

TRIAD™ TnT X-Ray Field Service/Calibration/QA Kit

Model 10500AMT

DI

Diagnostic Imaging

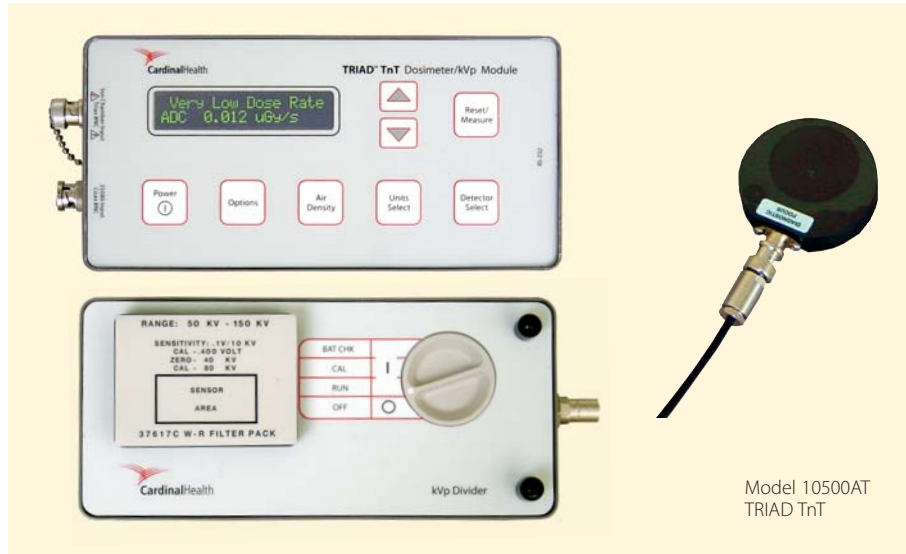
New TRIAD TnT performance

Save time in setup and procedure

- Automatic temperature and pressure correction for faster operation in any environment
- New time saving scroll functionality for faster initial settings and recovery
- Recognizes and ignores spurious background signals

Expand the range of functionality from a single instrument

- Very Low Dose Rate (down to 20 nGy/sec at a resolution of 1 nGy/sec)
- Broader range of dental unit kV and time measurement to include units with filament preheat
- Pulse count mode for use with single phase units with pulse count timers
- Easily measure small image intensifiers (6 inch and smaller)
- AC adapter for use in lieu of batteries



Model 10500AT
TRIAD TnT

Introduction

The TRIAD TnT Kit is a full-function, x-ray dosimeter kit that performs fast, highly sensitive measurements in all modalities for x-ray field service, calibration, and quality assurance testing. The Model 10100AT TRIAD TnT Dosimeter Kit features the Model 35050AT Dosimeter, a technologically advanced, microprocessor-controlled, x-ray radiation dosimeter. The kit also includes ion chambers and test stand, triaxial/coaxial cable, AC adapter, HVL filter set, RS-232 interface cable with adapters, customization software, instruction manual CD and lightweight carrying case.

Applications

The TRIAD TnT Kit is ideal for government compliance testing, troubleshooting, repair of diagnostic x-ray equipment, installation and setup of new equipment, preventative maintenance, radiographic quality assurance measurements, and measurements required for JCAHO accreditation. The TRIAD TnT Kit performs measurements for all modalities: radiographic, fluoroscopic, mammographic (MQSA), CT, cine and dental.

The TRIAD TnT incorporates the latest design innovations to enhance ease of use, range of applications and save valuable time. TRIAD TnT continues the TRIAD tradition as the most accurate, widely used instrument of its kind available.



Model 10500AMT

Features

- Bright display direct readout in user-selected units, including R, Sv, Gy, /sec, /min, /hr, /frame, or electrical units (C or A)
- Image intensifier measurements at 0.1 μ R and 0.1 μ R/sec resolution; cine in μ R/frame
- Expanded kVp and exposure time measurement capabilities
- Patented Linear Mammo Filter Pack kVp corrected based on Mammo K-Edge Filter Pack
- Simplified controls include auto-reset, auto-ranging, automatic offset & drift compensation, automatic power-down and automatic pressure and temperature correction
- Includes kVp and exposure time measurements when the Model 35050AT is used with the Model 35080B Non-invasive kVp Divider
- Optional TRIAD Toolkit for Excel for remote operation, waveform capture and calibration, includes MQSA, Rad and Fluoro templates
- Self-checking features include Model 35050AT battery voltage, bias voltage, ion chamber/cable leakage, and hardware/software checks
- Six AA alkaline batteries provide instrument power, as well as 300 V electronic ion chamber bias. Auto power-down feature extends battery life
- New AC adapter that can be used in lieu of battery operation to minimize delays associated with battery replacement

Specifications for TRIAD TnT Dosimeter Kit (Model 10100AT)

Exposure and exposure rate accuracy Basic accuracy of Model 35050AT is $\pm 1\%$ of reading ± 2 range resolution steps over range of 18° to 28°C and $\pm 2\%$ of reading ± 2 range resolution steps over the full operating temperature range of 0° to 50°C. 3% NIST-traceable calibration provided with each system and includes effects of Models 35050AT, 96035B and 96020C

Exposure time measurement Exposure time accuracy is $\pm 0.1\%$ of reading ± 0.2 msec. Maximum exposure time is 6.5 seconds and measurement resolution is 0.2 msec

Nominal measurement range

Ion chamber	Units	Effective range***	Resolution step size
15 cc	R	100 μ to 20	1 μ
	R/sec	100 μ to 20	1 μ
	R/min	5 m to 1200	50 μ
	R/hr	100 m to 72 k	1 m
	R/frame**	2 μ to 333 m	0.02 μ
	Gy	1 μ to 175 m	0.01 μ
	Gy/sec	1 μ to 175 m	0.01 μ
	Gy/min	50 μ to 10.5	0.5 μ
	Gy/hr	1 m to 630	0.01 m
150 cc	R	10 μ to 2	0.1 μ
	R/sec	10 μ to 2	0.1 μ
	R/min	0.5 m to 120	5 μ
	R/hr	10 m to 7.2 k	0.1 m
	R/frame**	0.2 μ to 33 m	0.002 μ
	Gy	0.1 μ to 17.5 m	0.001 μ
	Gy/sec	0.1 μ to 17.5 m	0.001 μ
	Gy/min	5 μ to 1050 m	0.05 μ
	Gy/hr	0.1 m to 63.0	0.001 m
150 cc VLDR	R/sec	2 μ to 2*	0.1 μ
	R/min	0.1 m to 120*	5 μ
	R/hr	2 m to 7.2 k*	0.1 m
	R/frame**	0.04 μ to 33 m*	0.002 μ
	Gy/sec	0.02 μ to 17.5 m*	0.001 μ
	Gy/min	1 μ to 1050 m*	0.05 μ
	Gy/hr	0.02 m to 63.0*	0.001 m
	Gy/frame**	0.4 n to 290 μ *	0.02 n
Electrical units	C	1 p to 100 n	0.01 p
	A	1 p to 100 n	0.01 p
Values for ion chambers are calculated using nominal sensitivities:			
15 cc: 2.4×10^{-8} R/C			
150 cc: 2.4×10^{-7} R/C			
*Very Low Dose Rate effective range at 5% resolution steps			
**At 60 frames/sec (1 to 120 frames/selectable)			
***IEC 61674 effective range at 1% resolution steps			

Measurement modes

kVp/Dose/Time Single shot, direct beam measurement of exposure, kVp, and time. Auto-ranging across three decade ranges. Auto reset between exposures. Display update after each exposure

kVp/Rate Simultaneous measurement of kVp and exposure rate

Full sensitivity dose Auto-ranging across five decades of sensitive ranges. Automatic drift & offset compensation, and automatic post-exposure display hold

Full sensitivity rate Measurement range covers a span from low-level image intensifier measurements to unattenuated direct beams. Automatic offset compensation and nonlinear filtering. Auto-ranging provides five decades of sensitivity ranges. Display updates once per second

Very Low Dose Rate (VLDR) This mode is only for making very low dose rate measurements. Nonlinear digital filtering and autoranging provide five decades of sensitivity ranges. Display updates once per second. In this mode, automatic current offset and drift compensation is disabled. As a result, the system can display very low dose rates

Power requirements Life ~30 hours with six AA alkaline batteries. Automatic power-down after user-selected period of unattended operation (5-255 minutes). An AC adapter is supplied with each 35050AT. When the AC adapter is in use, the auto power down feature is disabled, providing continuous operation. User selections for ion chamber, units, kV filter pack, temperature, pressure, and frame are stored in nonvolatile memory before automatic turnoff; eliminates manual re-selection at power-up

Bias voltage supply Fixed electronic bias (~ 300 V). Bias voltage is removed from triaxial input connector at instrument turnoff

Customization Allows user to modify contents of nonvolatile memory including ion chamber and kV filter pack conversion factors, temperature and pressure units, radiation units, and power down interval. A field customization software program is included for use with an IBM®-PC or compatible

Display Two-line, 20-character alphanumeric PLED (polymer LED), with 0.5 cm character height. Indicates all ion chamber/kV filter pack identification information, numerical measurement results, battery level, calibration date and other information

Weight 14 lb (6.4 kg)

Connections

Model 35080B interface Male, two lug BNC

Computer interface RS-232, using RJ-45 connector. 9,600 baud 8-bit, 1 stop, no parity, xon/xoff. Enables fully-programmable operation and waveform display from a PC with optional Excel add-in. Powered when connected to computer

Ion chamber input Triax, BNC. Collector and guard positive-biased relative to ion chamber body and dosimeter chassis

Power 2.1 mm DC Power Jack, power input for an unregulated 9 V, 200 mA adapter with a center negative, 2.1 mm plug

Optional accessories

USB to RS-232 adapter (Model 38617)

Accessories supplied

Test stand (Model 37581) Machined stainless steel upright rod with base, ion chamber holder, and tray for HVL filters, which includes one ion chamber stem

Programming kit (Model 37594) Includes customization software on CD, IBM-PC format and 6.5 ft (2 m) RS-232 interface cable with adapters for PC-type and AT-type computers

Instruction manual (Model 35050ATCD) Model 10100AT TRIAD Field Service Kit Operator's Instruction Manual on CD

Cable (Model 38208) 20 ft (6 m) coax/triax cable

AC adapter 9 V, 200 mA, DC

HVL filter set (Model 37668) Set of 12 aluminum filters for half-value layer measurements, which includes one 2 mm, two 1 mm, two 0.5 mm, three 0.1 mm, one 0.2 mm and three 0.05 mm

Kit carrying case (Model 37500D) High density polyethylene (HDPE) plastic absorbs impact to protect contents. Custom-cut, high quality foam interiors surround and protect standard kit equipment and accessories. Dimensions 13 (w) x 18 (d) x 6 in (h) (33 x 46 x 15 cm)

Diagnostic ionization chambers (Models 96035B and 96020C)

Energy range

96035B: 30 to 150 kVp; 20 to 50 kVp for mammographic

96020C: 30 to 150 kVp

Nominal sensitivity

96035B: 2.00×10^8 R/C (1.75×10^6 Gy/C) at 22°C and 1013 hPa

2.21×10^8 R/C (1.94×10^6 Gy/C) at 22°C and 1013 hPa. Flat response suitable for conventional diagnostic radiography and mammography

96020C: 2.08×10^7 R/C (1.82×10^5 Gy/C) at 22°C and 1013 hPa.

Optimized for low-level image intensifier and cine measurements

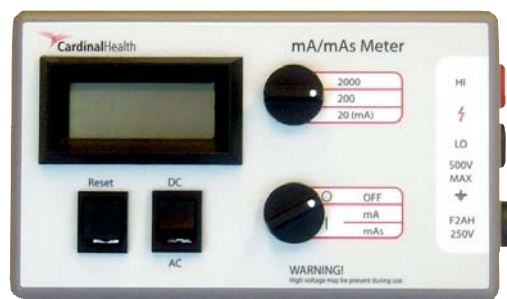
Construction

96035B: Graphite-coated acrylic, parallel-plate, air-vented

96020C: Composite graphite-filled thermoplastic; parallel-plate, air-vented

Volume 96035B: 15 cm³; 96020C: 150 cm³

Specifications for mA/mAs Meter (Model 35035)



The Model 35035 Digital mA/mAs Meter is a versatile instrument that is used by x-ray service engineers, field service engineers and biomedical engineers to accurately measure mAs and fluoroscopic mA accurately for diagnostic, radiographic, and fluoroscopic imaging equipment. The Digital mA/mAs Meter operates with one, easily replaceable 9 volt alkaline battery, facilitating convenience and portability.

Milliamp seconds (mAs)

Range	Resolution	Input impedance*
200 mAs	0.1 mAs	10 ohms
2000 mAs	1.0 mAs	1 ohm
* Does not include fuse resistance. Also, does not include effect of bridge rectifier present when unit is set for AC		

Current (mA)

Range	Resolution	Input impedance*
20 mA	0.01 mA	100 ohms
200 mA	0.1 mA	10 ohms
2000 mA	1 mA	1 ohm
* Does not include fuse resistance. Also, does not include effect of bridge rectifier present when unit is set for AC		

Signal input limits

Function	Range	Maximum input limit
mA	OFF	Input shorted; 2.0 A maximum (fuse protected)
	20	250 mA for 30 s*
	200	1.0 A for 30 s*
	2000	2.0 A maximum (fuse protected)
mAs	200	1.0 A for 30 s*
	2000	2.0 A maximum (fuse protected)
*Limit set by power dissipation rating of shunt resistors		

Controls Power mA/mAs switch; Reset switch; Range switch:

200 mA/mAs, 2000 mA/mAs and 20 mA range settings; AC/DC switch

Accuracy 1% of reading \pm two least significant digits for all ranges

Environmental

Temperature range 5 to 35°C

Relative humidity 0 to 80%

Storage temperature - 20 to 50°C

Dimensions 2 (w) x 2 (d) x 3.50 in (h) (15 x 5.0 x 8.75 cm)

Weight 0.78 lb (0.35 kg)

Display Liquid crystal display (LCD), 3.50 digit, 0.5 in (h) (13 mm)

Input Two banana jacks

Power requirements One 9 V alkaline battery with easy replacement

Accessories supplied

Test Lead Kit (Model CA-23)

Specifications for Non-Invasive kVp Divider (Model 35080B)



The Model 35080B Non-Invasive kVp Divider quickly and accurately measures kV for all modalities. The unit checks both above and below table tubes and displays the results on either the Model 35050AT Dosimeter, a storage oscilloscope, or optional Excel Add-in software. The Model 35080B Non-Invasive kVp Divider is highly portable and eliminates the need for bulky and heavy high-voltage divider tanks.

A patented* wide range filter pack is included with the Model 35080B Non-Invasive kVp Divider and provides accurate readings for the range of 50 to 150 kVp. Four optional filter packs are available for use with the Model 35080B Non-Invasive kVp Divider for CT, mammographic, and mobile applications.

Features

- Non-invasive technology eliminates the hazards of high-voltage cables and the need for bulky divider tanks
- Optional filter packs enable testing in virtually all modalities
- Rh/Rh measurement capability when Model 35080B Non-Invasive kVp Divider is used with Cadmium K-Edge and Linear Mammo Filter Pack Pair

Range 50 to 150 kVp, using only the wide-range radiographic filter pack (Model Number 37617). Range and versatility are extended with the use of special optional filter packs

Accuracy Accuracy of $\pm 2\%$ of reading in the range of 50 to 150 kVp, exclusive of linearity, filtration, and gain effects. Linearity corrections automatically applied when using Model 35080B Non-invasive kVp Divider with Model 35050AT Dosimeter

Response time 150 μ s (10% to 90%)

Calibration Internally generated signal provides a calibration check

Minimum time for valid reading 1 ms, 3-phase; one line cycle, single-phase

Tube current Wide dynamic range from 4 to 3000 mA (3 phase), 2 to 1500 mA (single phase). Generator settings will vary in waveform and distance. Less than ± 1 kV effect for wide-range radiographic filter pack covering 50 to 150 kVp. Specialty filter packs may have different characteristics

Environmental

Temperature range 0 to 35°C

Relative humidity 20 to 80%

Storage temperature - 35° to 50°C

Orientation Long axis of the Model 35080B Non-invasive kVp Divider oriented perpendicular to axis of x-ray tube to eliminate heel effect

Power requirements One 9 V battery, 60 hours operation

"Battery-Check" function connects battery to output terminals for voltage measurement

Dimensions 2.375 (w) x 3.5 (d) x 8.25 in (h) (6.0 x 9.0 x 21 cm)

Weight 1.50 lb (0.68 kg)

Accessories supplied

Wide-Range Filter Pack (Model 37617) For 50 to 150 kVp

Fitted carrying case

Optional accessories

CT Filter Pack (Model 33551) Provides precision measurements in the 70 kVp to 140 kVp range with an accuracy of $\pm 2\%$. Active area is just 3.8 cm x 0.48 cm, to accommodate the narrow beam of most scanners

Cadmium K-Edge and Linear Mammo Filter Pack Pair (Model 37351/37355) Cadmium K-Edge Mammo Pack uses the inherent stability of the cadmium k-edge as an absolute reference for precision measurements between 27.5 and 29.5 kVp with ± 0.5 kV accuracy. Use the Linear Mammo Pack with the Cadmium K-Edge Mammo Pack for precision calibrations of ± 1.0 kV accuracy from 22 to 40 kVp

Mobile Filter Pack (Model 37946) Easily and accurately measures kV on mid-frequency generators (> 1 kHz) with substantial kV ripple ($> 8\%$). Provides precision measurements in the range of 50 to 135 kVp with accuracy of $\pm 2\%$

Low Range Filter Pack (Model 38237) Provides precision measurements in the 30 to 90 kVp range with an accuracy of $\pm 2\%$. For radiographic generators using tungsten target

CE Tested. Meets applicable standards.

