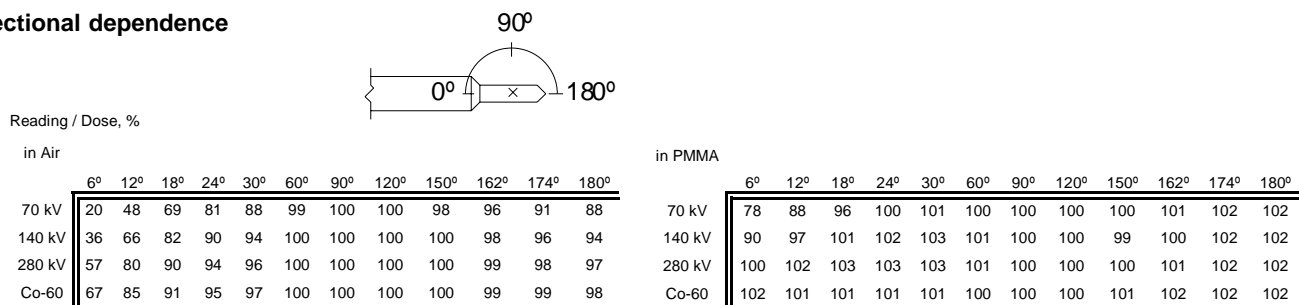
Approximate dimensions in mm.
Drawing not to scale.



Energy dependence



Directional dependence



Optional accessories

Check Source, ⁹⁰Sr, 33 MBq (892 µCi) (Model 30-657)

Available model(s)

30-351 Farmer-Type Ionization Chamber, 0.6 cm³, Waterproof, includes BNC Triax connector and PMMA buildup cap

Other types of triaxial cable connectors available

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA. Specifications are subject to change without notice.

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30-351-ds rev 1 11 mar 03

Semiflex™ Ionization Chamber, 0.125 cm³, Waterproof Model 30-344



Radiation Oncology



- Suitable for use in water phantoms or solid state phantoms
- Measuring volume is fully vented via the connector
- Fully guarded up to measuring volume
- Touchable parts free of high voltage
- Extension cables up to 100 meters in length are available

The 0.125 cm³ ionization chamber type (Model 30-344) is designed for measurements in the useful beam of high energy photon and electron fields. The chamber is waterproof and is used mainly for relative measurements in a water phantom or in an air scanner. The measuring volume is approximately spherical resulting in a flat energy response over an angle of 160° and a uniform spatial resolution, in all three axes, during measurements in a phantom. The chamber includes a 4.3 ft (1.3 m) cable, BNC Triax connector, PMMA buildup cap, and a short (36 mm) rigid stem for easy mounting.

Specifications

Volume 0.125 cm³

Response $4 \cdot 10^{-9}$ C/Gy

Leakage $\pm 4 \cdot 10^{-15}$ A

Polarizing voltage Maximum 500 V

Cable length 4.3 ft (1.3 m)

Cable leakage 10^{-12} C/(Gy • cm)

Wall material PMMA (C₅H₈O₂), Graphite (C)

Wall density 1.19 gm/cm³ (PMMA), 0.82 gm/cm³ (C)

Wall thickness 0.55 mm PMMA, 0.15 mm C

Area density 78 mg/cm²

Electrode Aluminum, 1.0 mm Ø, 5.0 mm long

Nominal useful range 30 keV to 50 MeV

Range of temperature 10° to 40°C

Range of relative humidity 10% to 80%

Ion collection time

300 V: 0.14 ms

400 V: 0.10 ms

500 V: 0.08 ms

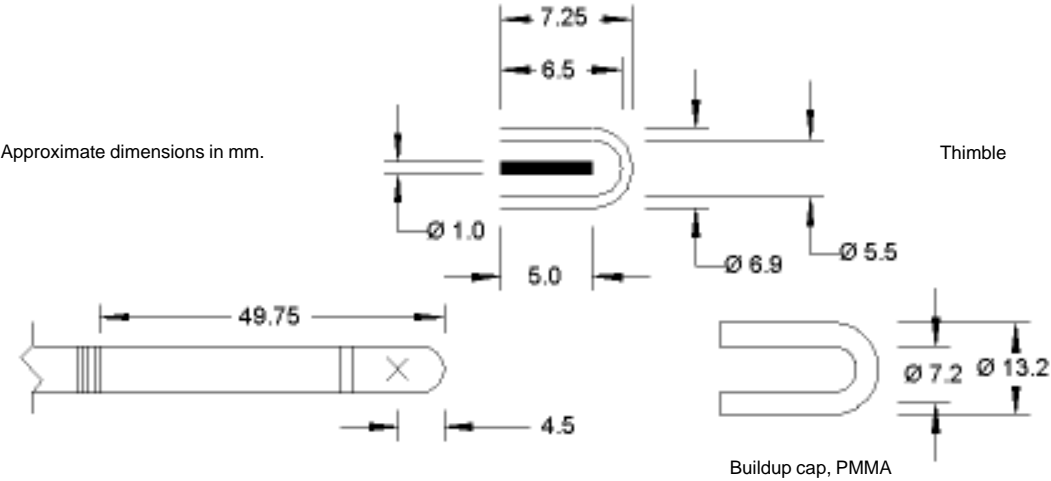
Saturation behavior

| Saturation behavior | Polarizing voltage | 99.0% saturation | 99.5% saturation |
|---|--------------------|------------------|------------------|
| Maximum dose rate at continuous irradiation | 300 V | 5.6 Gy/s | 2.8 Gy/s |
| | 400 V | 10.0 Gy/s | 5.0 Gy/s |
| | 500 V | 15.0 Gy/s | 7.5 Gy/s |
| Maximum dose rate per irradiation pulse | 300 V | 0.7 mGy | 0.4 mGy |
| | 400 V | 1.0 mGy | 0.5 mGy |
| | 500 V | 1.2 mGy | 0.6 mGy |

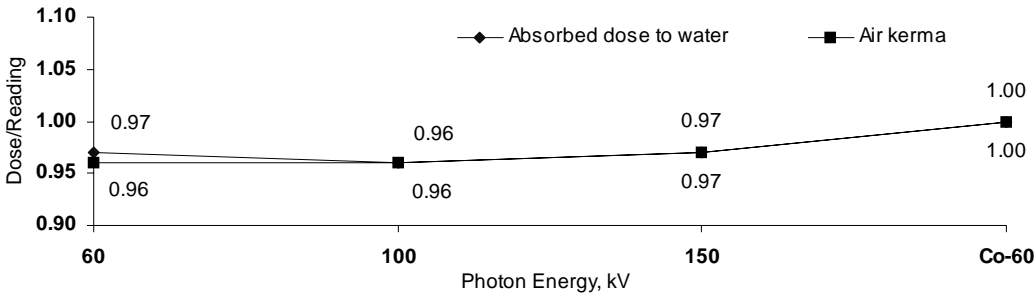
See next page for more specifications.

Specifications (continued)

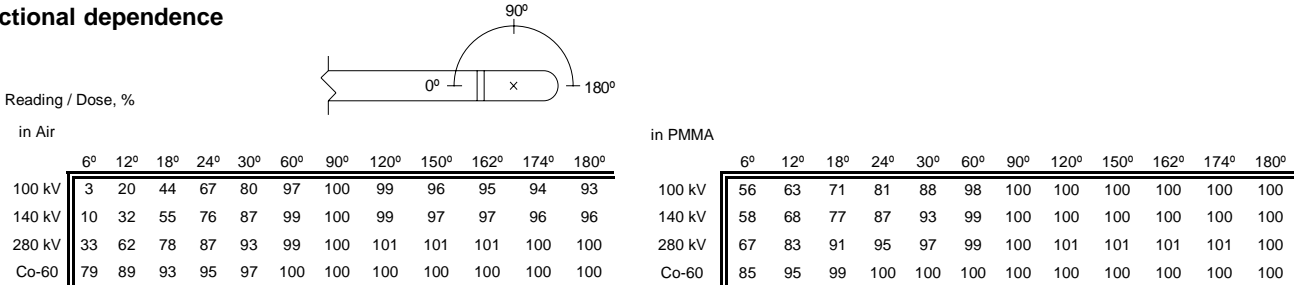
Diagram



Energy dependence



Directional dependence



100 kV, 0.17 mm Cu HVL; 140 kV, 0.49 mm Cu HVL; 280 kV, 3.4 mm Cu HVL

Optional accessories

Check Source, ⁹⁰Sr, 33 MBq (892 μCi) (Model 30-657)

Available model(s)

30-344 Semiflex Ionization Chamber, 0.125 cm³, Waterproof, includes BNC Triax connector, PMMA buildup cap, and 36 mm rigid stem for mounting

Other types of triaxial cable connectors available

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

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30-344-ds rev 1 11 mar 03

Semiflex™ Ionization Chamber, 0.3 cm³, Waterproof Model 30-316



Radiation Oncology



- Suitable for use in water phantoms or solid state phantoms
- Measuring volume is fully vented via the connector
- Fully guarded up to measuring volume
- Touchable parts free of high voltage
- Extension cables up to 100 meters in length are available
- Type tested by PTB Braunschweig

| |
|-------|
| 23.21 |
| 85.1 |

The 0.3 cm³ ionization chamber (Model 30-316) is designed for measurements in the useful beam of high energy photon and electron fields. The chamber is waterproof and is used mainly for relative measurements in a water phantom or in an air scanner. The measuring volume is open to the surrounding air via the 4.3 ft (1.3 m) cable and BNC Triax connector. This chamber has a short rigid stem for easy mounting, includes a PMMA buildup cap, and is type tested by PTB Braunschweig.

Specifications

Volume 0.3 cm³

Response $1 \cdot 10^{-8}$ C/Gy

Leakage $\pm 4 \cdot 10^{-15}$ A

Polarizing voltage Maximum 500 V

Cable length 4.3 ft (1.3 m)

Cable leakage 10^{-12} C/(Gy • cm)

Wall material PMMA (C₅H₈O₂)

Wall density 1.19 gm/cm³ (PMMA)

Wall thickness 0.7 mm PMMA

Area density 83.3 mg/cm²

Electrode Aluminum, graphite coated, 1.0 mm Ø, 14.25 mm long

Nominal useful range 30 keV to 50 MeV

Range of temperature 10° to 40°C

Range of relative humidity 20% to 75%

Ion collection time

300 V: 0.10 ms

400 V: 0.08 ms

500 V: 0.06 ms

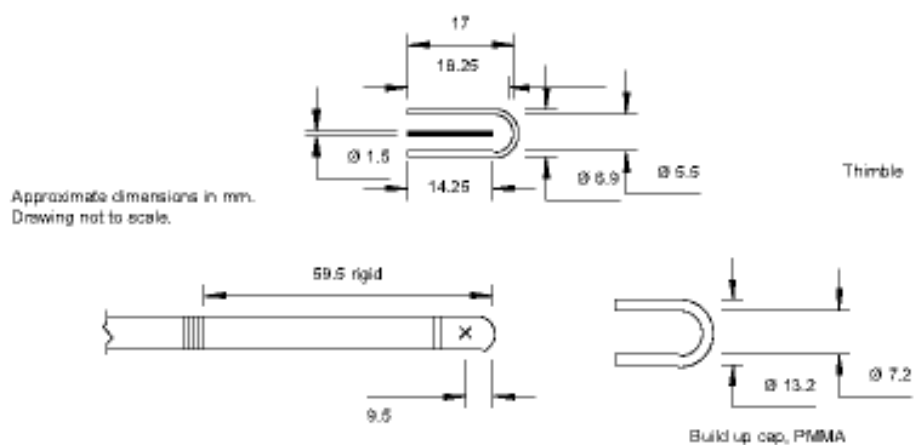
Saturation behavior

| Saturation behavior | Polarizing voltage | 99.0% saturation | 99.5% saturation |
|---|--------------------|------------------|------------------|
| Maximum dose rate at continuous irradiation | 300 V | 17.0 Gy/s | 8.5 Gy/s |
| | 400 V | 30.0 Gy/s | 15.0 Gy/s |
| | 500 V | 45.0 Gy/s | 23.0 Gy/s |
| Maximum dose rate per irradiation pulse | 300 V | 1.0 mGy | 0.4 mGy |
| | 400 V | 1.3 mGy | 0.5 mGy |
| | 500 V | 1.7 mGy | 0.7 mGy |