* Patent numbers 4,843,619 and 4,916,727.

Specifications for Diagnostic Ion Chambers (Models 96020C and 96035B)



The Models 96020C and 96035B Diagnostic Ion Chambers are vented volume, parallel-plate air ionization chambers with side-mounted BNC triaxial connectors. The Model 96020C Ion Chamber has a nominal volume of 150 cm³; the Model 96035B has a nominal volume of 15 cm³. Both ion chambers have a fully-guarded, centrally-located collector plate that provides superior collection efficiency.

The patented* Model 96035B has a dual energy range that enables both diagnostic and mammographic measurements. Diagnostic measurements are taken using one side of the chamber as the entrance window, and mammographic measurements are accomplished using the other side as the entrance window.

Features

- Very low leakage and low noise
- Rugged mechanical construction
- These ionization chambers are supplied with triaxial BNC connectors

Energy range

96020C 30 to 150 kVp

96035B 30 to 150 kVp for diagnostic measurements. 20 to 50 kVp for mammographic measurements

Nominal volume

96020C 150 cm³; 11.30 cm diameter by 1.50 cm thick active volume

96035B 15 cm³; 3.96 cm diameter by 1.22 cm thick active volume

Nominal sensitivity

96020C H60: 2.08×10^7 R/C at 22°C and 760 mmHg. Optimized for low-level image intensifier and cine measurements

96035B L100: 2.0×10^8 R/C at 22°C and 760 mmHg. MV30 (PTB Mammo Point): 2.21×10^8 R/C at 22°C and 760 mmHg. Flat energy response suitable for conventional diagnostic radiography and mammography

Leakage current < 10 fA under normal bias conditions (300 V)

Collection efficiency

96020C 95% at 2,000 R/min

96035B 95% at 5,000 R/min

Wall material

96020C Composite graphite-filled thermoplastic

96035B Graphite-coated acrylic (methyl-methacrylate)

Window material

96020C 0.76 mm thick, graphite-coated polycarbonate

96035B Both entrance windows are made of 0.25 mm graphite-coated polycarbonate

Window density

96020C 91 mg/cm²

96035B 32 mg/cm²

Active window area

96020C 100 cm², centered within the chamber body

96035B Each side of the chamber has a circular active window region centered 7.1 mm further from the BNC connector than the center of the chamber body. Active window regions have an area of 12.32 cm²

Collector plate

96020C 0.8 mm thick graphite-coated acrylic plate, 10.80 cm in diameter. A 2.16 cm x 2.85 cm guard region is electrically isolated from the collector area

96035B 0.25 mm thick, centrally mounted, graphite-coated, polycarbonate plate, 3.18 cm, ± 0.01 cm in diameter. A 1.27 x 0.89 cm guard region is electrically isolated from the collector area

Connector Side-mounted, triaxial, two-lug BNC connector

Calibration

96020C standard calibration The standard calibration is performed at H60 (NIST defined as 60 kVp, first HVL of 6.0 mm Al, homogeneity coefficient of 94)

96035B standard calibration The standard calibration is performed at one diagnostic and one mammographic beam quality. Calibration factors are normalized to 22°C and 760 mmHg

Diagnostic unattenuated beam Calibration on the diagnostic side of the chamber is performed at M80 (NIST defined as 80 kVp, first HVL of 2.97 mm Al, homogeneity coefficient of 57)

Mammographic beam Calibration on the mammographic side is performed at Mo/Mo28 (NIST defined as 28 kVp, first HVL of 0.332 mm Al, homogeneity coefficient of 74.3) or MV30 (PTB defined as 30 kVp, first HVL of 0.337 mm Al)

* Patent number 5,508,526.

Available model(s)

Model 10100AT

- Dosimeter (Model 35050AT)
- 15 cm³ Ion Chamber (Model 96035B)
- 150 cm³ Ion Chamber (Model 96020C)
- Coax/Triaxial Cable, 20 ft (6 m) (Model 38208)
- Programming Kit (Model 37594), includes customization software on CD, two-meter RS-232 interface cable and adapters
- Test Stand (Model 37581), Ion Chamber Stem, HVL Filter Tray
- HVL Filter Set (Model 37668)
- AC Adapter, 9 V, 200 mA, DC
- Instruction Manual (Model 37580)
- Kit Carrying Case (Model 37500D)

Model 10500AT

Components in Model 10100AT Kit, plus:

- Non-Invasive kVp Divider (Model 35080B)
- Wide-Range Filter Pack (Model 37617) (50 to 150 kVp)

Model 10500AMT

Components of Model 10500AT Kit, plus:

- mA/mAs Meter (Model 35035)
- Universal Test Lead Kit (Model CA-23)

Optional accessories

For all kits:

- CT Ion Chamber, 3.2 cm³ (Model 500-100)
- Ultra-High Purity HVL Attenuators (Model 07-434), for mammo, set of 6
- TRIAD Toolkit for Excel (Model 10500EXL)
- USB to RS-232 adapter (Model 38617)

For Models 10500AT & 10500AMT kits:

Mammographic Filter Pack Pair (Model 37355/37351) includes:

- Cadmium K-Edge Mammo Filter Pack (27.5 to 29.5 kVp) \pm 0.5 kV accuracy
- Linear Mammo Filter Pack (22 to 40 kVp) \pm 1.0 kV accuracy

Note: Mammo Filter Packs are designed for molybdenum anode, beryllium window generators

- Mobile Filter Pack (Model 37946) (50 to 135 kVp) \pm 2% accuracy
- CT Filter Pack (Model 33551) (70 to 140 kVp) \pm 2% accuracy

For additional information, please contact the 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 Road, Cleveland, Ohio 44139-3303, USA.

Specifications are subject to change without notice.
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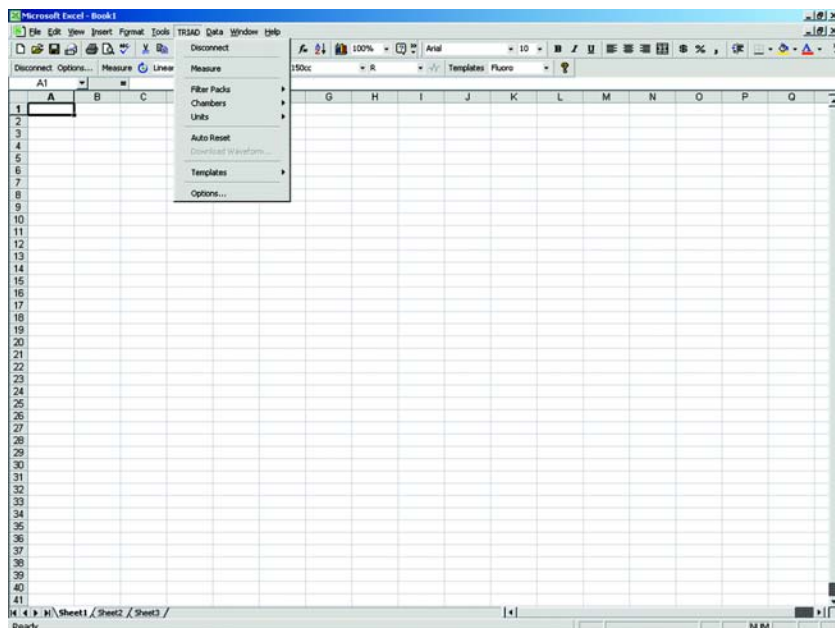
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TRIAD™ Toolkit for Excel

Model 10500EXL

DI

Diagnostic Imaging



- Automatically collects measurement results and places them in an Excel worksheet
- Automatically captures kV waveforms and charts them in an Excel worksheet
- Templates are provided for QA tests on radiographic, fluoroscopic and mammographic x-ray machines
- Templates may be modified to perform user specific tests and generate user customized reports

Introduction

The TRIAD Toolkit for Excel is a complete software package for the TRIAD that includes an Excel Add-In, called TRIAD Tool and Excel templates that may be used to evaluate the performance of radiographic, mammographic, and fluoroscopic x-ray machines. The TRIAD Tool collects measured results from the Model 35050A Dosimeter and places the data in the active Excel worksheet. In addition, the TRIAD Tool may be used to acquire and graph kV waveforms from the TRIAD as well as remotely control the TRIAD Dosimeter.

Features

- Allows complete remote control of the TRIAD
- Automatically downloads Model 35050A Dosimeter configuration settings
- Compatible with Windows® 95, 98, ME®, NT® 4.0, 2000, and Microsoft® Excel 97, 2000

Reproducibility

Machine Settings

kVp	mA	FS	SDD	msec
80.0	200.0	small	26 in	100

Machine Settings

kVp	msec	mR
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76.1	95.4	365.0
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75.4	94.9	354.0
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75.7	95.3	359.0
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76.4	95.3	368.0
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75.3	95.1	364.0
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Avg	75.8	95.2	362.0
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CV (<0.000)	0.006	0.002	0.015
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Pass/Fail	Pass	Pass	Pass
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Accuracy

kV Accuracy

kVp Set	kVp	kV % Error	Pass/Fail
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50.00	53.06	6.12%	Fail
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60.00	57.06	-4.90%	Pass
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70.00	66.78	-4.60%	Pass
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80.00	76.80	-4.00%	Pass
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90.00	85.80	-4.67%	Pass
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100.00	99.33	-0.67%	Pass
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110.00	106.80	-1.09%	Pass
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120.00	118.70	-1.08%	Pass
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Timer Accuracy

msec Set	msec	m% Error	Pass/Fail
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200.0	193.7	-2.66%	Pass
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200.0	144.7	-3.53%	Pass
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200.0	120.1	0.08%	Pass
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200.0	95.3	-4.70%	Pass
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200.0	62.1	3.50%	Pass
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200.0	45.5	-9.00%	Fail
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200.0	28.8	-10.00%	Fail
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200.0	20.4	2.00%	Pass
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mAs Linearity

Machine Settings

kVp	SDD	msec
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80.0	26 in	100
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Pass/Fail Criteria

Adj.	Non-Adj.
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<0.050	<0.100
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Machine Settings

Set mA	mR	mR/mAs	CL	Pass/Fail
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25 s	36.2	15.97	-	
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50 s	96.9	20.29	0.119	Fail
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100 s	193.4	20.25	0.001	Pass
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100 L	181.1	18.96	0.033	Pass
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150 L	265.0	18.71	0.007	Pass
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200 L	350.0	18.36	0.009	Pass
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300 L	534.0	18.76	0.011	Pass
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Beam Quality

Machine Settings

kVp	mA	FS	SDD	msec
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80.0	200.0	L	26 in	0.2
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Min HVL	2.30
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Calculated HVL	2.66
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Pass/Fail	Pass
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Beam Quality

mmAl	Normalized Exposure
0	1.0
2.5	0.50622
3.0	0.46888

Specifications

Controls

The TRIAD Tools menu provides an interface for the user to remotely control the TRIAD, select filter packs, chambers, units, retrieve kV waveforms, open templates, and change the options. A description of each control follows:



Connect/Disconnect

Connects or disconnects the TRIAD to the communications port. Connect instructs the TRIAD Tool to read configuration information such as the filter packs, chambers, and units

Options

Several options can be specified including COM port, temperature, pressure, and frame rate

Measure

Sets the TRIAD up for a single exposure using the selected filter pack, chamber, and unit

Auto Reset

Informs the TRIAD Tool to automatically reset the TRIAD for another exposure, allowing a series of exposures to be made without used intervention. At the time Auto Reset is clicked, the TRIAD will be set up for an exposure

Filter Packs

Selects the filter pack to use for kVp measurements

Chambers

Selects the ion chamber to use for exposure measurements

Units

Selects the unit to use for exposure measurements

Download Waveform

The Waveform button will be enabled after an exposure is made and before the TRIAD is setup for another exposure. When the Waveform button is pressed, a dialog box opens and the user is prompted for the start and end times for the waveform chart, allowing the user to specify any portion of the kV waveform. The default start and end times are for the complete waveform. The waveform data will then be placed in the active cell in the active workbook

Help

Opens the TRIAD Toolkit for Excel Instruction Manual

Templates

Three templates are also provided with the TRIAD Toolkit for Excel: a radiographic template, a mammographic template and a fluoroscopic template. Each template includes a help worksheet with detailed instructions for its use.

The TRIAD Radiographic Template is used to perform the following radiographic tests:

- Reproducibility
- kVp accuracy
- Timer accuracy
- Linearity
- Beam quality

The TRIAD Mammographic Template may be used to perform mammography tests required for ACR and MQSA. Measured data from the Model 35050A Dosimeter may be automatically collected in the following worksheets:

- kVp accuracy
- kVp reproducibility
- Beam quality
- Breast entrance exposure
- AEC reproducibility
- Average glandular dose
- Radiation output rate

The TRIAD Fluoroscopic template is used to perform the following fluoroscopic tests:

- kVp Accuracy
- Beam quality
- Fluoro Exposure Rate

These templates are easy to use and can be modified to fit the user's needs

System requirements

- Windows 95, 98, ME, NT 4.0, 2000
- Microsoft Excel 97, 2000
- One serial port (COM1 through COM4)

Available model(s)

10500EXL TRIAD Toolkit for Excel

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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10500EXL-ds rev 2 07 mar 03

NERO® mAx

Victoreen® Model 8000



Diagnostic Imaging



- 100 kHz sampling speed captures data from the most difficult machines
- 0.5 kV or 1% accuracy from 22 to 160 kV
- Measures kVp average, kV effective, kV peak, time, exposure or rate, mA or mAs, HVL, exposure/frame, and mAs/frame
- Displays R or Gy
- Excel Add-in includes MQSA, Rad, and Fluoro templates
- RS-232 computer interface
- Enhanced dental capabilities

Introduction

The Victoreen NERO mAx, Non-invasive Evaluator of Radiation Outputs, evaluates the widest range of x-ray machines on the market today. Evaluation of pulsed fluoro, cine, computed tomography (CT), portable, mammographic, dental, radiographic, fluoroscopic, low, medium, and high frequency machines is finally made possible with a single instrument. This fifth generation instrument features 100 kHz sampling speed and direct mA/mAs measurements. The NERO mAx's innovative Easy Flow Menu (EFM) system and flexible softkeys provide an intuitive, user friendly operating environment for quick, accurate, and easy measurements. All measurement modes and functions are displayed on the NERO mAx's super bright LCD and are controlled by the five softkeys directly below the display and three hard keys to the right.

Seven user selectable measurement modes and three system control modes are available and clearly displayed on the control console screen for easy access and selection.

Applications

The NERO mAx consists of the control console, detector, detector cable, two filter cards, mAs leads, Excel Add-in, AC adapter, HVL plates, instruction manual, and carrying case.

The compact control console houses the rechargeable battery, super bright easy to read backlit display, eight control buttons, and the sophisticated electronics necessary for accurate, reproducible measurements. Connectors for power input, RS-232, printer, scope output and the NERO mAx detector are located on the control console's rear panel.

The NERO mAx detector contains sensors for simultaneously measuring kV, exposure or rate and mA or mAs. Solid state detectors are used to measure kV. An ion chamber, located in the top of the detector, is used for exposure/rate measurements. Connectors for external ion chambers and the NERO mAx detector interface are located on the rear panel of the detector. The front panel has a keyed opening for the NERO mAx filter cards and a connector for mAs leads.

The filter cards contain the various filters needed to accurately measure kilovoltage. Each filter card is coded so that the NERO mAx "knows" which filter is in use and its position. The NERO mAx also verifies that the filter card is valid for the selected measurement mode. The two filter cards are keyed so that they may only be inserted properly. The W/AI filter card and the Mammo filter card are clearly labeled as to the x-ray tube targets for which they are calibrated.

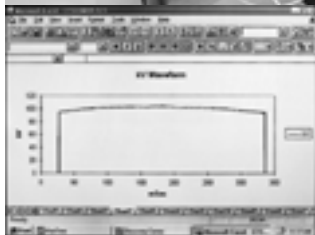
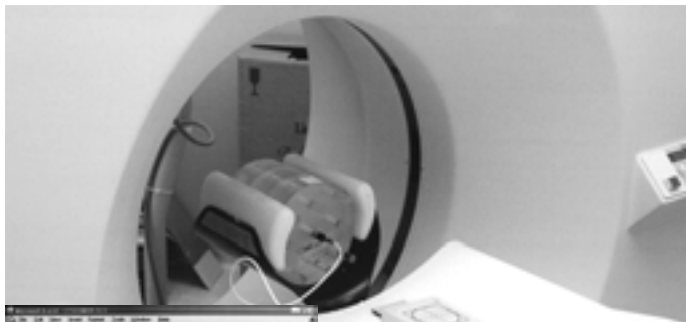
External chambers

External ion chambers for CT, mammographic, image intensifier tube, and special radiographic applications are available.

Chamber calibration factors can be stored in the NERO mAx for direct readout of measurements.

The Excel Add-in acquires measured data and waveforms directly into an Excel spread sheet to maximize flexibility for report generation.

Real-time CT



UNIT ID SETUP CAL HVL			
EXP	10PULSE		
CT EXP	ZERO		
AMSE	75%		
FLUORO	80%	LOW	
MAMMO	90%	HIGH	10 mS
RADIO			
MODE	%kV	SENS	DELAY

Easy Flow menu, Mode Select screen

80.0	kVp Avg	100	msec
79.2	kV Eff	392	mR
81.1	kV Peak	0.0	mAs
RADIO	75%	LOW	10 mS
MODE	%kV	SENS	DELAY
MAKE EXPOSURE			

Easy Flow menu, Radio screen

24.8	kVp Avg	226.1	msec
24.3	kV Eff	240	mR
27.3	kV Peak	19.9	mAs
MAMMO	HIGH	MOLY	Mo 30μ
MODE	SENS	TARGET	FILTER
MAKE EXPOSURE			

Easy Flow menu, Mammo screen

75.4	kVp Avg	0.159	R/min
71.1	kV Eff	0	mAs/pulse
80.8	kV Peak	177	μR/pulse
FLUORO	PULSED	LOW	
MODE	TYPE	SENS	
MAKE EXPOSURE			

Easy Flow menu, Pulsed Fluoro display

74.1	kVp Avg	102.1	mSec/frame
72.7	kV Eff	359.3	mR/frame
74.8	kV Peak	30.5	mAs/frame
AMSE	LOW		
MODE	SENS		
MAKE EXPOSURE			

Easy Flow menu, AMSE screen

3.65 R			
CT EXP	LOW	10 mm	
MODE	SENS	BEAM	
RESET			

Easy Flow menu, CT EXP screen

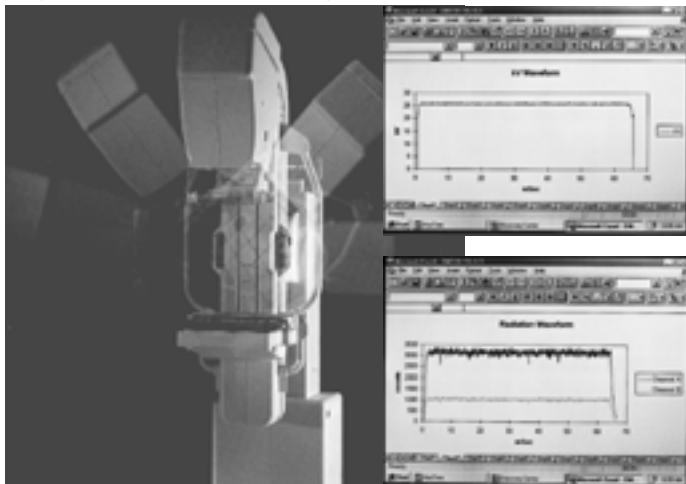
1.23 mR				
EXP	FLUORO	INTEG	HIGH	
MODE	CHAMBER	MODE	SENS	
RESET				

Easy Flow menu, EXP screen

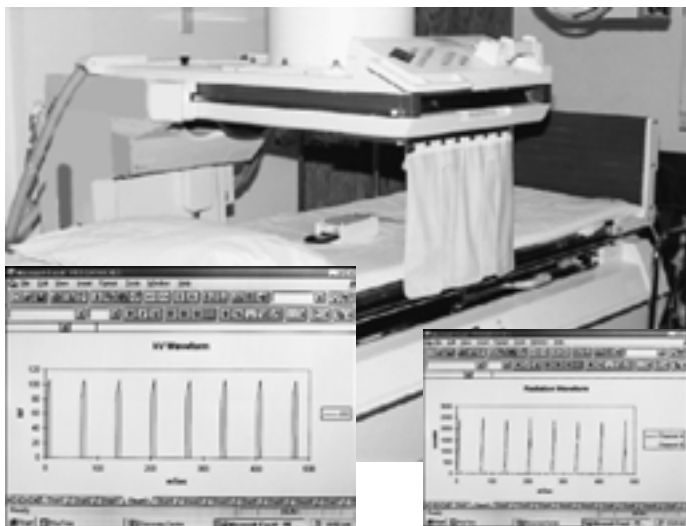
6.2 R	HVL	3.76	mmAl
	r = 1.000		
Please wait...			
HVL	CT	LOW	10 mm
MODE	CHAMBER	SENS	BEAM

Easy Flow menu, HVL screen

High frequency mammography



Pulsed fluoro/AMSE



NERO mAx operating modes

Radio mode Radio mode is used to make measurements on tungsten target, aluminum filtered radiographic x-ray generators

Selections are available for % kV peak for the type of generator being tested. For example, Zero Crossing, Single Phase Pulse, 75%, 80%, or 90% of kVp modes are available for accurate exposure measurements on difficult x-ray machines

Radio mode simultaneously measures:

- kVp Avg
- exposure
- kV Eff
- exposure time
- kV Peak
- mAs

Mammo mode Mammo mode is used to make measurements on mammographic x-ray generators

Mammo mode simultaneously measures:

- kVp Avg
- exposure
- kV Eff
- exposure time
- kV Peak
- mAs

Fluoro mode Fluoro mode is used to make measurements on fluoroscopic x-ray generators. Fluoro mode supports both continuous fluoro and pulsed fluoro measurements

In the continuous fluoro mode, the NERO mAx measures:

- kVp Avg
- exposure rate (R/min)
- kV Eff
- mA
- kV Peak

In the pulsed fluoro mode, the NERO mAx measures:

- kVp Avg
- exposure rate (R/min and mR/pulse)
- kV Eff
- mAs/pulse
- kV Peak

AMSE mode AMSE mode is used for Automated Measurement of Sequential Exposures. This mode is used to measure the output of CINE generators

In AMSE mode, the NERO mAx measures:

- kVp Avg
- exposure rate (mR/frame)
- kV Eff
- mAs/frame
- kV Peak
- time/frame (ms/frame)

CT Exposure mode CT Exposure mode is used to make CT exposure measurements using the Victoreen Model 6000-100 CT ion chamber. The CT probe must be connected to the NERO mAx detector's external ion chamber input in this mode

Exposure mode Exposure mode is used to make exposure and rate measurements using the NERO mAx's internal ion chamber or an external ion chamber

HVL mode In the HVL mode, the NERO mAx calculates half value layer based upon a series of exposure or rate measurements made with varying thicknesses of aluminum absorbers placed in the x-ray beam. A minimum of two exposures are required and up to ten exposures may be used

Calibrate mode Calibrate mode is used to enter and store calibration factors for ion chambers used with the NERO mAx

Setup mode Setup mode is used to setup various features of the NERO mAx. From the setup screen the user can set the instrument's parameters such as the real time clock, temperature and pressure

Unit ID Displays the NERO mAx's serial number, firmware part number and level

Specifications

Kilovoltage Measured during the first 480 ms of exposure

Measured quantity kVp Avg, kV Eff, kV Peak

Accuracy 0.5 kV or $\pm 1\%$

Reproducibility 0.5 kV or $\pm 1\%$

Range

Target/Filter	Range	Filtration
W/Al	30 - 60 kV	
	50 - 100 kV	
	80 - 160 kV	1.2 mm of Al
Mo/Mo	22 - 35 kV	30 μ of Mo
Mo/Rh	22 - 40 kV	25 μ of Rh
Mo/Al	22 - 49 kV	1 mm of Al
Rh/Rh	25 - 49 kV	25 μ of Rh
Rh/Al	25 - 49 kV	1 mm of Al
<i>All calibrations performed with NIST traceable calibration beam.</i>		

Analyze/Display cycle time

Radio & mammo 3 seconds for 0.1 second exposure, 1 second for each 32 ms of exposure time

Fluoro & AMSE 15 seconds for all exposures

Time

Radio mode Measured during entire exposure at 90, 80, 75% rise/fall of waveform, zero crossing, or pulse count

Mammo mode Measured during entire exposure at 90% rise/fall of waveform

Accuracy 0.1 ms

Resolution 0.1 ms

Range All diagnostic exposures from 0.1 ms to 60 seconds

Exposure & rate Measured during entire exposure with automatic energy, temperature, and pressure correction

Measured quantity Roentgens or Grays

Accuracy $\pm 5\%$

Reproducibility Radio and mammo modes: $\pm 2\%$ or 2 mR

Resolution 0.1 mR

Range All diagnostic exposure and rate measurements from 1 mR to 9999 R

Fluoro rate 0.1 R/min to 999 R/min

mAs and mA Measured invasively during entire exposure

Accuracy 2%

Reproducibility $\pm 1\%$ or 0.2 mAs

Range 0.1 mAs to 9999 mAs, 0 to 1000 mA

HVL

Accuracy $\pm 5\%$

Range 0.1 to 99.9 mmAl

Physical

Display Super bright 240 x 60 pixel, super twist LCD with cold cathode fluorescent backlight

Detectors Ion chamber and solid state (kV detectors)

Ion chamber volume 45 cc nominal

Window area/density 38 mg/cm² Polycarbonate

HVL set 2.30 mm, 1.0 mm, 0.3 mm Al

Power requirements 12 VDC 1 A external supply

Rechargeable internal batteries supply more than 4 hours of continuous service with overnight charge

Physical (continued)

Size Volume is 3960 in³ (0.065 m³)

Console 9.00 x 9.12 x 3.25 in (22.86 x 23.17 x 8.26 cm)

Detector 6.56 x 3.70 x 2.58 in (16.66 x 9.4 x 6.55 cm)

Filter cards 2.4 x 6.25 x 0.31 in (6.1 x 15.88 x 0.8 cm)

Weight

Shipping 23 lb (10.43 kg)

Console 4.56 lb (2.067 kg)

Detector (with card) 1.65 lb (0.747 kg)

Filter cards 2.9 and 3.2 oz (0.090 and 0.094 kg)

External chamber accessories

Radiographic Ion Chamber, 30 cm³ (Victoreen Model 6000-528): energy response: within 7% from 30 to 150 kVp (15 to 65 keV); cable: 15 ft (4.5 m); chamber dimensions: 4 x 4 x 0.54 in thick (10.2 x 10.2 x 1.4 cm)

Mammographic Ion Chamber, 3.3 cm³ (Victoreen Model 6000-529): energy response: within 5% from 0.2 to 5.0 mm Al HVL (16 to 90 kVp); cable: 15 ft (4.5 m); chamber dimensions: 4 cm \varnothing x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber. Option: Probe Holder (Model 6000-529-95) for BRH2 test stand

Image Intensifier Ion Chamber, 150 cm³ (Victoreen Model 6000-530B): energy response: $\pm 10\%$ from 1.8 to 10 mm Al HVL; cable: 10 ft (3.0 m); chamber dimensions: 6.26 x 8 x 0.63 in (15.9 x 20.6 x 1.6 cm)

Scatter Ion Chamber, 400 cm³ (Victoreen Model 6000-532B) energy response: $\pm 5\%$ from 32 to 850 keV; cable 10 ft (3.0 m); chamber dimensions: 6.26 x 8 x 0.63 in (15.9 x 20.6 x 1.6 cm)

CT Ion Chamber, 3.2 cm³ (Victoreen Models 6000-100 and 500-100): energy response: $\pm 5\%$ from 1 to 10 mm Al HVL; cable: 3 ft (0.9 m); sensitive length: 4 in (10.0 cm); chamber inside \varnothing : 0.25 in (6.4 mm)

CT High Sensitivity Ion Chamber, 10 cm³, for multislice CT (Victoreen Models 6000-200 and 500-200): energy response: $\pm 5\%$ from 1 to 10 mm Al HVL; cable: 3 ft (0.9 m); sensitive length: 4 in (10.0 cm); chamber inside \varnothing : 0.45 in (11.44 mm)

Optional accessories

Ultra-High Purity HVL Attenuators (Model 07-434), for mammo, set of 6

Available model(s)

8000 NERO mAx X-Ray Test Device, consists of a control console, detector, detector cable, two filter cards, mAs leads, Excel Add-in, HVL plates, instruction manual, and carrying case

Available AC adapters (specify with order)

Model	Description	Typical geo. region
14-328	110 VAC 12 VDC 1000 mA	USA, Japan
14-401	230 VAC 12 VDC 1000 mA	Europe
14-414	230 VAC 12 VDC 1000 mA	UK
14-414 and 14-416 adapter	230 VAC 12 VDC 1000 mA	Australia

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.

CE Tested. Meets applicable standards.

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NERO® mAx Toolkit for Excel

Victoreen® Model 8000mAx

DI

Diagnostic Imaging

- Automatically collects measurement results and places them in an Excel worksheet
- Automatically captures kV waveforms and charts them in an Excel worksheet
- Templates are provided for QA tests on radiographic, fluoroscopic, and mammographic x-ray machines
- Templates may be modified to perform user specific tests and generate user customized reports

MEDICAL PHYSICIST'S MAMMOGRAPHY QC TEST SUMMARY

Preliminary Results

Site: _____

Room ID: _____

Survey Date: _____

X-Ray Unit Manufacturer: _____

Model: _____

Medical Physicist's QC Tests	ACR Guides (Pass/Fail)	MQSA Regs (Pass/Fail)
1. Mammographic Unit Assembly Evaluation	Pass	Pass
2. Collimation Assessment	Pass	Pass
3. Evaluation of Focal Spot Performance	Pass	Pass
4. Automatic Exposure Control (AEC) System Performance	Pass	Pass
5. Uniformity of Screen Speed	Fail	Fail
6. Artifact Evaluation	Pass	Pass
7. Phantom Image Quality Evaluation**	Pass	Pass
8. kVp Accuracy and Reproducibility	Pass	Pass
9. Beam Quality (Half-Value Layer) Assessment	Pass	Pass
10. Breast Entrance Exposure, Average Glandular Dose**	Pass	Pass
AEC Reproducibility, and Radiation Output Rate	Pass	Pass
11. Viewbox Luminance and Room Illuminance	Pass	N/A

**If any of the starred MQSA tests fail (Phantom Image Quality and Average Glandular Dose), corrective action must be taken before any further exams are performed.

Failure of any other MQSA-mandated tests requires corrective action within 30 days of the test date.

Recommended Corrective Action:

Evaluation of Site's Technologist QC Program	ACR Guides (Pass/Fail)	MQSA Regs (Pass/Fail)
1. Darkroom cleanliness (daily)		
2. Processor QC - performed, records maintained, action taken when needed (daily)		
3. Screen cleaning (weekly)		
4. Mammo phantom imaging - performed, records maintained, action taken as needed (weekly)		
5. Darkroom fog (semiannually)		
6. Film-screen contact test (semiannually)		
7. Compression pressure monitored (semiannually)		
8. Repeat analysis - performed, records maintained, reviewed by radiologist (quarterly)		
9. Viewboxes and viewing conditions (weekly)		
10. Analysis of fixer retention (quarterly)		
11. Visual checklist (monthly)		

Specific Comments:

Signature _____

Physicist's Name _____

Phone Number _____

This is only a preliminary list of findings. A full and final report will be mailed to you shortly.
Please call me if you have any questions about this summary.

Introduction

The NERO mAx Toolkit for Excel is a complete software package for the NERO mAx that includes an Excel Add-In, called NERO mAx Add-In and Excel templates that may be used to evaluate the performance of radiographic, mammographic and fluoroscopic x-ray machines. The NERO mAx Add-In collects measured results from the NERO mAx and places the data in the cells of the active Excel worksheet, starting at the active worksheet cell. The NERO mAx Add-In also may be used to acquire and graph radiation and kV waveforms from the NERO mAx as well as remotely control the NERO mAx.

Features

- Allows complete remote control of the NERO mAx
- Complete on-line help speeds learning
- Compatible with Windows® 95, 98, ME®, NT® 4.0, 2000, and Microsoft® Excel 97, 2000

Specifications

Controls

The NERO mAx menu provides an interface for the user to remotely control the NERO mAx and retrieve radiation and kV waveforms. A description of each menu option follows:

Select Mode...

Selects the NERO mAx measurement mode. This allows the user to select the correct measurement mode for the template in use. For instance, the radio mode is selected when using the radiographic template, the mammo mode is selected when using the mammographic template and the fluoro mode is selected when using the fluoroscopic template

Retrieve Rad Waveform

Retrieves the radiation waveforms from the NERO mAx. When this is selected, a dialog box opens and the user may select either all of the waveform or a portion of the waveform to be charted. If a portion of the waveform is desired, the user prompted for start and end times (in milliseconds) of the waveform window

Retrieve kV Waveform

Retrieves the kV waveform from the NERO mAx. When this is selected, a dialog box opens and the user may select either all of the waveform or a portion of the waveform to be charted. If a portion of the waveform is desired, the user prompted for start and end times (in milliseconds) of the waveform window

Select Com Port...

Allows the user to choose serial communication port COM1 – COM4 for Model 8000 NERO mAx connection

Templates

Three templates are also provided with the NERO mAx Toolkit for Excel: a radiographic template, a mammographic template and a fluoroscopic template. Each template includes a help worksheet with detailed instructions for its use.