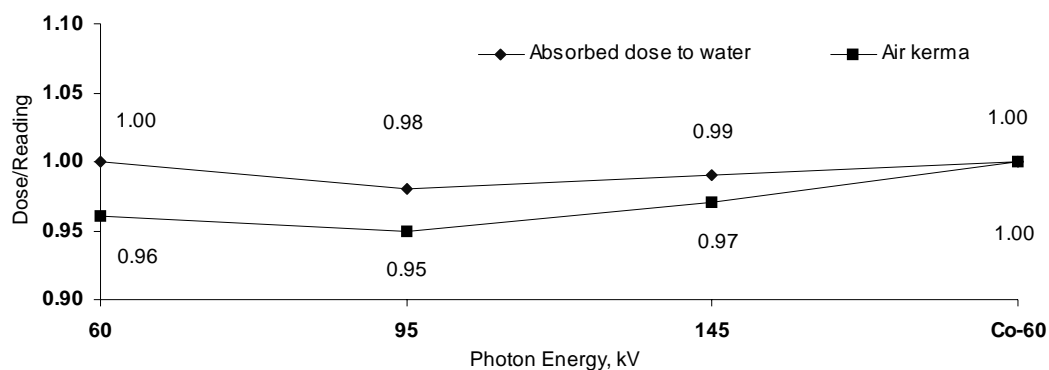
See next page for more specifications.

Specifications *(continued)*

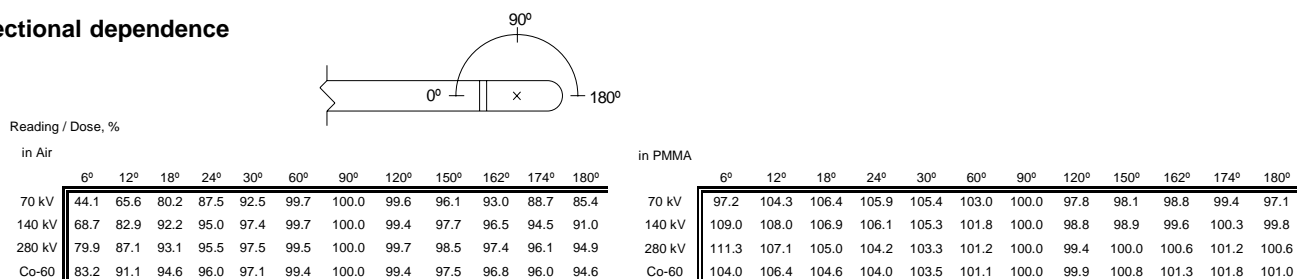
Diagram



Energy dependence



Directional dependence



Optional accessories

Check Source, ^{90}Sr , 33 MBq (892 μCi) (Model 30-657)

Available model(s)

30-316 Semiflex Ionization Chamber, 0.3 cm³, Waterproof, includes BNC Triax connector, PMMA buildup cap, and rigid stem for mounting

Other types of triaxial cable connectors available

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

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30-316-ds rev 1 11 mar 03

PinPoint™ Ionization Chamber, 0.015 cm³, Waterproof Model 30-350



Radiation Oncology



- Specifically designed for stereotactic field measurements
- Completely Waterproof
- 0.015 cm³ volume
- 2 mm active diameter
- 5 mm active length
- Directional dependence is better than 0.5% when tilting the chamber by ± 20 degrees
- Open volume, vented
- Fully guarded up to measuring volume
- Touchable parts free of high voltage

The 0.015 cm³ PinPoint ionization chamber is specifically designed for stereotactic field measurements. PinPoint is a waterproof cylindrical ion chamber ideally suited to perform relative measurements in water phantoms or solid-state phantoms when superior spatial resolution is required. The chamber is fully guarded up to its measuring volume and open to the surrounding air via its 4.3 ft (1.3 m) cable and BNC Triax connector. PinPoint has a short rigid stem for mounting and includes a PMMA buildup cap.

Specifications

Volume 0.015 cm³

Response $4 \cdot 10^{-10}$ C/Gy

Leakage $\pm 4 \cdot 10^{-15}$ A

Polarizing voltage Maximum 400 V

Cable length 4.3 ft (1.3 m)

Cable leakage 10^{-12} C/(Gy • cm)

Wall material PMMA (C₅H₈O₂), Graphite (C)

Wall density 1.19 gm/cm³ (PMMA), 0.82 gm/cm³ (C)

Wall thickness 0.56 mm PMMA, 0.15 mm C

Area density 79 mg/cm²

Electrode Steel, 0.18 mm Ø, 4.5 mm long

Nominal useful range ⁶⁰Co to 50 mV

Range of temperature 10° to 40°C

Range of relative humidity 10% to 80%

Ion collection time

100 V: 80 µs

200 V: 40 µs

300 V: 20 µs

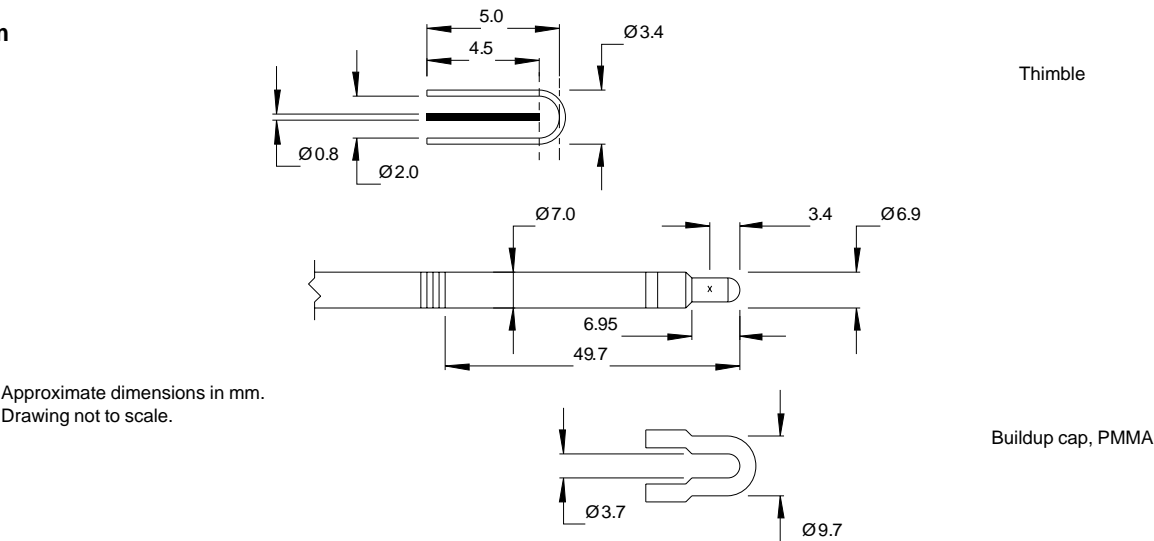
Saturation behavior

| Saturation behavior | Polarizing voltage | 99.0% saturation | 99.5% saturation |
|---|--------------------|------------------|------------------|
| Maximum dose rate at continuous irradiation | 100 V | 145 Gy/s | 74 Gy/s |
| | 200 V | 585 Gy/s | 290 Gy/s |
| | 400 V | 2,340 Gy/s | 1,160 Gy/s |
| Maximum dose rate per irradiation pulse | 100 V | 1.3 mGy | 0.6 mGy |
| | 200 V | 2.6 mGy | 1.3 mGy |
| | 400 V | 5.0 mGy | 2.5 mGy |

See next page for more specifications.

Specifications (continued)

Diagram



Spatial resolution

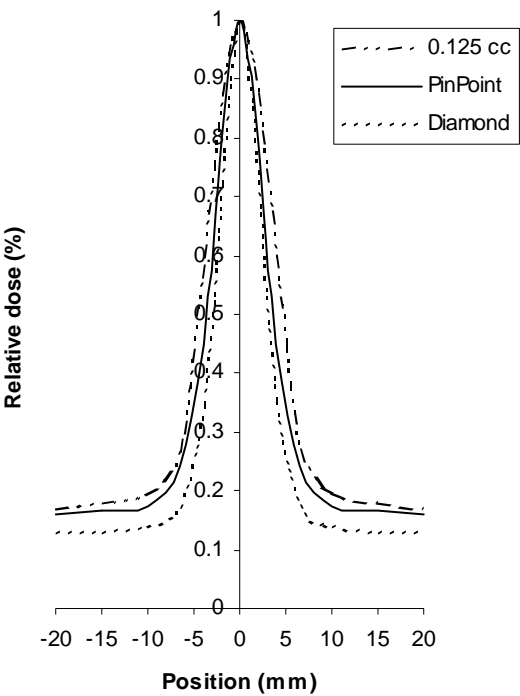


Chart showing profiles of a 0.5 cm gap for 18 mV photons at 3.0 cm depth in water:

| Detector Type | 50% profile width, cm |
|-----------------------|-----------------------|
| 0.125 cm ³ | 1.01 |
| PinPoint | 0.80 |
| Diamond | 0.70 |

Available model(s)

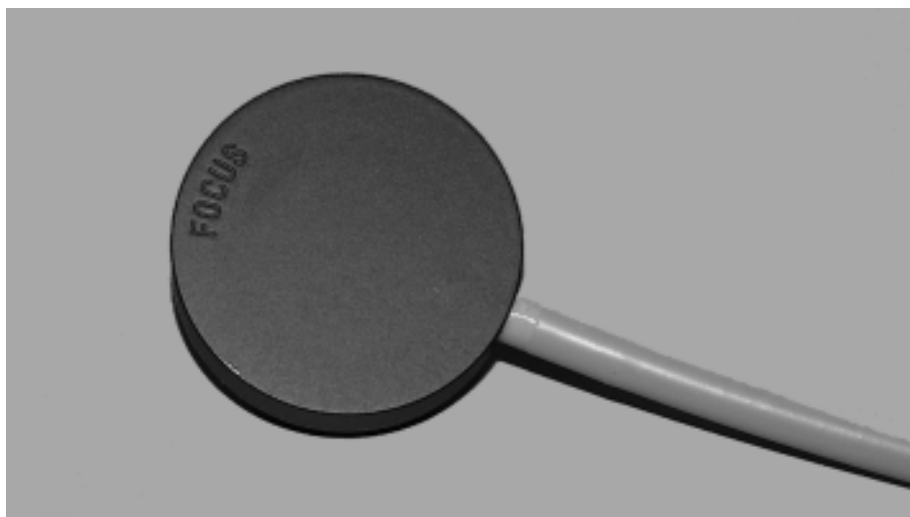
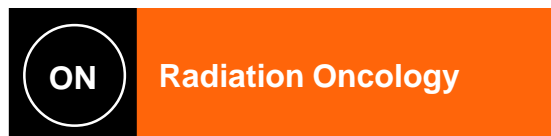
30-350 PinPoint Ionization Chamber, 0.015 cm³, Waterproof, includes BNC Triax connector, PMMA buildup cap, and 33 mm rigid stem for mounting