The NERO mAx Radiographic Template is used to perform the following radiographic tests:

- Reproducibility
- kVp accuracy
- Timer accuracy
- Linearity
- Beam quality

The NERO mAx Mammographic Template may be used to perform mammography tests required for ACR and MQSA. Measured data from the Model 8000 NERO mAx may be automatically collected in the following worksheets:

- kVp accuracy
- kVp reproducibility
- Beam quality
- Breast entrance exposure
- AEC reproducibility
- Average glandular dose
- Radiation output rate

The NERO mAx Fluoroscopic template is used to perform the following fluoroscopic tests:

- kVp accuracy
- Beam quality
- Fluoro exposure rate

These templates are easy to use and can be modified to fit the user's needs

System requirements

- Windows 95, 98, ME, NT 4.0, 2000
- Microsoft Excel 97, 2000
- One serial port (COM1 through COM4)

Available model(s)

8000mAx NERO mAx Toolkit for Excel

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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X-Ray Test Device

Victoreen® Model 4000M+



Diagnostic Imaging



- Measures kVp maximum, kVp average, kVp effective, dose and time in one exposure
- Compact, lightweight design
- Displays R or Gy
- External ion chambers for Mammo, CT, image intensifier and phototiming measurements
- Automatic exposure reset for hands-off operation
- Rechargeable Ni-Cd batteries provide more than six hours of continuous service
- RS-232 computer interface
- Storage scope output for real-time waveform display
- Reversible display for fluoro measurements

Introduction

The Model 4000M+ does it all. Simply place the instrument in the x-ray beam, make one exposure, and it serially displays kVp Maximum, kVp Average, kVp Effective, dose, and time. The Model 4000M+ then automatically resets for the next exposure. A CsI photodiode pair provide the kVp measurements through five user-selectable filter pairs. This ensures optimum accuracy over the entire diagnostic range with minimum filtration dependence. Exposure measurements are made with a parallel plate ionization chamber located above the filter wheel. Exposure time is measured with quartz crystal accuracy. Plus, a variety of external ion chambers may be connected for even greater flexibility.

Specifications

Kilovoltage

Accuracy

1 kV Mo/Mo (22 to 35 kVp)
(Mammo generators w/30 μ Mo)

Range

W/AI Tubes: 27 to 155 kVp
Mo/Mo Tubes: 21 to 50 kVp

Time

Measured during entire exposure at 90% rise/fall of waveform

Accuracy Within 2% or 2 ms, whichever is greater

Range 1 ms to 10 seconds

Exposure

Measured during entire exposure;
kVp corrected

Accuracy $\pm 5\%$

Range 10 mR to 10 R

Fluoroscopic rate

Measured over one second intervals during fluoro exposure

Accuracy $\pm 5\%$

Range 0.5 to 200 R/min

Detectors

kV CsI/photodiode pair measures x-ray transmission through differential attenuators

Time Computed from kV waveform stored in memory against quartz crystal time base

Exposure Parallel plate ionization chamber

Volume 36 cm³

Window 38 mg/cm², 18.9 cm² Polycarbonate

Calibration Reference to a NIST traceable voltage divider and a calibrated exposure monitor during irradiation

See next page for more specifications.

Specifications *(continued)*

Physical

Display 16 character dot-matrix LCD

Controls Model 4000+ Five rocker switches

On/Off Power switch

Radio/Fluoro Select radiographic or fluoro operation

High/Low Select for sensitivity

Roll Roll thru data

Exposure/All Select exposure only for external ion chamber

Mo/Mo or W/AI Select anode/filter of x-ray tube

Connectors

Power 9 VDC, 500 mA

Scope BNC for oscilloscope connection

RS-232 DB-9 connector configured as DCE. BNC and banana plug for external Ion chamber

Power requirements 9 VDC 500 mA external supply

Rechargeable internal Ni-Cd batteries supply more than six hours of continuous service with overnight charge

Dimensions 8.5 (w) x 9 (d) x 3 in (h) (21.5 x 23 x 7.6 cm)

Weight Approximately 3.5 lb (1.59 kg)

HVL set Aluminum filters: 2.3, 1.0, and 0.3 mm

Optional accessories

4000 Toolkit for Excel (Model 4000EXL)

Ultra-High Purity HVL Attenuators (Model 07-434): for mammo, set of 6

Carrying Case (Model 4000-69)

RS-232 Cable, 25 ft (7.6 m), 9-pin to 9-pin (Model 190004)

External chamber accessories

Radiographic Ion Chamber, 30 cm³ (Victoreen Model 6000-528): energy response: within 7% from 30 to 150 kVp (15 to 65 keV); cable: 15 ft (4.5 m); chamber dimensions: 4 x 4 x 0.54 in thick (10.2 x 10.2 x 1.4 cm)

Mammographic Ion Chamber, 3.3 cm³ (Victoreen Model 6000-529): energy response: within 5% from 0.2 to 5.0 mm Al HVL (16 to 90 kVp); cable: 15 ft (4.5 m); chamber dimensions: 4 cm Ø x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber. Option: Probe Holder (Model 6000-529-95) for BRH2 test stand

Image Intensifier Ion Chamber, 150 cm³ (Victoreen Model 6000-530B): energy response: ± 10% from 1.8 to 10 mm Al HVL; cable: 10 ft (3.0 m); chamber dimensions: 6.26 x 8 x 0.63 in (15.9 x 20.6 x 1.6 cm)

Scatter Ion Chamber, 400 cm³ (Victoreen Model 6000-532B) energy response: ± 5% from 32 to 850 keV; cable 10 ft (3.0 m); chamber dimensions: 6.26 x 8 x 0.63 in (15.9 x 20.6 x 1.6 cm)

CT Ion Chamber, 3.2 cm³ (Victoreen Models 6000-100 and 500-100): energy response: ± 5% from 1 to 10 mm Al HVL; cable: 3 ft (0.9 m); sensitive length: 4 in (10.0 cm); chamber inside Ø: 0.25 in (6.4 mm)

CT High Sensitivity Ion Chamber, 10 cm³, for multislice CT (Victoreen Models 6000-200 and 500-200): energy response: ± 5% from 1 to 10 mm Al HVL; cable: 3 ft (0.9 m); sensitive length: 4 in (10.0 cm); chamber inside Ø: 0.45 in (11.44 mm)

Available model(s)

4000M+ X-Ray Test Device

Available AC adapters (specify with order)

Model	Description	Typical geo. region
14-301	110 VAC 9 VDC 500 mA	USA, Japan
14-399	230 VAC 9 VDC 500 mA	Europe
14-415	230 VAC 9 VDC 500 mA	UK
14-415 and 14-416 adapter	230 VAC 9 VDC 500 mA	Australia

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.

CE Tested. Meets applicable standards.

Specifications are subject to change without notice.

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4000 Toolkit for Excel

Victoreen® Model 4000EXL

DI

Diagnostic Imaging

- Automatically collects measurement results and places them in an Excel worksheet
- Captures radiation and kV waveforms and charts them in an Excel worksheet
- Templates are provided for QA tests on radiographic, fluoroscopic, and mammographic x-ray machines
- Templates may be modified to perform user specific tests and generate user customized reports

MEDICAL PHYSICIST'S MAMMOGRAPHY QC TEST SUMMARY

Preliminary Results

Site: _____

Room ID: _____

Survey Date: _____

X-Ray Unit Manufacturer: _____

Model: _____

Medical Physicist's QC Tests	ACR Guides (Pass/Fail)	MQSA Regs (Pass/Fail)
1. Mammographic Unit Assembly Evaluation	Pass	Pass
2. Collimation Assessment	Pass	Pass
3. Evaluation of Focal Spot Performance	Pass	Pass
4. Automatic Exposure Control (AEC) System Performance	Pass	Pass
5. Uniformity of Screen Speed	Fail	Fail
6. Artifact Evaluation	Pass	Pass
7. Phantom Image Quality Evaluation**	Pass	Pass
8. kVp Accuracy and Reproducibility	Pass	Pass
9. Beam Quality (Half-Value Layer) Assessment	Pass	Pass
10. Breast Entrance Exposure, Average Glandular Dose**	Pass	Pass
AEC Reproducibility, and Radiation Output Rate	Pass	Pass
11. Viewbox Luminance and Room Illuminance	Pass	N/A

**If any of the starred MQSA tests fail (Phantom Image Quality and Average Glandular Dose), corrective action must be taken before any further exams are performed.

Failure of any other MQSA-mandated tests requires corrective action within 30 days of the test date.

Recommended Corrective Action:

Evaluation of Site's Technologist QC Program	ACR Guides (Pass/Fail)	MQSA Regs (Pass/Fail)
1. Darkroom cleanliness (daily)		
2. Processor QC - performed, records maintained, action taken when needed (daily)		
3. Screen cleaning (weekly)		
4. Mammo phantom imaging - performed, records maintained, action taken as needed (weekly)		
5. Darkroom fog (semiannually)		
6. Film-screen contact test (semiannually)		
7. Compression pressure monitored (semiannually)		
8. Repeat analysis - performed, records maintained, reviewed by radiologist (quarterly)		
9. Viewboxes and viewing conditions (weekly)		
10. Analysis of fixer retention (quarterly)		
11. Visual checklist (monthly)		

Specific Comments:

Signature _____

Physicist's Name _____

Phone Number _____

This is only a preliminary list of findings. A full and final report will be mailed to you shortly.
Please call me if you have any questions about this summary.

Introduction

The 4000 Toolkit for Excel is a complete software package for the 4000M+ NERO® that includes an Excel Add-In, called 4000 Add-In and Excel templates that may be used to evaluate the performance of radiographic, mammographic and fluoroscopic x-ray machines. The 4000 Add-In collects measured results from the 4000M+ NERO and places the data in the cells of the active Excel worksheet, starting at the active worksheet cell. The 4000 Add-In also may be used to acquire and graph radiation and kV waveforms from the 4000M+ NERO as well as remotely control the 4000M+ NERO.

Features

- Allows complete remote control of the Model 4000M+ NERO
- Complete on-line help speeds learning
- Compatible with Windows® 95, 98, ME®, NT® 4.0, 2000, and Microsoft® Excel 95, 97, 2000
- Automatically detects the presence of Model 4000M+ NERO

Specifications

Controls

The 4000 menu provides an interface for the user to remotely control the 4000M+ NERO and retrieve radiation and kV waveforms. A description of each menu option follows:

Remote Control...

Selects the 4000M+ NERO measurement mode and measurement options. This allows the user to select the correct measurement mode for the template in use. For instance, the radio mode is selected when using the radiographic template, the Mo/Mo target filter is selected when using the mammographic template and the fluoro mode is selected when using the fluoroscopic template

Retrieve Rad Waveform

Retrieves the radiation waveform data from the 4000M+ NERO and charts it in a new Excel chart

Retrieve kV Waveform

Retrieves the kV waveform data from the 4000M+ NERO and charts it in a new Excel chart

Templates

Three templates are also provided with the 4000 Toolkit for Excel: a radiographic template, a mammographic template and a fluoroscopic template. Each template includes a help worksheet with detailed instructions for its use.

Templates *(continued)*

The 4000 Radiographic Template is used to perform the following radiographic tests:

- Reproducibility
- kVp Accuracy
- Timer accuracy
- Linearity
- Beam quality

The 4000 Mammographic Template may be used to perform mammography tests required for ACR and MQSA. Measured data from the Model 4000M+ NERO may be automatically collected in the following worksheets:

- kVp accuracy
- kVp reproducibility
- Beam quality
- Breast entrance exposure
- AEC reproducibility
- Average glandular dose
- Radiation output rate

The 4000 Fluoroscopic template is used to perform the following fluoroscopic tests:

- kVp accuracy
- Beam quality
- Fluoro exposure rate

These templates are easy to use and can be modified to fit the user's needs

System requirements

- Windows 95, 98, ME, NT 4.0, 2000
- Microsoft Excel 95, 97, 2000
- One serial port (COM1 through COM4)

Available model(s)

4000EXL 4000 Toolkit for Excel

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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4000EXL-ds rev 3 07 mar 03

Crescent X-Ray Leakage Detection System

Model 10970



Diagnostic Imaging

Introduction

The Crescent X-Ray Leakage Detection System is custom-designed for accurate low-level radiation measurements. When used in a suitable configuration, the system demonstrates compliance to Title 21 CFR subchapter J, Part 1020.30 (k) of the Radiation Control Act.

The Model 10970 Crescent X-Ray Leakage Detection System consists of a combination of Ion Chamber/Electrometer Modules (Model 96010A/50300A), and a Control Console (will include Model 70010A Dual Channel Comparator Modules, 70020 Reference Control Modules and power supply). The air-filled ion chamber/electrometer module is the basic component of the system. Seventeen of these modules are sufficient to provide a full spherical scan and are connected to the control console through low-impedance cable, enabling remote monitoring. The Control Console contains the high-voltage ionization potential, a precision comparator and trip circuits, reference module, system control logic, and a spare HV power supply. The entire system has a modular design for add-on capability, interchangeability, and ease of maintenance.



- Ion Chamber array performs x-ray leakage tests for diagnostic x-ray tube manufacturers and tube reloaders
- Demonstrates product compliance to the Radiation Control Act
- Standard 17-channel, 3-channel, or custom designed systems are available
- 17 chambers mounted around a semicircle of 1 meter radius provides 180° coverage with overlap between chambers

Features

- Fast full spherical scan (2 minutes)
- Direct readout in mR/hr
- Reliable modular construction
- Expandable from one to eighteen channels
- Highest channel readout

Applications

The only sure way to demonstrate compliance to leakage radiation standards is with a full spherical scan of the x-ray emitting products, such as diagnostic x-ray tubes. X-ray leakage tests are made easy for x-ray tube manufacturers and tube reloaders. A rapid 100% production test can be less expensive than design analysis, analysis of tolerances and tolerance buildup, and costly quality control procedures and inspection. With the X-Ray Leakage Detection System, you can perform a full scan of your product in only two minutes.

System configurations

A basic three-channel leakage radiation system can be assembled from an Ion Chamber/Electrometer Module used in combination with one Model 10970 Mainframe, two Model 70010A Dual Channel Comparator Modules, one Model 70020 Reference Control Module, and one High Voltage Power Supply. You can expand this system up to 18 channels to provide a full spherical scan by adding plug-in modules. Listed below are two standard system configurations: a 17-channel and a 3-channel system. Any number of channels from 3 to 18 may be ordered. Details of system modules are described in the table.

Leakage detection system configurations

	17-channel system	3-channel system
Module/Description	No. req.	No. req.
96010A Ion Chamber w/NIST traceable calibration	17	3
50300A Electrometer*	17	3
10970 Mainframe†	1	1
70010A Dual Channel Comparator**	9	2
70020 Reference Control Module	1	1
55 foot interface cable	9	2
High-voltage supply	1	1
Ion chamber mounting ring and hardware	1	--
High-voltage cable (17-channel)	1	--
Rack Cabinet Control Module	1	--
High-voltage cable (3-channel)	--	1
Calibration current source	1	1
* Requires one per channel		
** Requires two per channel		
† Specify 120 or 22 VAC		

NOTE: Typical systems are configured with either 17 channels or 3 channels. All systems are custom designed. Spare components are recommended. On-site installation is recommended. Calibration source and standard NEMA® rack cabinet are required.

Mainframe

(Model 10970)

- Pre-wired mainframe
- Expandable system **Rack Mount Control Module**
- Line-operated
- Self-checking



The Model 10970 Mainframe includes a 19 inch rack mount cage, 7 inches high which will accept up to nine Model 70010A plug-in Dual Channel Comparator Modules and one Model 70020 Reference Control Module. The Mainframe includes power supplies (± 15 volts and 6.3 VDC) for up to eighteen Model 50300A Electrometers, nine Model 70010A Dual Channel Comparators, and one Model 70020 Reference Control Module.

Model 50300A Electrometers are connected to the back panel of the Mainframe. Power required is 120 or 220 VAC (specify at time of order). An output connector provides the contacts of the fault relay as well as the output of the highest channel in those systems using the Model 70010A.

Ion Chamber/Electrometer Module

(Models 96010A/
50300A)

- Fully-guarded air-equivalent chamber
- NIST-traceable calibration
- Electrometer directly connected to ion chamber
- Low-noise, high-speed performance



Ion Chamber/Electrometer Module
(Models 96010A/50300A)

The Model 96010A Ion Chamber is constructed of air-equivalent plastic and is vented. The chamber has a window area of 100 cm² (5 x 20 cm), and a volume of 500 cm³.

When used to demonstrate compliance to the Radiation Control Act, seventeen chambers mounted around a semicircle of 1 meter radius provide 180° coverage with overlap between chambers.

The Model 50300A Electrometer may be combined with a Model 96010A Ion Chamber to eliminate the problems associated with high-impedance cable. The rise time is approximately 250 msec (10-90%) and the output noise is less than 10 mV, peak-to-peak (1 mR/hr peak-to-peak). Based on the typical characteristics of the Model 96010A Ion Chamber, the electrometer module will be factory adjusted to provide a scale factor of 1 volt for 100 mR/hr NIST traceable ion chamber calibration.