Other types of triaxial cable connectors available

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

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30-350-ds rev 1 11 mar 03

Roos™ Electron Ionization Chamber, 0.35 cm³, Waterproof Model 30-332



- Designed as a standard chamber for electron dosimetry
- Wide guard ring excludes perturbation effects, even at low electron energies
- Negligible polarity effect, < 0.5% at 10 MeV
- Energy dependence is only influenced by the stopping power correction, a type dependent correction is not necessary
- Completely Waterproof
- Ideal for use in water phantoms or suitable solid state phantoms
- Open volume, vented

The Roos chamber, a development from Dr. Roos of PTB-Braunschweig, is used as a standard chamber for electron dosimetry. This chamber has a very wide guard ring to exclude any perturbation effect, even at low electron energies. The polarity effect is negligible. Energy dependence is only influenced by the stopping power correction, a type dependent correction is not necessary. The chamber is waterproof and vented through the connection cable. Roos includes a 3.5 ft (1.08 m) cable and BNC Triax connector.

Specifications

Volume 0.35 cm³

Response $1 \cdot 10^{-8}$ C/Gy

Leakage $\pm 4 \cdot 10^{-15}$ A

Polarizing voltage 100 V recommended, maximum 400 V

Cable length 3.5 ft (1.08 m)

Cable leakage $3.5 \cdot 10^{-12}$ C/(Gy • cm)

Wall material Acrylic (C₅H₈O₂)

Wall density 1.19 gm/cm³

Wall thickness 1.0 mm

Area density 119 mg/cm²

Electrode Acrylic, graphite coated, 15 mm Ø

Guard ring 4 mm wide

Nominal useful range 2 to 25 MeV

Range of temperature 10° to 40°C

Range of relative humidity 10% to 80%

Ion collection time

100 V: 0.37 ms

200 V: 0.13 ms

300 V: 0.07 ms

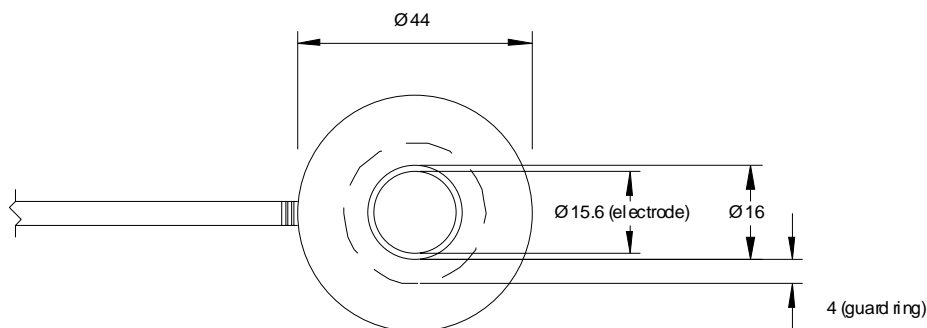
Saturation behavior

| Saturation behavior | Polarizing voltage | 99.0% saturation | 99.5% saturation |
|---|--------------------|------------------|------------------|
| Maximum dose rate at continuous irradiation | 100 V | 2.6 Gy/s | 1.3 Gy/s |
| | 200 V | 11.0 Gy/s | 5.2 Gy/s |
| | 400 V | 42.0 Gy/s | 21.0 Gy/s |
| Maximum dose rate per irradiation pulse | 100 V | 0.5 mGy | 0.2 mGy |
| | 200 V | 0.9 mGy | 0.5 mGy |
| | 400 V | 1.9 mGy | 0.9 mGy |

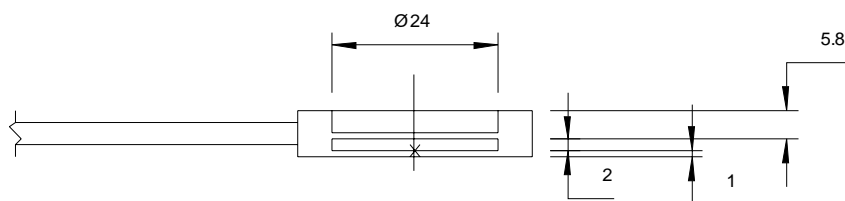
See next page for more specifications.

Specifications *(continued)*

Diagram



Approximate dimensions in mm.
Drawing not to scale.



Directional dependence

The deviation of the response following tilting of the chamber by up to 10° at 6 and 20 MeV, at the dose maximum in water, is less than 0.1%.

Optional accessories

Check Source, ⁹⁰Sr, 20 MBq (541 µCi) (Model 30-658)

Available model(s)

30-332 Roos Electron Ionization Chamber, 0.35 cm³, Waterproof, includes BNC Triax connector

Other types of triaxial cable connectors available

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

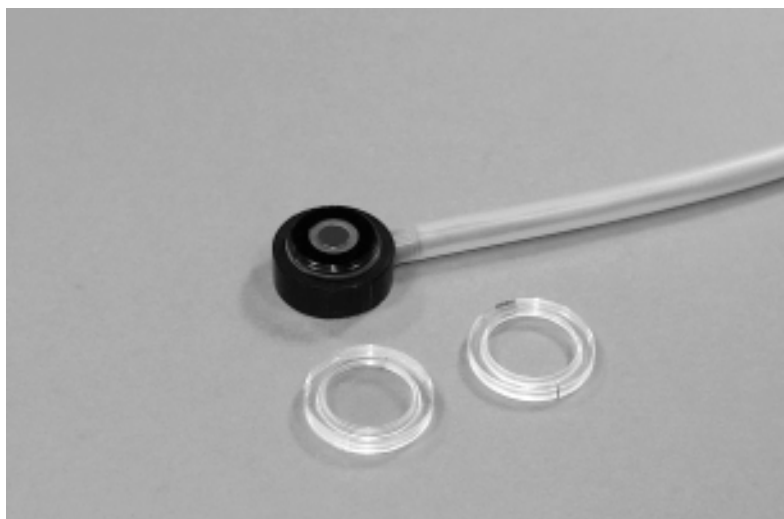
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30-332-ds rev 1 11 mar 03

Markus™ Electron Ionization Chamber, 0.055 cm³, Waterproof Model 30-329



- Suitable for use in solid state phantoms and water phantoms
- Vented measuring volume
- Fully guarded up to measuring volume
- Touchable parts free of high voltage
- Extension cables up to 100 meters in length are available

The Markus chamber is the very first chamber specifically designed for electron dosimetry. The chamber may be used for measurements in water phantoms or solid state phantoms. A PMMA waterproofing cap, 0.87 mm thick (equivalent to 1 mm of water), and an annulus, for solid state phantom measurements, are included. The chamber's small measuring volume makes it ideal for electron measurements when very high spatial resolution is required. The diaphragm front allows measurements in the buildup region of electron fields to a depth of virtually zero. Markus includes a 3.4 ft (1.05 m) cable and BNC Triax connector.

Specifications

Volume 0.055 cm³

Response $2 \cdot 10^{-9}$ C/Gy

Leakage $\pm 2 \cdot 10^{-16}$ A

Polarizing voltage 300 V recommended, 400 V maximum

Cable length 3.4 ft (1.05 m)

Cable leakage $3.5 \cdot 10^{-12}$ C/(Gy • cm)

Wall material Polyethylene CH₂

Membrane thickness 0.03 mm

Area thickness 2.5 mg/cm²

Electrode Acrylic, graphite coated, 5.3 mm Ø

Nominal useful range 2 to 45 MeV

Range of temperature 10° to 40°C

Range of relative humidity 10% to 80%

Ion collection time

150 V: 0.20 ms

300 V: 0.09 ms

400 V: 0.07 ms

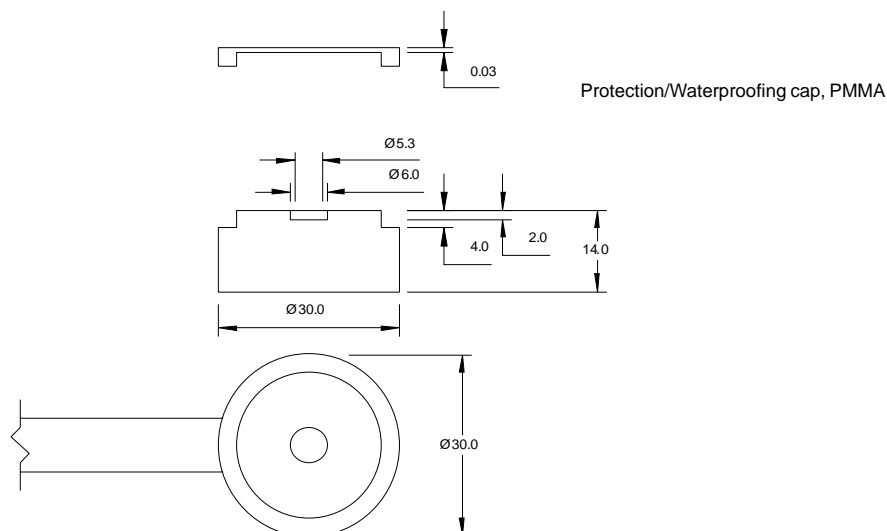
Saturation behavior

| Saturation behavior | Polarizing voltage | 99.0% saturation | 99.5% saturation |
|---|--------------------|------------------|------------------|
| Maximum dose rate at continuous irradiation | 150 V | 5.9 Gy/s | 2.9 Gy/s |
| | 300 V | 24.0 Gy/s | 12.0 Gy/s |
| | 400 V | 42.0 Gy/s | 21.0 Gy/s |
| Maximum dose rate per irradiation pulse | 150 V | 0.7 mGy | 0.4 mGy |
| | 300 V | 1.4 mGy | 0.7 mGy |
| | 400 V | 1.9 mGy | 0.9 mGy |

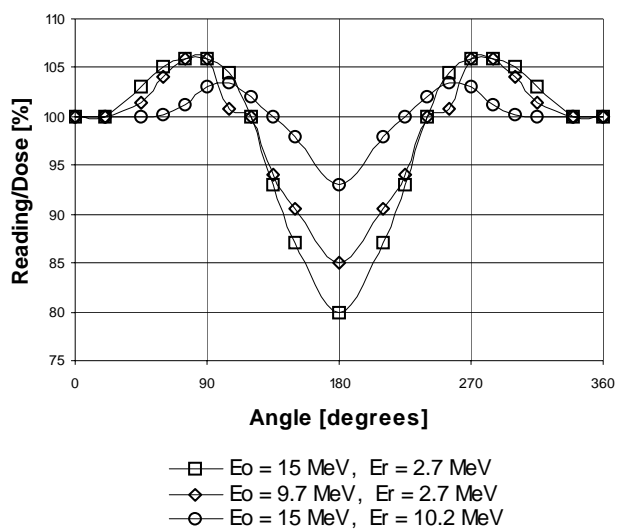
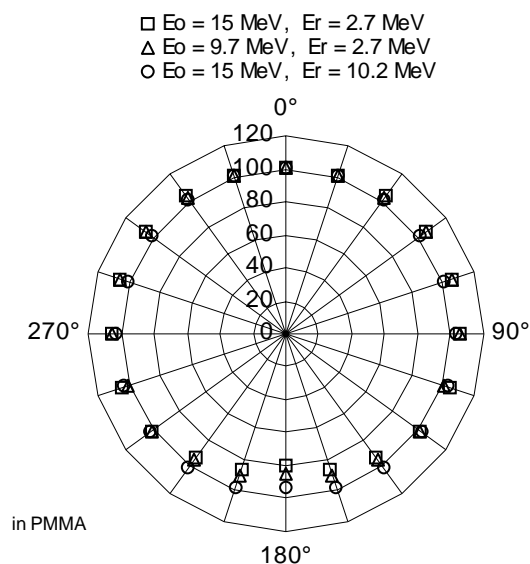
See next page for more specifications.