Dual Channel Comparator

(Model 70010A)

- Bright visual fault indication
- Altitude compensation
- Direct readout in mR/hr
- Front panel monitoring and test
- Readout of highest channel



Dual Channel Comparator
(Model 70010A)

The Model 70010A Dual Channel Comparator compares outputs of the Model 96010A/50300A Ion Chamber/Electrometer and any desired reference radiation level. You can select an input reference voltage of 500 mV (50 mR/hr) to demonstrate compliance to the Radiation Control Act. If the output of the ion chamber/electrometer exceeds this value, a bright red light will go on and remain on until manually reset.

The Model 70010A Module has an adjustable gain and offset for the output of the Model 50300A Electrometer. Gain is adjusted to compensate for altitude, so readings are correct for installations as high as 8000 feet above sea level. You can typically disregard normal changes in barometric pressure as they will not exceed $\pm 3\%$. To correct reading for normal barometric pressure changes, use the correction table (included).

The Model 70010A has two independent channels so you can connect each channel to a Model 50300A Electrometer. Fifty-five feet of cable (included) connect the electrometers to the back of the Model 10970 Mainframe. The Model 10970 supplies all required power.

The Model 70010A permits the highest output of all electrometers on the system to be read. You can use this output as the Y-axis on an X-Y plot to demonstrate that no output exceeds the 100 mR/hr legal level.

Reference Control Module

(Model 70020)

The Model 70020 Reference Control Module sends a calibrated rejection level to the Model 70010A Dual Channel Comparators. You can set this level to between 0 and 100 mR/hr with a direct-reading dial setting.

The Model 70020 also provides a convenient voltage source to check the actual trip levels of each Dual Channel Comparator Module. All comparator modules are forced into the "fault" indication when the test switch is pressed. This quickly checks all channels.

There are two operational modes: in the Interrupt mode a fault relay closes whenever any channel goes above the trip level; in the Continuous mode the relay is not activated. The relay contacts can activate an alarm or stop the drive motor when the system is scanning.



Reference Control Module
(Model 70020)

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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AEC-6 System

Model 07-AEC6



- May be used to calibrate/adjust AEC systems without film
- May be used for performance assessment of mammo/radiographic AEC systems without film
- Can be calibrated to the local screen film/processing conditions

Introduction

The AEC-6 System, consisting of an electronic screen-film cassette, an electronic interface box, and a Palm Pilot (or computer software), can assess the performance and calibration of mammo/radiographic AEC systems and can provide information to estimate the relative speed and gradient of screen-film and processing systems. Once the AEC-6 meter is calibrated to the screen-film characteristics and processing conditions, the meter provides the user with a readout in optical density for each exposure made.

Applications

Service engineers use the AEC-6 meter to calibrate and make adjustments to mammo/radiographic AEC systems instead of using film. Medical Physicists use the AEC-6 for performance assessment of mammo/radiographic AEC systems and based on the assessment, make recommendations for corrective action. Radiation inspection officers use the AEC-6 to assess mammo/radiographic calibration and suggest corrective action to x-ray equipment operators. Technologists use the AEC-6 meter for teaching and routine quality control evaluation and balancing optical density from room to room.

Features

The electronic cassettes, once calibrated, mimic the screen-film systems used in a radiology department. Each electronic cassette contains circuitry that analyzes the light output from the intensifying screen(s) and converts the light into a digital electrical signal which is fed to an onboard microprocessor for analysis. The microprocessor sends information via the interface box to a Personal Data Assistant, PDA (Palm Pilot) or computer for software analysis using mathematical algorithms that converts the microprocessor information to optical density readouts.

Specifications

AEC-6 System

Accuracy Optical Density (OD) prediction ± 0.1 OD ranging from 0.5 to 3.0

Dynamic range 0.2 to 4.0 OD

Setup and reset Manually using PDA or computer keys

Controls Manually using PDA or computer keys

Functions OD, Time, AEC#

Power requirements 2 externally-accessible 9 V batteries (Duracell MN 1604 or equivalent)

Typical battery life > 40 hr

Operating environment 59° to 95°F (15° to 35°C)

Electronic cassettes

The electronic cassettes (mammography and radiography) simulate the film-screen cassette used in the radiology department and provide digital electrical signals to the PDA or computer.

The mammographic cassette is specifically designed to mimic the attenuation of the film-screen cassette. An accessible compartment (drawer) allows various thicknesses of aluminum to be placed in the cassette to match the attenuation of the film-screen cassette.

Mammographic cassette

Dimensions 7.5 x 14.37 x 0.5 in (19 x 36.5 x 1.3 cm)

Weight 4 lb (1.8 kg)

Radiographic cassette

Dimensions 10.5 x 10.5 x 0.5 in (26.7 x 26.7 x 1.3 cm)

Weight 1.7 lb (0.80 kg)

Mammographic attenuation filters

Six type 1100 aluminum filters

Five Filters 0.2 mm thickness by 10 x 8.1 cm

One Filter 0.1 mm thickness by 10 x 8.1 cm

Electronic interface module

Interface box allows the electronic cassettes to be connected to the PDA or computer.

Dimensions 4.92 x 4.13 x 1.96 in (12.5 x 10.5 x 5 cm)

Weight 2.2 lb (1.0 kg)

Personal Data Assistant (PDA) Palm Pilot M105

Computer software CD-Rom containing compiled AEC-6 program (Windows® version 95 or higher)

Cassette/interface cable 10 foot 25-pin straight thru serial cable F/M (DB-25 male and DB-25 female)

Interface/computer cable Serial cable provided with Palm Pilot or optional 15 foot Serial Mouse Extension Cable (DB-9 male and DB-9 female) if using computer

Optional accessories

AEC-6 Interface (Model 07-AEC6I)

Mammographic Cassette and Adapter (Model 07-AEC6MC)

Radiographic Cassette (Model 07-AEC6RC)

Palm Pilot with Software (Model 07-AEC6PP105)

Computer Software for AEC-6 systems (Model 07-AEC6SW)

Available model(s)

07-AEC6 AEC-6 System, consists of AEC-6 Interface, Mammographic Cassette and Adapter, Radiographic Cassette, and Palm Pilot with Software (or computer software)

07-AEC6M AEC-6 Mammo System, consists of AEC-6 Interface, Mammographic Cassette and Adapter, and Palm Pilot with Software (or computer software)

07-AEC6R AEC-6 Rad System, consists of AEC-6 Interface, Radiographic Cassette, and Palm Pilot with Software (or computer software)

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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07-AEC6-ds rev 1 07 mar 03

MAS-5 Meter

Model 07-MAS5



Diagnostic Imaging

Introduction

For many years, service engineers have been asking for a meter that measures mAs, exposure time, and mA at the same time. Diagnostic Imaging Specialists has produced this meter with extra features. Not only will the MAS-5 provide mAs, exposure time, and mA, but the meter provides mA waveform information. The MAS-5 displays three 50 milliseconds mA waveform samples so that radiographic and mammographic pre-heat circuits can be analyzed and adjusted without using an oscilloscope. Based on feedback from field service engineers, the MAS-5 also has a button that when pushed causes the meter to ignore the first 10 milliseconds of the mA waveform.



- An intelligent meter that measures mAs, exposure time, and mA all at the same time
- Provides mA waveform information
- At a button press, the MAS-5 meter will ignore the first 10 milliseconds of exposure
- AC and DC inputs

Applications

The MAS-5 intelligent meter uses a microcontroller to analyze the digital mA waveform and accurately displays the values essential for analyzing and calibrating radiographic and mammographic equipment.

The four line LCD displays the following:

Line 1 **mAs** (average tube current (mA) times mA waveform exposure time)

Line 2 **Exposure Time** (mA waveform exposure time in seconds)

Line 3 **mA** (average tube current (mA) over the entire mA waveform)

Line 4 **Three sample mA waveform values:**

1st waveform value represents the average mA for the 1st 50 milliseconds of exposure

2nd waveform value represents the average mA for the 2nd 50 milliseconds of exposure

3rd waveform value represents the average mA for the 3rd 50 milliseconds of exposure

Features

- A button that causes the meter to ignore the first 10 milliseconds of exposure
- A diagnostic power-up sequence to indicate operational status
- Auto LCD update
- Optional manual reset
- Automatic power-down when meter is not used for more than five minutes
- Displays when an exposure is detected
- Low battery indication

Specifications

Reset Auto LCD update; optional manual reset

Dynamic range 10 to 2000 mA; 0.1 to 999.9 mAs; 1 ms to 6.535 sec

Accuracy

mAs ± 0.1 mAs or 1% (whichever is greater)

mA \pm mA or 0.5% (whichever is greater)

Time ± 1 ms or 1% (whichever is greater)

Operating temperature 59° to 95°F (15° to 35° C)

Power requirements One 9 V battery

Typical battery life > 40 hr

Size 4 x 6.5 x 0.33 in (10.16 x 16.51 x 0.84 cm)

Weight 0.625 lb (0.28 kg)

Available model(s)

07-MAS5 MAS-5 Meter

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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07-MAS5-ds rev 1 07 mar 03

Radchex/AEC

Model 07-RCX

- An intelligent meter that monitors daily quality control of the entire radiographic machine
- Convenient, fast, and accurate assessment of the AEC Systems' performance
- Separates x-ray machine from film processing quality control
- For AEC mammography applications, see Mamchex/AEC (Model 07-MCX)

Features

- Diagnostic power-up sequence to indicate operational status
- Manual reset using the Power/Reset button
- Automatic power-down when meter is not used for more than one minute
- Displays when an exposure is being made
- Displays exposure time in milliseconds
- Low battery indication

Specifications

Reset Manual using Power/Reset button

Operating temperature 59° to 95°F (15° to 35°C)

Dynamic range 0 to 999.9

Power requirements Two 9 V batteries

Radiation exposure time accuracy ± 1 millisecond or 1%, whichever is greater

Introduction

Radiographic machines incorporating calibrated automatic exposure control (AEC) systems are designed to maintain constant film density regardless of the x-ray energy (kVp) used or patient thickness/density. The Radchex/AEC meter provides a convenient, fast, and accurate assessment of the performance of the AEC system and provides daily quality control of the entire radiographic machine.



Applications

The Radchex meter consists of a calibrated electronic radiographic cassette that responds to radiation the same way a film/screen cassette responds to light from intensifying screens. No film is needed to determine the performance of the AEC system or daily quality control of the machine. If the AEC system is calibrated properly and the machine doesn't drift, then the digital number displayed by the Radchex meter should always be the same from day-to-day or for various x-ray energies or patient thickness.

To convert the Radchex number to an optical density number, software is provided for the conversion; however, in most cases this conversion is unnecessary since the Radchex number should remain constant when kVp and thickness changes.

When using the meter to assess AEC performance or daily machine quality control, no film/screen has to be used, therefore eliminating processing variations in the assessment.

The Radchex is easy to operate:

1. Slip Radchex into the Bucky, the same as the film/screen cassette, until it locks into place.
2. Turn it on.
3. Push the reset button, wait till the LCD says "Ready for Exposure."
4. Expose it.
5. Read the number and compare it to a calibration number. The number tells whether the operator has a "go" or "no go" situation.

Short/Long term drift < 0.5%

Typical battery life > 40 hr

Size 10.5 x 10.5 x 0.5 in (26.7 x 26.7 x 1.3 cm)

Weight 3.9 lb (1.8 kg)

Available model(s)

07-RCX Radchex/AEC, consists of M/R Interface and Radiographic Cassette

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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07-RCX-ds rev 1 07 mar 03

X-Ray & CT Exposure Measurement Instrument

Victoreen Model 660



Diagnostic Imaging

Introduction

The Model 660 instrument is the optimum choice for flexibility in x-ray and computed tomography (CT) exposure measurement. The Model 660 consists of a readout, carrying case, and choice of four optional ion chamber based probes with built-in calibrations, allowing interchangeability to customize the instrument to a particular measurement requirement. The Model 660 instrument is suitable for use for energies ranging from mammography through 1.3 MeV.

The Model 660 Measurement readout is part of a complete x-ray and CT exposure measurement instrument which saves time and effort during routine diagnostic quality assurance measurements. This portable and light weight readout unit with large three digit LED display can be used with any of the four optional interchangeable ion chamber based probes to cover a range of 1.0 μ R to 100 R in the exposure mode and 0.1 mR/min to 1000 R/min in the rate mode. The Model 660 readout may be line operated or powered by NiCad rechargeable batteries.

Each Model 660 Series ion chamber based probe contains an electrometer that permits probe calibration independent of the readout. The ion chamber current signal is then digitized, and this digital signal is then transmitted over the cable to the readout resulting in a virtually noise free transmission of data, unaffected by cable length or stress. Cables are available up to 250 feet (about 76 meters).

Applications

The Model 660 X-Ray & CT Exposure Measurement Instrument is suitable for in-beam and scatter exposure and exposure rate measurements of diagnostic x-ray beams, mammographic range x-ray machines, as well as CT output measurements, depending on the ion chamber based probe(s) selected. The ease of portability of this instrument makes it an excellent choice for measurements necessary in maintaining a diagnostic quality assurance program for several machines and modalities.



- Digital, auto-ranging, data display
- Electrometer in probe handle
- Digital signal transmitted over shielded cable for noise immunity
- Automatically calibrated and adjusted for any 660 series probe
- Available in SI units
- Includes fitted carrying case
- Exposure or exposure rate modes
- Rechargeable batteries or AC power
- Built-in calibration auto-ranging
- Unit is very portable

Specifications

Range 3-decade auto-ranging and auto-indicating with proper decimal placement and measurement units. See selected ion chambers' specifications for specific ranges

Calibration Unnecessary. Response depends on frequency of internal crystal oscillator ($\pm 0.01\%$ from 10° to 40°C)

Accuracy Depends only on crystal oscillator frequency in Exposure Rate mode. See selected probe's specifications for measurement accuracy

Controls *Function switch:* selects off, total exposure or exposure rate modes

Reset switch: selects run, stop, or reset (in Total Exposure Mode)

Intensity knob: controls readout brightness

Error prevention logic

Low battery - auto turnoff

OverRange indicator

Excessive intensity indicator

Probe disconnected indicator

Display 3-digit LED legends

R/min, R/hr, mR/hr, R, mR, mSv/min, mSV/h, mSv, μ Sv

Battery life 6 hours between charges at 20°C with normal usage. Automatic shutoff when charge drops below usable level

Battery complement One 67.5 V collecting potential (shelf-life) and 4 rechargeable 1.25 V "D" batteries for instrument power

Battery charge time 10 hours to full recharge at 20°C (instrument OFF)

CE Tested. Meets applicable standards.

AC recharge input 117 V $\pm 15\%$ 50/60 Hz power cord furnished 230 V $\pm 15\%$ available on special order

Dimensions 5.50 (w) x 8.50 (d) x 4.50 in (h) (14 x 21.6 x 11.4 cm)

Weight 7 lb (3.2 kg) net

Accessories supplied

Includes foam-lined carrying "brief" case

2 and 10 ft ion chamber cables

An AC recharging cable

The instruction and maintenance manual

Probe (to fit in case) available separately

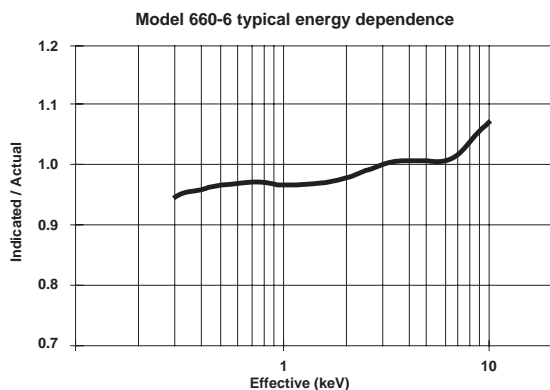
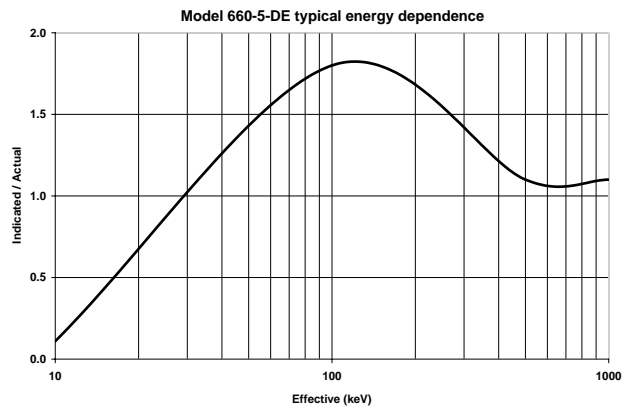
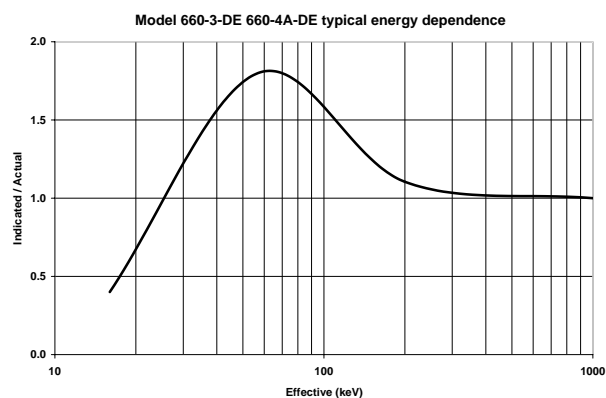
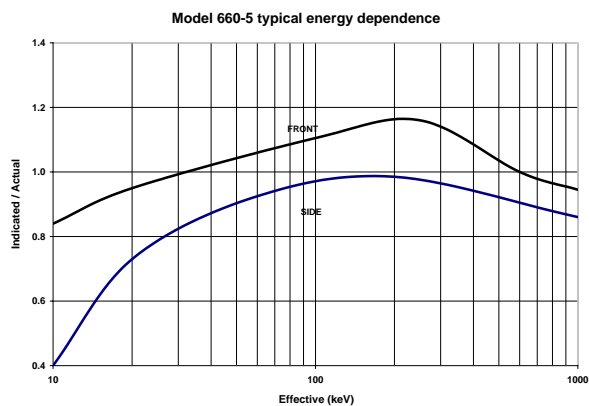
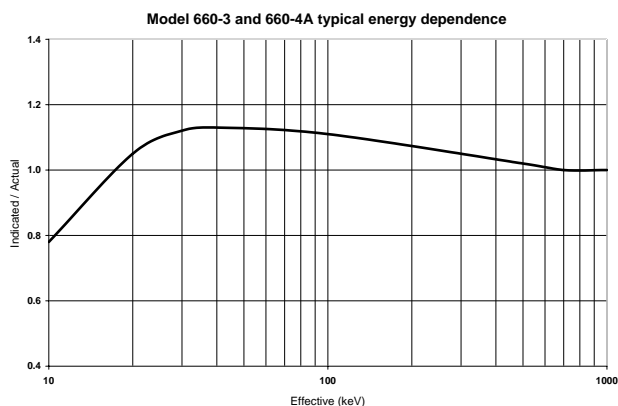
Available model(s)

660 X-Ray & CT Exposure Measurement Instrument

See next page for available ion chambers.