Specifications (continued)

Diagram



Directional dependence



The values given in the diagrams are typical for the construction.

Optional accessories

Check Source, ^{90}Sr , 20 MBq (541 μCi) (Model 30-658)

Available model(s)

30-329 Markus Electron Ionization Chamber, 0.055 cm³, Waterproof, includes BNC Triax connector and PMMA buildup cap

Other types of triaxial cable connectors available

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

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Advanced Markus™ Electron Ionization Chamber, 0.02 cm³, Waterproof Model 30-331



Radiation Oncology



- Vented sensitive volume of 0.02 cm³
- Same dimensions as the Markus chamber
- Suitable for relative and absolute electron dosimetry
- Very thin entrance window
- The chamber is waterproof when used with protective cap

The 0.02 cc Advanced Markus Chamber is our newest development in plane-parallel electron ion chambers. This chamber combines the advantages of both Roos™ and Markus chamber types into one truly exceptional plane-parallel electron chamber. Developed for relative and absolute electron dosimetry in water or solid type phantoms, the advanced design of this chamber makes it possible to perform absolute electron dosimetry without perturbation effects.

This chamber is designed in strict accordance with the recommendations of IEC 60731 and it is waterproof. Since the outer shape is identical to that of the Markus chamber, all existing Markus chamber phantom plates and adapters can be used with the Advanced Markus chamber. The small sensitive volume makes this chamber ideal for dose distribution measurements in a water phantom, giving a good spatial resolution. An improved design of the guard ring reduces the influence of scattered radiation from the housing, and makes it possible to perform absolute electron dosimetry without perturbation effects. The chamber features a flat energy response within the nominal useful range from 2 to 45 MeV. The membrane material is polyethylene of 0.03 mm thickness. The Advanced Markus chamber comes with a protective acrylic cover 0.87 mm thick (1 mm water equivalence) for use in water. In addition, the chamber includes a 3.4 ft (1.05 m) cable and BNC Triax connector. Air density correction is required for each measurement. A radioactive check device is available as an option.

Note: The Advanced Markus chamber was developed in cooperation with Prof. Rosenow, Göttingen University, Germany IEC 60731: "Medical electrical equipment - Dosimeters with ionization chambers as used in radiotherapy."

Specifications

Type of product Vented plane-parallel chamber type 34045 with guard ring

Application Dose and dose rate measurements in high-energy electron beams

Measuring quantities and units Absorbed dose to water (Gy); absorbed dose rate to water (Gy/min)

Radiation quality Electrons 2 to 45 MeV

Response 670 pC/Gy

Sensitive volume 0.02 cm³

Directional dependence The deviation of the response following tilting of the chamber by up to 10° is smaller than 0.1%

Entrance window Polyethylene (CH₂) foil with 0.03 mm thickness

Electrode Acrylic (PMMA), graphite coated 5 mm Ø

Area density 2.5 mg/cm²

Reference point Center of entrance foil

Chamber voltage Maximum 400 V

Leakage current ± 4 fA

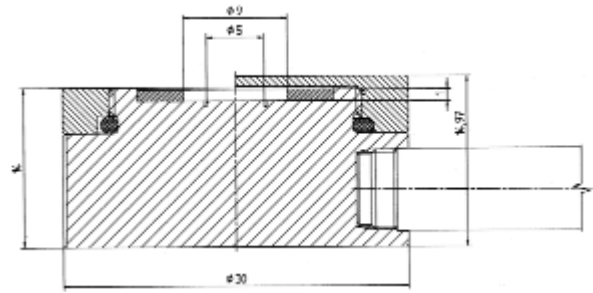
Cable leakage Less than or equal to 1 pC/(Gy • cm)

Ion collection time

150 V: 44 µs

300 V: 22 µs

400 V: 17 µs



Range of temperature 10° to 40°C, 50° to 104°F

Range of relative humidity 10 to 80%, max 20 g/m³

Range of air pressure 700 to 1060 hPa

Temperature equilibrium 2 to 3 min/K

Pressure equilibrium Less than or equal to 10 s

Optional accessories

Check Source, ⁹⁰Sr, 20 MBq (541 µCi) (Model 30-658)

Available model(s)

30-331 Advanced Markus Electron Ionization Chamber, 0.02 cm³, Waterproof, includes BNC Triax connector and PMMA buildup cap

Other types of triaxial cable connectors available

Extension Cable Reel for Ionization Chambers Model 30-355

- Prevents tangled, loose, or misplaced triaxial-connector cables
- A must for every therapy department

This handy reel makes locating, using, and storing cable easy. Just reel-off the exact length of cable needed, and connect it to your equipment. After use, wind the cable back into its covered reel. No more tangled, loose, dirty, or lost cable.

The Extension Cable Reel holds 40 feet of cable. It has a triaxial male connector at the extendable end, and a female triaxial receptacle on the reel housing.



Specifications

Dimensions 7 (w) x 3.25 (d) x 8.25 in (h) (17.78 x 8.26 x 20.95 cm)

Weight 2 lb (0.90 kg)

Available model(s)

30-355 Extension Cable Reel for Ionization Chambers

For additional information, please contact Cardinal Health, Radiation Management Services customer service at 440.248.9300, 800.850.4608, or fax: 440.349.2307; located at 6045 Cochran Road, Cleveland, Ohio 44139-3303, USA.

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Radioactive Check Source, ^{90}Sr , 33 MBq (892 μCi)

Model 30-657



Radiation Oncology

Introduction

The Radioactive Check Source, Model 30-657, provides the Medical Physicist with an easy way to check the constancy of response of compact thimble type ionization chambers. The device contains 33.3 MBq of ^{90}Sr , in a fully shielded container, and is equivalent to ISO Class C43323. Holders for reproducible chamber positioning during check measurements are available for a variety of ion chambers.

Applications

Use of the Radioactive Check Source, Model 30-657, is recommended for high precision dosimetry and is required by IEC 60731 - Dosimeters with ionization chambers as used in radiotherapy, 1977. A check measurement performed before each dose measurement will assure the ionization chamber is responding properly. Since the radioactive source is in the shape of a tube, the chamber volume is irradiated from all directions.

Check readings must be corrected for the 28.7 year half-life time of the ^{90}Sr source. However, under constant environmental conditions (temperature, pressure, air humidity) the current produced in an ionization chamber is reproducible with an uncertainty of $\pm 1\%$.

Holders to assure correct positioning and repositioning accuracy for the 0.6 cm^3 Farmer-type chambers (Models 580-006-WP and 30-351), 0.125 cm^3 Semiflex™ chamber (Models 30-344), 0.3 cm^3 Semiflex™ chamber (Models 30-316), and 0.015 cm^3 PinPoint™ chamber (Model 30-350) are available. If this device is used with other types of chambers, proper positioning becomes the responsibility of the user.

The Radioactive Check Source, Model 30-657, is equipped with an attached thermometer. When making check measurements care must be taken to obtain temperature equilibrium between the ionization chamber, check device, and the surrounding environment. After use, the protective cover should be replaced and secured. With the protective cover in place the dose rate from the source is reduced to less than 1 $\mu\text{Sv/h}$ at 10 cm. Leaving an ionization chamber in the check device when not in use is not recommended since this can damage the ion chamber.

Note: A radioactive materials license for ^{90}Sr is required for purchase.



- Radioactive check device for constancy checks of thimble-type ion chambers
- Checks for proper functioning of the complete dosimetry system
- Holders available for a variety of thimble-type chambers

Specifications

Radioactive content 33.3 MBq (892 μCi)

Half-value time 28.7 years

Optional accessories

Holder for 0.6 cm^3 Farmer-Type (Models 580-006-WP and 30-351) Ion Chambers Model 30-657-1000

Holder for 0.125 and 0.3 cm^3 Semiflex (Model 30-344 and 30-316) Ion Chambers Model 30-657-2000

Holder for 0.015 cm^3 PinPoint (Model 30-350) Ion Chamber Model 30-657-3000

Available model(s)

30-657 Radioactive Check Source, ^{90}Sr , 33 MBq (892 μCi). A radioactive materials license is required

**For additional information, please contact
Radiation Management Services business of
Cardinal Health at 440.248.9300, fax 440.349.2307, or
e-mail rmsinfo@cardinal.com; located at 6045 Cochran Rd.,
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Radioactive Check Source, ^{90}Sr , 20 MBq (541 μCi)

Model 30-658

Introduction

The Radioactive Check Source, Model 30-658, provides the Medical Physicist with an easy way to check the constancy of response of flat plane-parallel type ionization chambers. The device contains 20 MBq of ^{90}Sr in a fully shielded container, and is equivalent to ISO Class C64444. Holders for reproducible chamber positioning during check measurements are available for the Markus, Advanced Markus, and Roos ion chambers.

Applications

Use of the Radioactive Check Source, Model 30-658, is recommended for high precision dosimetry and is required by IEC 60731 - Dosimeters with ionization chambers as used in radiotherapy, 1977. A check measurement performed before each dose measurement will assure the ionization chamber is responding properly. Since the radioactive source is cylindrical, the entrance window of the flat plane-parallel is placed near the source by means of the appropriate holding device.

Check readings must be corrected for the 28.7 year half-life time of the ^{90}Sr source. However, under constant environmental conditions (temperature, pressure, air humidity) the current produced in an ionization chamber is reproducible with an uncertainty of $\pm 1\%$.

Holders to assure correct positioning and repositioning accuracy for the 0.055 cm^3 Markus chamber (Model 30-329), 0.02 cm^3 Advanced Markus chamber (Model 30-331), and 0.35 cm^3 Roos chamber (Model 30-332) are available. If this device is used with other types of chambers, proper positioning becomes the responsibility of the user.

When making check measurements with the Radioactive Check Source, Model 30-658, care must be taken to obtain temperature equilibrium between the ionization chamber, check device, and the surrounding environment. After use, the protective cover should be replaced and secured. With the protective cover in place the dose rate from the source is reduced to less than 1 $\mu\text{Sv/h}$ at 10 cm. Leaving an ionization chamber in the check device when not in use is not recommended since this can damage the ion chamber.

Note: A radioactive materials license for ^{90}Sr is required for purchase.



Radiation Oncology

- Radioactive check device for constancy checks of flat plane-parallel type ion chambers
- Checks for proper functioning of the complete dosimetry system
- Holders available for Markus™, Advanced Markus™, and Roos™ ion chambers

Specifications

Radioactive content 20 MBq (541 μCi)

Half-value time 28.7 years

Optional accessories

Holder for 0.055 cm^3 Markus (Model 30-329) and 0.02 cm^3 Advanced Markus (Model 30-331) Electron Ion Chambers Model 30-658-1000

Holder for 0.35 cm^3 Roos (Model 30-332) Electron Ion Chamber Model 30-658-2000

Available model(s)

30-658 Radioactive Check Source, ^{90}Sr , 20 MBq (541 μCi).
A radioactive materials license is required

**For additional information, please contact
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Cardinal Health at 440.248.9300, fax 440.349.2307, or
e-mail rmsinfo@cardinal.com; located at 6045 Cochran Rd.,
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