Ion Chambers

	660-3 660-3DE	660-4A 660-4DE	660-5 660-5DE	660-6
Application	Diagnostic Beam Measurement		Scatter	CT
Probe volume	4 cm ³		400 cm ³	3.2 cm ³
Measurement area	10 cm ²		100 cm ²	NA
Maximum rate	999 R/min	99.9 R/min	9.99 R/hr	999 R• cm/min
Maximum exposure	99.9 R	9.99 R	99.9 mR	99.9 R• cm
Resolution on most sensitive	Rate 10 mR/min	1 mR/min	0.1 mR/hr	0.01 R• cm/min
	Exposure 1 mR	0.1 mR	1 µR	0.001 R• cm
Intensity limit for 99% collection efficiency	40 R/sec	1.8 R/sec	10.8 R/hr	985 R/min



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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660-ds rev 2 25 mar 03

RAD-CHECK® PLUS

Victoreen Model 06-526



“The original” x-ray exposure meter

Introduction

Proven RAD-CHECK technology specifically designed to provide you with the ultimate in versatility and cost-effective operation.

Accurate, lightweight, portable...this “industry standard” enables you to gain the critical edge in your QC program.

Applications

Battery operation and built-in detector virtually eliminate setup time. Just place the meter or external ion chamber on x-ray table; collimate, shoot, and read the result.

Precision ion chamber and digital display ensure accuracy plus easy readability.

Specifications

Ranges 0.001 to 2 R, 0.01 to 20 R/min

Internal chamber 30 cc volume, energy response $\pm 5\%$ from 15 to 65 keV (30 to 150 kVp filtered). 20.5 cm² (5.1 cm Ø) effective measurement area. Center of chamber 1.03 cm below top of chamber

Standard calibration At 75 kVp with 4 mm Al filtration at 22°C and one atmosphere

Reproducibility Within 2% short-term over 100 mR to 2 R range (1 to 20 mGy)

Electrometer drift 0.5 to 1 mR/min typical; 6 mR/min maximum (5 to 10 µGy; 60 µGy/min maximum)

Maximum exposure rate Minimum 90% collection efficiency at 20 R/sec

Automatic reset Resets display to zero; can also be reset manually

Operating temperature 10 to 40°C

Relative humidity 0 to 90%, non-condensing

Display 3.50 x 0.50 inch LCD, low battery indicator

Controls Auto or manual reset selector. Display zero reset button. Dose or dose rate output selector. Integral or remote ion chamber selector. On/off switch

Power requirements 9 V alkaline battery, > 100 hours operation (50 hours in manual reset mode)

Dimensions 6 (w) x 6.25 (d) x 2.75 in (h) (15.25 x 15.9 x 7 cm)

Weight 1.125 lb (0.51 kg)

Optional accessories

Radiographic Ion Chamber, 30 cm³ (Victoreen Model 6000-528): energy response: within 7% from 30 to 150 kVp (15 to 65 keV); cable: 15 ft (4.5 m); chamber dimensions: 4 x 4 x 0.54 in thick (10.2 x 10.2 x 1.4 cm)

Mammographic Ion Chamber, 3.3 cm³ (Victoreen Model 6000-529): energy response: within 5% from 0.2 to 5.0 mm Al HVL (16 to 90 kVp); cable: 15 ft (4.5 m); chamber dimensions: 4 cm Ø x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber. Option: Probe Holder (Model 6000-529-95) for BRH2 test stand

CT Ion Chamber, 3.2 cm³ (Victoreen Model 6000-100): energy response: $\pm 5\%$ from 1 to 10 mm Al HVL; cable: 3 ft (0.9 m); sensitive length: 4 in (10.0 cm); chamber inside Ø: 0.25 in (6.4 mm)

DI

Diagnostic Imaging

RAD-CHECK PLUS can perform:

- Entrance skin exposure measurements (ESE)
- Fluoroscopy exposure measurements
- Exposure checks; radiographic (mR/mAs)
- Beam quality; half value layer (HVL)
- mAs reciprocity; mA station checks...plus many others, depending on the remote external chambers used
- The American College of Radiology (ACR) recommends this type of product in their quality assurance program

Features

- Fast and easy-to-use. Battery operation and built-in detector eliminate setup time
- Measures dose up to 2 R; dose rate up to 20 R/min
- Energy response is $\pm 5\%$ from 30 to 150 kVp for the RAD-CHECK PLUS internal chamber
- Optional remote chambers for mammographic and cine imaging systems
- Extremely compact...6 x 6.25 x 2.75 inch; weighs only 1.125 lb

Image Intensifier Ion Chamber, 150 cm³ (Victoreen Model 6000-530B): energy response: $\pm 10\%$ from 1.8 to 10 mm Al HVL; cable: 10 ft (3.0 m); chamber dimensions: 6.26 x 8 x 0.63 in (15.9 x 20.6 x 1.6 cm)

Carrying Case (Model 89-525): holds RAD-CHECK PLUS and accessories

Available model(s)

06-526 RAD-CHECK PLUS

06-526-2200 RAD-CHECK PLUS, SI Units

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.

CE Tested. Meets applicable standards.

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RAD-CHECK® MICRO-R

Victoreen Model 06-526-5240

Performs:

- Entrance skin exposure measurements (ESE)
- Fluoroscopy exposure examinations
- Exposure checks; radiographic (mR/mAs)
- Beam quality; half value layer (HVL)
- mAs reciprocity; mA station checks...plus many others, depending on the remote external chambers used
- The American College of Radiology (ACR) recommends this type of product in their quality assurance program

Features

- Fast and easy to use
- Dual-range for high and low dose rate fluoroscopy
- Optimized for use with our 100 cm³ Image Intensifier Ion Chamber (Model 06-524-3000)
- Portable, no AC power cords

Introduction

This state-of-the-art electrometer is designed for measuring dose and rate under high and low dose rate conditions. It is excellent for cardiac cath and fluoroscopy and the perfect choice for tight budgets.

RAD-CHECK MICRO-R technology gives you the ability to measure dose and rate in fluoroscopy with the accuracy and reliability of equipment that costs two or three times more.



X-ray exposure meter

Applications

With the RAD-CHECK MICRO-R, measurements are easy to perform and highly accurate. Incorporate RAD-CHECK MICRO-R into your routine QC program for fluoroscopy now, and accurately measure what your patient exposures actually are from fluoroscopically-guided procedures. This precision electrometer also features a tilt-stand for convenient adjustment of display visibility.

Specifications

Ranges

Low: 0.01 to 19.99 mR; 0.1 to 199.9 R/min

High: 0.01 to 19.99 R; 0.1 to 1999 R/min

Standard calibration At 75 kVp with 4 mm Al filtration at 22°C and one atmosphere using Model 06-524-3000 chamber

Reproducibility Within 2% short-term over 100 mR to 2 R range (1 to 20 mGy)

Maximum exposure rate Minimum 90% collection at 20 R/sec

Electrometer drift

Low Range: 1 mR/min typical; 6 mR/min maximum

High Range: 10 µR/min typical; 60 µR/min maximum

Manual reset Resets display to zero

Operating temperature 50° to 104°F (10° to 40°C)

Relative humidity 0 to 90%

Display 3.50 x 0.50 inch LCD, low battery indicator

Control Reset button, dose or dose rate output selector, high or low range selector, on/off switch

Power requirements 9 V alkaline battery, > 50 hour life

Dimensions 6 (w) x 6.25 (d) x 2.75 in (h) (15.25 x 6.25 x 7 cm)

Weight 1.125 lb (0.51 kg)

Optional accessories

Carrying Case (Model 89-525): holds RAD-CHECK MICRO-R and accessories

Available model(s)

06-526-5240 RAD-CHECK MICRO-R

06-526-5242 RAD-CHECK MICRO-R, SI Units

(Must have Model 06-524-3000 chamber and must be calibrated at the same time)

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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06-526-5240-ds rev 3 10 mar 03

Wide-Range, Mammographic, & Dental kVp Meters

Models 07-494, 07-492, 07-479



Diagnostic Imaging

Introduction

Whether you choose the Wide-Range, Mammographic, or the Dental Digital kVp Meter, you will get quick and accurate measurements of your diagnostic x-ray generator tube potential. These instruments need no connection to the x-ray generator.



- Choose from three kVp meters
- Easy read digital display
- Painless setup

Applications

These lightweight, rugged units are extremely easy to use: simply place on the x-ray table, with the detector facing the x-ray source. With the beam's central ray centered on the detector, an exposure is made, and the reading appears immediately on the large, easy-to-read liquid crystal display.

Unique features are provided to ensure maximum efficiency and accuracy. Readings remain on display until the next exposure is made, at which time the reading is automatically updated. Automatic display indicators tell you when adjustment of exposure factors or battery replacement is necessary. Neither remote-control cables nor time-consuming manual re-zeroing are needed.

A BNC connector is provided for radiation waveform display on a storage oscilloscope.

Features

- Automatic display reset
- No remote control cables
- Scope output for waveform analysis
- Compact, lightweight, and battery-operated

Specifications

Ranges

Wide-Range

Low: 50 to 90 kVp, 0.1 kVp resolution

High: 80 to 150 kVp, 0.1 kVp resolution

Mammographic 24 to 40 kVp, 0.1 kVp resolution

Dental 45 to 90 kVp, 0.1 kVp resolution

Accuracy

Wide-Range $\pm 3\%$ or 3 kVp, whichever is greater

Mammographic $\pm 3\%$ or 1.5 kVp, whichever is greater

Dental $\pm 3\%$ or 3 kVp, whichever is greater

mAs requirements

Wide-Range (45.7 cm SDD) 18 mAs at 120 kVp; 50 mAs at 60 kVp, single phase. Minimum exposure time 1/20 (0.05) sec

Mammographic (25 cm SDD) 100 mAs at 24 kVp. Minimum exposure time 1/20 (0.05) sec

Dental 8.5 mAs at 45 kVp; 0.026 mAs at 90 kVp

Controls

Wide-Range On/off, single/three-phase and range selection switch

Mammographic On/off and Moly/Tungsten selector switches

Dental On/off and single/three-phase selector switches

Operating temperature 50° to 104°F (10° to 40°C)

Relative humidity 0 to 90%, non-condensing

Power requirements 9 V alkaline battery, 150 hours operation

Display 3.50 x 0.50 inch LCD. Automatic indication of (a) low battery condition, (b) need to adjust exposure factors

Output signal BNC connector for waveform analysis

Dimensions 8 (w) x 6 (d) x 2.50 in (h) (20 x 15 x 6 cm)

Weight 2 lb (0.9 kg)

Optional accessories

Carrying Case (Model 89-473)

Available model(s)

07-494 Wide-Range Digital kVp Meter

07-492 Mammographic Digital kVp Meter

07-479 Dental Digital kVp Meter

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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07-494-ds rev 2 10 mar 03

Service & Quality Control Kits

Model 18-526 Series

- Each kit contains the essential instruments that service personnel, physicists, and QC technicians rely on to check and calibrate today's most vital equipment
- Every instrument selected for inclusion in our Service/QC kits was chosen for its reliability, accuracy, and ease-of-use
- Each Service/QC kit includes an easy-to-carry, durable, insulated carrying/storage case, to keep your equipment safe, wherever you go
- Optional mAs meter available

Cardiac Cath/Special Procedures QC Kit (Model 18-526-3000)



Contains the essential non-invasive test tools for special procedures:

- RAD-CHECK® MICRO-R (Model 06-526-5240)
- Wide-Range kVp Meter (Model 07-494)
- Digital X-Ray Pulse Counter/Timer (Model 07-453)
- Image Intensifier Ionization Chamber, 150 cm³ (Model 06-524-3000)
- Carrying Case (Model 89-426)

Mammography QC Kit (Model 18-526-1000)

Everything you need to make compliance with ACR and MQSA regulations easy:

- RAD-CHECK® PLUS (Model 06-526)
- Mammographic kVp Meter (Model 07-492)
- Digital X-Ray Pulse-Counter/Timer (Model 07-453)
- Mammographic Ion Chamber, 3.3 cm³ (Model 6000-529)
- Carrying Case (Model 89-426)



Radiography/Fluoroscopy QC Kit (Model 18-526-2000)

All the test devices necessary to perform QC in radiographic and fluoroscopic suites:

- RAD-CHECK® PLUS (Model 06-526)
- Wide-Range Digital kVp Meter (Model 07-494)
- Digital X-Ray Pulse-Counter/Timer (Model 07-453)
- Radiographic Ion Chamber, 30 cm³ (Model 6000-528)
- Carrying Case (Model 89-426)



Dental QC Kit (Model 18-526-4000)

Service and QC will be easier and more cost-effective than ever with this comprehensive kit:

- RAD-CHECK® PLUS (Model 06-526)
- Dental kVp Meter (Model 07-479)
- Digital X-Ray Pulse-Counter/Timer (Model 07-453)
- Remote Sensor (Model 07-453-2000): for use with Model 07-453
- Radiographic Ion Chamber, 30 cm³ (Model 6000-528)
- Carrying Case (Model 89-426)



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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Digital X-Ray Pulse Counter/Timer

Nuclear Associates Model 07-453



Diagnostic Imaging

Introduction

Poor or inconsistent quality of x-ray images is often caused by inaccuracy or inconsistency of the generator's timer. This results in repeat examinations, which cost time and money. A poorly maintained system is also a hazard to the patient; when a malfunction in the timer occurs, the patient may receive unnecessary radiation doses. It is for important reasons such as these, that regular monitoring of x-ray systems and timers is an essential part of a good quality assurance program.



Applications

The Digital X-Ray Pulse Counter/Timer from Nuclear Associates is a non-invasive, solid-state instrument that can be used to measure the exposure time of either AC or DC x-rays. It can also measure the duration of radiation output produced by a wide variety of medical and dental x-ray systems. A sensitive x-ray detector in the instrument allows direct measurement of exposure from the x-ray head. Pulses produced by half-wave and full-wave x-rays are measured as 60 or 120 pulses per second. For DC, capacitor discharge and three-phase x-rays, the Digital X-Ray Pulse Counter/Timer measures the exposure time in milliseconds. When testing x-ray timers and controls, the time of relay contact closure can be measured using the AC input feature.

An output connector on the side of the Digital X-Ray Pulse Counter/Timer allows the user to view a radiation output waveform on an oscilloscope. Using this feature, technicians can diagnose and troubleshoot problems with x-ray generators.

- Easy-to-read digital display
- Automatic reset; holds a reading until the next exposure
- Battery-operated, light weight; fits easily into tool box or pocket
- Output connector (included) allows a radiation output waveform to be viewed on an oscilloscope
- For added operator convenience, the remote sensor is available as an option

Features

- Measures duration of radiation output produced by x-ray generators
- Measures AC or DC x-rays
- Gives direct readings (time or pulses)
- Can be used for medical or dental x-ray systems
- Designed specifically to allow service personnel to accurately and easily assess the performance of x-ray generators, timers, and controls
- Reduces repeat examinations; saves time and money

Specifications

Accuracy

AC input ± 1 count

DC input 2%, ± 1 count

X-ray detection ± 1 count

Sensitivity

AC input 65 VAC minimum

X-ray input 50 kVp, 5 mA at 5 cm from top surface of case, pointed to target on case

Range 9999 pulses; 9999 milliseconds

Display 0.4 inch liquid crystal

Power requirements 9 V battery, alkaline or equivalent, 24 hours continuous; typically 6 months of normal use

AC input jacks 130 volts AC maximum; 65 V AC minimum; input circuit not affected by reversed polarity

Controls/Indicators

Three-position switch: Pulse, Off, Milliseconds

Four-digit LCD (0.4 inch character)

Low battery indicator

"Low Batt" appears in display when battery voltage reaches $4.8 \text{ V} \pm 0.5 \text{ V}$

Power-on: LED (green); oscilloscope output

Remote sensor The optional Remote Sensor can be used when the user would like to have the unit in their hand, so that readings can be seen without having to walk back-and-forth from the x-ray table to the control room after each exposure. The Remote Sensor can also be used when placement of the Digital X-Ray Pulse Counter/Timer in the beam is questionable, such as in a Panorex dental x-ray unit

Output signal BNC connector for waveform analysis

Connections None required for direct exposure measurement

Dimensions 3.15 (w) x 5.8 (d) x 1.6 in (h) (8 x 14.7 x 4 cm)

Weight 0.5 lb (0.21 kg)

Optional accessories

Remote Sensor with 10 ft cable (Model 07-453-2000)

Oscilloscope Leads (Model 88-453)

Carrying Case (Model 89-453)

Available model(s)

07-453 Digital X-Ray Pulse Counter/Timer

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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07-453-ds rev 2 26 mar 03

Dual-Range Digital mAs Meter

Nuclear Associates Model 07-487



- Accurately measure x-ray generator mAs values
- Meets today's QC needs for accuracy and dependability
- Used for calibration of high current and phototimer accuracy
- Calibrated directly in mAs; no calculations required
- Hand-held, battery operated, and lightweight

☞ **Tested.** Meets applicable standards.

Introduction

The Model 07-487 Dual-Range Digital mAs Meter allows service personnel to check and adjust the mA settings of x-ray generators. This easy-to-use instrument is calibrated directly in mAs, thus eliminating the need for the calculations typically required with more complicated and expensive equipment.

The digital mAs meter is very sensitive. It can measure increments of 0.1 mAs. It has a low range of 0 to 199.9 mAs; push a button and the range expands to 0 to 1999 mAs.

Applications

The greatest use for the Model 07-487 mAs meter is in calibrating the high-current, short-time station where a conventional mAs meter is precluded by tube ratings. The instrument can be used (after verifying the generator accuracy) to set all mA stations and check that phototiming error does not exceed the limits of good practice. To use, simply connect the cable to the x-ray generator and make the required exposure. The mAs reading appears instantaneously on the four-digit LCD. A display indicator warns of the need for battery replacement.

Specifications

Range 0 to 199.9 mAs ("+" overrange indicator above 160 mAs). Also 0 to 1999 mAs ("+" overrange indicator above 1600 mAs)

Accuracy $\pm 2\%$ of reading

Input 25 to 1000 mA

Drift Zero

Operating temperature 50°F to 100°F (15°C to 30°C)

Controls POWER (on/off), RANGE (high-low), and RESET

Power requirements Single 9 V alkaline battery; typical life 80 hours

Input jack Uses 2 banana jacks

Dimensions 3.50 (w) x 6.63 (d) x 1.38 in (h) (8.9 x 16.8 x 3.5 cm)

Weight 0.44 lb (0.2 kg)

Accessories supplied 24 inch cable with banana plugs and insulated alligator clips on opposite ends

Available model(s)

07-487 Dual-Range Digital mAs Meter

The Wave Precision High-Voltage Divider

Nuclear Associates Model 07-469

- Frequency response is within 2 dB DC, to 100 kHz
- Voltage rating anode to cathode: 160 kVp
- Includes frequency compensation circuit
- Conservative design
- Generous insulation

Specifications

Voltage rating

Anode to cathode 160 kVp

Anode to ground 80 kVp

Cathode to ground 80 kVp

Ratio 100,000: 1, 2% or better

Accuracy $\pm 2\%$ or better

Frequency response Within 2 dB dc, to 100 kHz

Output impedance 1,000 ohms, 1%

Connector Federal standard

Output Anode-Cathode BNC type

Insulation Oil

Dimensions 11 in \varnothing x 12 in (h) (28 x 30.5 cm)

Introduction

The Wave from Nuclear Associates views the anode and cathode waveforms of x-ray tubes at levels up to 150 kVp. Its frequency response is above 100 kHz. The circuit requires no external power and has a ratio of 100,000:1, 100 kVp = 1.0 kVp.

Applications

- Checking the waveform flatness in cine or photofluoroscopy imaging
- Observing the discharge waveform of capacitive mobile x-ray machines
- Examining the voltage compensation of falling load machines
- Checking mammography voltage smoothing and checking for defective contactors
- Checking for spiking at leading edge of waveforms (cable killers)
- Checking voltage commutation of energy switchers (bone cancelling DSA)

Weight 35 lb (16 kg)

Optional accessories

Carrying Case (Model 89-476)

High-Voltage Cable, 5 ft (Model 07-478)

Available model(s)

07-469 *The Wave* Precision High-Voltage Divider, without cables

07-469-4780 *The Wave* Precision High-Voltage Divider, with two cables

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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07-487-ds rev 1 10 mar 03



VeriLUM® Color Dual Mode Pod Model 18-116



Introduction

VeriLUM is an innovative tool for ensuring consistent video display performance. It provides an easy and efficient way to judge whether a video display system is continuing to function normally or needs adjustment or replacement.

Applications

VeriLUM can be used for acceptance testing of a video display system.

It also provides a quick visual check for the user. A SMPTE test pattern is displayed on each video monitor. If the gray scale range and stability is adequate and if all of the monitors have essentially the same look-and-feel, then the video system is ready for use.

VeriLUM makes a rapid set of measurements of the display luminance for tracking consistent performance over time. These measurements take less than 30 seconds per monitor and the history chart can be printed when hard copy documentation is needed.

VeriLUM can be used to perform gamma correction in conformance with the DICOM Part 14 Grayscale Standard Display Function or any other user-defined luminance response model. VeriLUM provides on-board gamma correction using BARCO/Metheus, DOME, Image Systems, Matrox, and RealVision gray scale video boards. If the operating system is Microsoft Windows 98, 2000, XP®, ME®, or NT®, and if the color video card supports downloadable gamma ramps, then VeriLUM will use that capability.

VeriLUM software can be installed on as many workstations as desired; no additional licenses are required. This allows the VeriLUM luminance pod to be taken from workstation to workstation to perform measurements. The VeriLUM luminance pod supports all CRTs and all LCD panels. It uses a serial communications port or a USB port on the PC, thus a simple extension cable (provided) allows for simple connection.



Diagnostic Imaging

- A quality control tool for ensuring consistent color and grayscale video display performance
- Can be used for acceptance testing
- Calibrates luminance to conform with DICOM® Part 14 Grayscale Standard Display Function
- Supports the whole range of Microsoft® Windows® operating systems
- Each VeriLUM package includes: pod and CD-Rom with software and user guide

Specifications

Minimum computer requirements Intel® PC, CD-Rom, Microsoft Windows 95, and a video board capable of 1024 x 768 pixels with a minimum of 256 colors or a grayscale video board

Calibration Traceable to a NIST source

Luminance accuracy $\pm 2\%$

Luminance repeatability $\pm 1\%$

Luminance range 0.05 to 1000 cd/sqm

Weight 1 lb (0.45 kg)

Available model(s)

18-116 VeriLUM Color Dual Mode Pod (please specify Serial or USB connector)

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 Road, Cleveland, Ohio 44139-3303, USA.

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18-116 -ds rev 1 26 jun 03

Precision Photometer

Nuclear Associates Model 07-621



Diagnostic Imaging



- The luminance of view boxes for interpretation or QC of mammography images meets or exceeds minimum levels
- Ambient illuminance levels are below prescribed levels
- Viewing conditions have been optimized
- NIST-traceable
- Performs required ACR (NITS) measurements

Introduction

Photometers are required for medical, scientific, and laboratory applications. This Precision Photometer utilizes a filtered sensor with spectral response tightly calibrated to the CIE photopic response. The illuminance receptors closely follow the Cosine Law relative sensitivity versus angle of illuminance.

The Precision Photometer is a highly accurate instrument designed to measure both illuminance (the amount of light falling on a surface) in lux (lumens per m²) and luminance (the amount of light emitted from a surface) in nit (candela per m²).

Applications

The Precision Photometer easily and quickly verifies that an x-ray collimator light and/or CT system light source used for patient alignment and localization, is in accordance with regulations and guidelines. It also measures the brightness and uniformity of an x-ray view box, quickly detecting non-uniformity (which may appear as artifacts, causing misdiagnosis). This battery-operated photometer has a bright LED display and only two operating controls: "Measure" for taking a reading, and "Range" to adjust the meter display to the light level being measured.

Features

- Easy to read digital display
- Small...convenient to carry and supplied with its own carrying case
- Rugged construction
- Measure button: press it to get continuously updated readings. Releasing the measure button freezes the last reading for convenient reference
- Range button: adjusts the measurement display for the resolution desired
- LED display: visible in very dim light, as well as direct sunlight. LED displays are inherently robust in comparison to liquid crystal displays (LCDs)
- The battery-powered photometer provides tens of thousands of readings

Specifications

Capabilities Illuminance measured in lux (foot-candles); or luminance measured in candela/m² (nit)

Readout display Three-digit LED, 0.25 inch high

Range 0.1 to 999,000 lux or nits (candela/m²), equivalent to 0.01 to 99,000 foot candles

Accuracy Within 7% of full scale range, for light sources between 2500° and 5400° Kelvin

Electrical accuracy 1% plus 2 digits

Sensor Silicon photodiode with photometric filter

Response curve shape Close match to CIE photopic response curve

Power requirements Type A-76 alkaline button cells or silver oxide equivalents

Dimensions 2.8 (w) x 1.2 (d) x 4 in (h) (7 x 3 x 10 cm)

Weight 0.25 lb (0.11 kg)

Optional accessories

Fiber-optic Probe, Flexible 12 inch (Model 07-634) (must be calibrated with meter)

Fiber-optic Probe, Rigid 1 inch (Model 07-634-1000) (must be calibrated with meter)

Rotating Illuminance Receptor (Model 07-634-1100) (must be calibrated with meter)

Carrying Case (Model 89-621)

Available model(s)

07-621 Precision Photometer, with carrying case

07-621-6341 Precision Photometer, with rotating illuminance receptor and carrying case

Factory recalibration available

Optional accessories



Flexible 12 inch Fiber-optic Probe

- Designed for measuring relative densities of areas on radiographs, or luminance of video screens and view boxes



Rigid 1 inch Fiber-optic Probe

- Designed for readings taken against a monitor or view box



Rotating Illuminance Receptor

- Designed for reading background light and field light

Radi-Stat™ Antistatic Solution Model 03-310

- Static control spray used on viewing screens and other static generating surfaces
- Water based, nonflammable, no solvents

Antistatic solution used to eliminate static buildup on viewing screens in x-ray areas. Minimizes dust and dirt on viewing screens and x-rays. Also used on computer screens, carpeting, fabrics, plastics, etc. Can be sprayed, dipped, or wiped.

Radi-Stat is tested by an independent laboratory for surface resistivity and decay rate. Testing was conducted in low humidity levels of 12% to show product effectiveness. Test results available upon request.

Optional accessories

Radi-Stat Antistatic Solution Refill, 1 gal (Model 03-312)

Available model(s)

03-310 Radi-Stat Antistatic Solution Spray Bottle, 4 oz

03-311 Radi-Stat Antistatic Solution Spray Bottle, 32 oz



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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07-621-ds rev 2 10 mar 03

Collimator/Beam Alignment Test Tool

Model 07-661-7662



Diagnostic Imaging

Collimator Verification of the proper alignment of the collimator light field with the x-ray field is essential in radiographic quality control. This device readily indicates a 1% or 2% misalignment at a 40 inch focal-film distance (FFD), but it may be used at any FFD. It consists of a flat 8 x 10 inch plate with a 14 x 18 cm pattern etched on its surface. It can also be used to check fluoroscopy alignment and collimation.

Beam alignment Improper central ray alignment will distort a radiographic image. This device provides a simple means of determining if the x-ray beam is perpendicular to the image receptor and centered with respect to the light field. A steel ball is mounted in the

center of a disc at each end of the 15 cm high clear plastic cylinder. When the balls are positioned over one another and at a right angle to the film, their images will appear as one if the central ray is truly perpendicular to the film. The approximate degree of improper angulation can also be determined.

Specifications

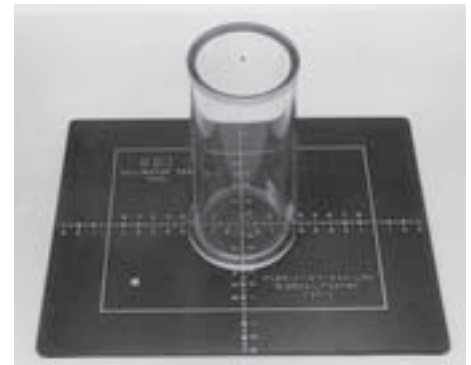
Dimensions beam alignment 5.9 (h) x 2.5 in OD (15 x 006.3 cm)

Weight beam alignment 0.54 lb (0.24 kg)

Weight collimator 0.41 lb (0.19 kg)

Available model(s)

07-661-7662 Collimator/Beam Alignment Test Tool



Grid Alignment Test Tool

Model 07-644

Increased patient radiation dose and reduced image contrast can result from lateral decentering or tilting of a focused grid used in a Bucky apparatus. The Grid Alignment Test Tool is used to check whether a focused grid is aligned properly with the central ray and the center of the film cassette. It consists of a set of three plastic-covered, 0.062 inch thick lead plates: one 9.125 x 3.625 inch test plate, and two 3.56 x 2.375 inch blocker plates. The large test plate contains five 0.375 inch test holes and five 0.062 inch orientation holes.



It's easy to use. The test tool is centered on the x-ray table and fixed in position perpendicular to the grid lines. Five exposures are made, with the x-ray beam sequentially centered on each of five holes, and the optical densities of the hole images are compared. A properly centered and leveled grid will result in equal density changes in the hole images on either side of the central hole. Unequal density changes indicate the need for corrective action.

Specifications

Weight 1.5 lb (0.68 kg)

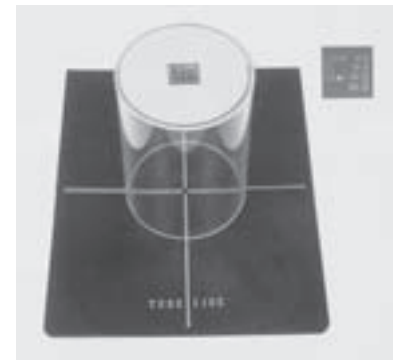
Available model(s)

07-644 Grid Alignment Test Tool, including Three Lead Plates

Focal Spot Test Tool

Model 07-591

Provides a simple "pass-fail" test to determine if an x-ray tube focal spot has been damaged. Consists of a 6 inch high stand with an eleven-group test pattern. Each group has six bars, three of which are positioned at right angles to the adjacent set. The groups diminish in size from 0.66 line pairs/mm (1.75 mm) to 2.88 line pairs/mm (0.3 mm). By observing the radiograph and using the supplied chart, showing resolution vs. focal spot size, the nominal focal spot dimension (in mm) can be determined.



Focal Spot Test Tool shown in use with an optional Flex Film Cassette

Specifications

Dimensions (stand) 2.50 in Ø x 6 in (h) (6.35 x 15.24 cm)

Weight 0.25 lb (0.11 kg)

Optional accessories

Flex Film Cassette, 5 x 7 inch (Model 07-800-5007)

Available model(s)

07-591 Focal Spot Test Tool

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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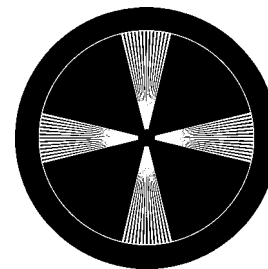
07-661-7662-ds rev 1 10 mar 03

Star Patterns

Models 07-503 to 07-551

Star X-Ray Test Patterns for Measuring Focal Spot Size

Focal spot size can be determined by observing the regions of blurring which occur when the pattern is radiographed by an x-ray source of finite dimensions. Radiation from different areas of the focal spot will cause a periodic blurring of the pattern due to penumbra effects. Knowledge of the geometric factors, and the distance from the center of the pattern to the region where blurring occurs, will permit the calculation of the focal spot size with the same accuracy as measurements made with a pinhole camera.



Shown in Model 07-509-2

Available model(s)

07-503-2 High-Precision Star X-Ray Test Pattern, 55 mm Ø. For measuring focal spots from 0.1 to 0.3 mm. Has four 15° patterned sectors with a 0.5° angle of a single line within a sector. Lead-foil thickness 0.03 mm

07-503-1 Ultra-High Precision Star X-Ray Test Pattern. (Same specifications as Model 07-503-2)

07-509-2 High-Precision Star X-Ray Test Pattern, 55 mm Ø. For measuring focal spots from 1 mm and up. Has four 45° sectors with a 2° angle of a single line within a sector. Lead-foil thickness 0.05 mm

07-509-1 Ultra-High Precision Star X-Ray Test Pattern. (Same specifications as Model 07-509-2)

07-542-2 Precision Star X-Ray Test Pattern, 55 mm Ø. For measuring focal spots from 0.3 to 0.6 mm. Has four 28 patterned sectors with a 1° angle of a single line within a sector. Lead-foil thickness 0.03 mm

07-542-1 Ultra-High Precision Star X-Ray Test Pattern. (Same specifications as Model 07-542-2)

07-543-2 High-Precision Star X-Ray Test Pattern, 55 mm Ø. For measuring focal spots from 0.8 to 1.5 mm. Has four 35° patterned sections with a 1.5° angle of a single line within a sector. Lead-foil thickness 0.03 mm

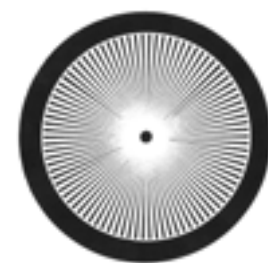
07-543-1 Ultra-High Precision Star X-Ray Patterns. (Same specifications as Model 07-543-2)

07-550 Ultra-High Precision Star X-Ray Patterns. (Same as Model 07-503-2 except it has four 45° patterned sectors, for easier interpretation). Lead-foil thickness 0.03 mm

07-551 Ultra-High Precision Star X-Ray Pattern. (Same as Model 07-503-2 except it has four 15° patterned sectors with a 0.25° angle). Lead-foil thickness 0.03 mm

07-510-2 High-Precision Star X-Ray Test Pattern, 55 mm Ø. For measuring focal spots from 1 mm and up. Has one 360° pattern sector with a 2° angle of a single line within a sector. Lead-foil thickness 0.05 mm

07-510-1 Ultra-High Precision Star X-Ray Test Pattern. (Same specifications as Model 07-510-2)



Shown in Model 07-510

High-Purity Aluminum Step Wedges

Model 07-456

■ Built to US Federal Specification GG-X-635C

■ Determines mAs linearity

■ Determines contrast vs. kVp

■ Used for:

- Darkroom fog testing
- Film and screen comparison
- Technique chart development

On these high-purity aluminum step wedges, even-numbered steps are identified with lead numerals.

Specifications

11 steps

Dimensions

Step wedge 2.50 x 5.50 x 1.375 in

Each step 0.5 in surface; 3 mm rise

Weight 1.10 lb (0.50 kg)

21 steps

Dimensions

Step wedge 3 x 10.3 x 1.85 in

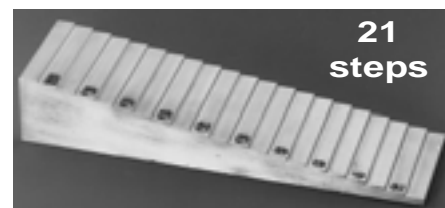
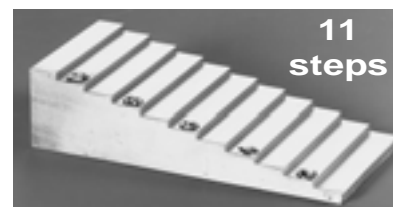
Each step 2.1 mm deep surface; 12 mm rise

Weight 3.20 lb (1.45 kg)

Available model(s)

07-456 11 Step Wedge, Type-2024 Aluminum

07-456-1100 11 Step Wedge, Type-1100 Aluminum



07-456-2100 21 Step Wedge, Type-2024 Aluminum

07-456-2111 21 Step Wedge, Type-1100 Aluminum

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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Test Patterns

Models 07-501 to 07-555



Diagnostic Imaging

X-Ray Test Patterns for Measuring Resolution

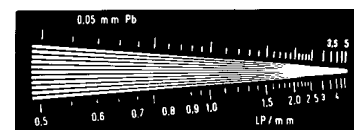
The choice of pattern depends on the specific application. The sector test patterns are 0.4°, and the group test patterns have varying numbers of line pair groups. Lead thicknesses are limited by the resolution, with a maximum thickness of 0.1 mm for test patterns up to 5 LP/mm. Radiopaque numbers indicate the resolution (in LP/mm) of each group.

Model	Range of resolution in LP/mm	Number of groups	Lead-foil thickness in mm	Dimensions in mm
07-501-2	1.0-4.8	16	0.1	110 x 40
07-501-1	Ultra-High Precision Pattern (same specifications as Model 07-501-2)			
07-521	2.0-10.0	15	0.05	94 x 50
07-525	3.15-16.6	15	0.03	94 x 50
07-547	3.15-16.6	15	0.01	94 x 50
07-555	5.0-20.0	13	0.02*	25 x 10
07-515	1.0-10.0	1	0.05	80 x 40
07-523-2	0.5-5.0	1	0.1	157 x 50
07-523-1	Ultra-High Precision Pattern (same specifications as Model 07-523-2)			
07-539	1.5-20.0	1	0.025	60 x 30
07-526	0.6-10.0	26	0.05	65 x 55
07-527	0.6-5.0	20	0.01	50 x 50
07-535	0.6-5.0	20	0.05	50 x 50
07-538-2	0.6-5.0	20	0.1	50 x 50
07-538-1	Ultra-High Precision Pattern (same specifications as Model 07-538-2)			
07-541-2	0.6-3.4	2 x 15	0.1	50 x 50
07-541-1	Ultra-High Precision Pattern (same specifications as Model 07-541-2)			
07-548	2.0-6.0	2 x 14	0.08	50 x 50

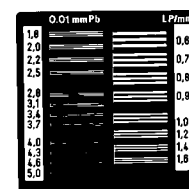
* Gold-foil thickness in mm.



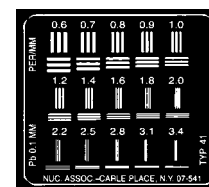
Shown in Model 07-501-2



Shown in Model 07-515



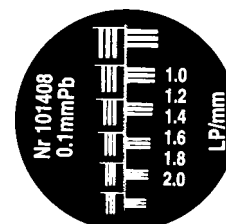
Shown in Model 07-527



Shown in Model 07-541-2

X-Ray Test Patterns for Measuring Resolution of Image Intensifiers and Video Systems

Model	Range of resolution in LP/mm	Number of groups	Lead-foil thickness in mm	Dimensions in mm
07-506	1.0-2.0	2 x 6	0.1	32
07-507	3.0-4.0	2 x 6	0.1	32
07-511	2.0-3.0	2 x 6	0.1	32
07-519	1.8-3.15	2 x 6	0.1	32
07-529	2.8-5.0	2 x 6	0.1	32
07-532	5.0-6.0	2 x 6	0.05	32
07-537	5.0-7.0	2 x 6	0.05	32



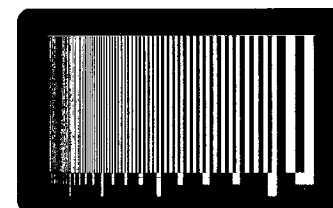
Shown in Model 07-537

Ultra-High Precision Test Pattern for Measuring Modulation Transfer Function

The Ultra-High Precision Test Pattern utilizes 22 groups of line pairs. Each group is indicated by the extended line above the pattern. The resolution of the individual groups can be taken from the table. Lead thickness is 0.05 mm. Pattern size is 71 x 44 mm.

Group	1	2	3	4	5	6	7	8	9	10	11
LP/mm	0.25	0.5	0.6	0.7	0.85	1	1.2	1.4	1.7	2.0	2.4

Group	12	13	14	15	16	17	18	19	20	21	22
LP/mm	2.9	3.5	4.2	5	6	7	8.5	10	8.5	7	6



Shown in Model 07-553

Available model(s)

07-553 Ultra-High Precision Test Pattern

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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X-Ray Output Detector

Model 07-451

Measures:

- Timer calibration (single-phase, three-phase or CP units)
- Loading characteristics
- Rectifier malfunctions
- Contactor problems
- Cable or connector arcing
- Shutter calibration, etc.



This low-cost X-Ray Output Detector offers a dynamic means of demonstrating x-ray generator performance. It is used with a storage or camera oscilloscope to display the intensity-time relationship of an x-ray beam. To use, the detector is placed in the x-ray beam, and the output cable is connected to the oscilloscope input. The resulting waveshape patterns are used to calibrate and/or diagnose malfunctions in the x-ray generator.

The detector supplies a crisp 200 mV signal at standard diagnostic conditions (80 kVp, 100 mA). This extremely high output permits the simple interpretation of oscilloscope displays. Since the detector rise time is better than 1 microsecond, no alteration of the true x-ray output pulse shape is introduced.

Specifications

Shock-resistant, solid-state diode detector. Power source: none required.
Rise Time: Less than 1 μ sec.

Dimensions 1.25 x 1.25 x 0.50 in (3.175 x 3.175 x 1.27 cm)

Weight 0.58 oz (16.6 g)

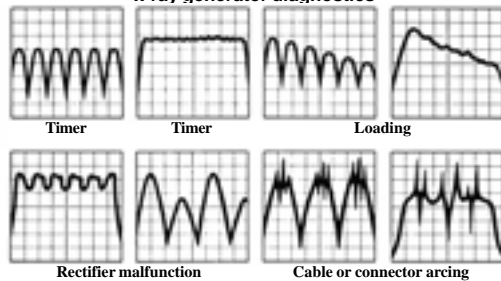
Optional accessories

Cable, 20 ft (6 m), BNC to BNC (Model 88-222)

Available model(s)

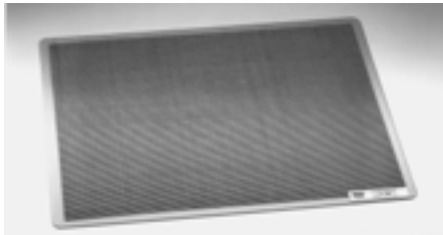
07-451 X-Ray Output Detector, includes BNC Output Connector

Scope tracing examples of typical
x-ray generator diagnostics



Screen/Film Contact Mesh

Model 07-608



The film/screen contact test tool determines the clarity of the focused image. This device allows problems to be identified so that image clarity can be restored. It consists of a 14 x 17 inch (35.6 x 43 cm) copper screen, with 0.125 inch (0.3 cm) mesh, embedded in durable plastic for long life use. To use, simply lay the unit over the cassette, radiograph, and develop the film. Look for screen image clarity across the film. Blurring or distortion indicates poor film/screen contact.

Specifications

Dimensions 15 x 18 x 0.125 in thick

Weight 1.5 lb (0.68 kg)

Available model(s)

07-608 Screen/Film Contact Mesh

Patient Phantom/Penetrometer System

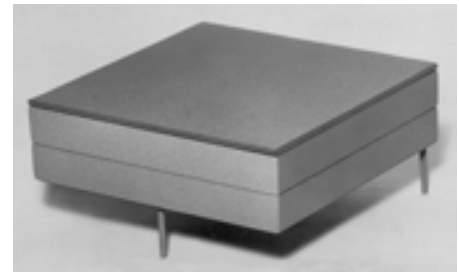
Model 07-706

To check the tabletop output of image-intensified fluoroscopic equipment properly, a simulated body or phantom should be placed between the x-ray output meter and the input phosphor. The phantom protects the phosphor from the direct beam and provides the simulated attenuation needed to check the performance of image-intensifier systems. A penetrometer permits the determination of system contrast gradient under simulated operating conditions.

Consists of: (a) Two 7 x 7 x 0.75 inch blocks of high-purity aluminum, which represent the equivalent absorption of 26 cm of water and simulate a thick or heavy-set patient at 90 kVp. A single block is the equivalent of a child or adult chest. Aluminum simulates the scatter characteristics of the human body.

(b) One 7 x 7 x 0.125 inch lead beam-stop plate. When placed in the beam, this plate allows automatic brightness-control machines to deliver maximum output.

(c) One 7 x 7 x 0.03125 inch aluminum



penetrometer plate with 0.25, 0.176, 0.125, 0.088, and 0.0625 inch holes. Place this plate between the two aluminum blocks and ascertain the contrast gradient of the penetrometer on image-amplified systems.

(d) Two sets of legs: one 1.25 inch long and one 10.375 inch long.

Specifications

Dimensions 7 x 7 x 1.875 in (h) (17.8 x 17.8 x 4.7 cm)

Weight 9.5 lb (4.3 kg)

Optional accessories

Aluminum Blocks (Model 07-629-1000), two
Type-1100 Al 7.125 x 7.125 x 0.75 in thick

Available model(s)

07-706 Patient Phantom/Penetrometer System

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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07-451-ds rev 1 07 feb 03

PACS Test Pattern in Digital and Film Formats

Model 07-450



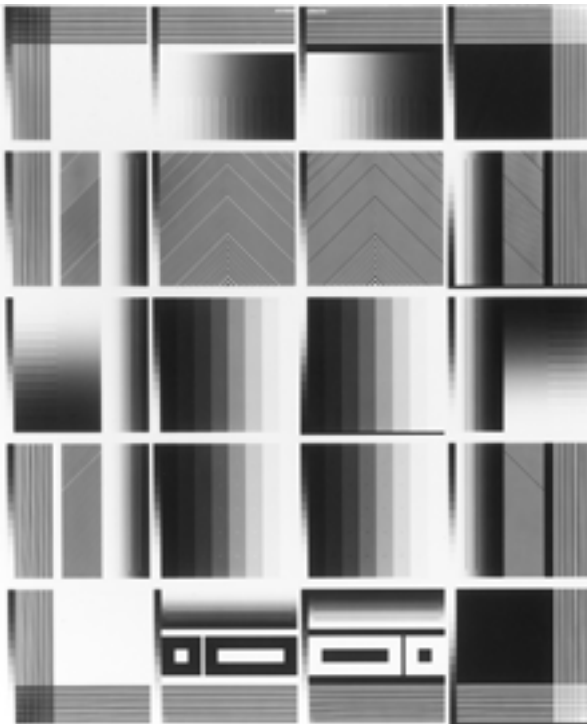
Diagnostic Imaging

Digital format

- For evaluating and calibrating monitors
- For testing film printers

Film format

- Detects two common problems associated with digitizing film: light leakage and film slippage



Introduction

The PACS Test Pattern provides a simple, objective approach to system evaluation and quality control, allowing for quick, objective testing of image quality by a single observer. Simply digitize the PACS Test Pattern film or load the test image from the disk and display it at full resolution on your display monitor. Then, using your systems controls, magnify and view different areas of the test pattern.

Applications

A regular quality control procedure is mandatory to ensure a diagnostic level of image quality with PACS and teleradiology. A quick, objective and reproducible QC test is needed to ensure optimization of the film digitizer and display system.

As an integral part of your regular QC for a laser scanner or CCD digitizer, the Film Format PACS Test Pattern will provide you with an easy method to detect, identify and quantify changes in digital image quality. The Digital Format PACS Test Pattern will prove itself as an invaluable QC tool for testing image display systems and film printers.

Features

Evaluates important benchmarks of radiographic image quality, including:

- High contrast resolution
- Low contrast discrimination
- Linearity of gray scale response
- Geometric distortion
- Reproduction of continuous fine lines
- Digitizer noise

“A teleradiology/PACS quality control test pattern may help identify problems that should be addressed to optimize printer quality. Regular interval testing of paper printers with a dedicated test pattern should be recommended as a part of the quality control program for all teleradiology/PACS systems.”*

* A.D. Maidment, Ph.D; M. Albert, Ph.D; and E.J. Halpern, M.D., “A Quality Control Program for Paper Printers Used with Teleradiology/PACS,” *Radiology*, 205 (P) (November 1997), 307.

PACS/Teleradiology Test Pattern is superior to the SMPTE Test Pattern for PACS/Teleradiology quality control

The PACS/Teleradiology Test Pattern tests:

- The ability to discriminate between 16 different gray scale levels from its lowest to its highest optical density, which is a greater number of gray scale levels than is tested by the SMPTE Test Pattern.
- For low contrast discrimination with a rose-hole-type pattern which is not available on the SMPTE Pattern.
- The ability to discriminate between different gray levels on both sides of the pattern, as well as in the center of the pattern. These features, designed specifically for QC in teleradiology systems, provide a more superior test of gray scale reproduction than the SMPTE Pattern.
- High contrast resolution in horizontal, vertical and diagonal axes, while the SMPTE Pattern test only horizontal and vertical axes.
- For specific artifacts which are important to digitization of radiographs, such as the ability to reproduce fine lines, blooming from bright areas, and light-leakage along the sides of the image.

Routinely using the Digital or Film Format PACS Test Patterns ensures optimized digitizer performance.

Specifications

Digital Format PACS Test Pattern

Horizontal, vertical, and diagonal high contrast line Pairs Tests resolution up to 6 lp/mm when printed on 14 x 17 inch film

Gray scale Tests full range of your printer or display

Low contrast pattern Digital values of low contrast squares differ from the background density by 9%

Weight < 1 lb

Film Format PACS Test Pattern

Horizontal and vertical high contrast line pairs

Range 0.6 to 3.5 lp/mm

6 sets 0.6, 0.7, 0.9, 1.2, 1.8, 3.5 lp/mm (along top and sides of the pattern)

Diagonal line pairs

Range 0.6 to 2.61 lp/mm

8 sets 0.6, 0.7, 0.85, 1.0, 1.3, 1.7, 2.6, 5.0* lp/mm (at the top-center of the pattern)

5 sets 1.0, 1.3, 1.7, 2.6, 5.0* lp/mm (along the sides of the pattern)

Gray scale Range: 0.20 - 3.00 Optical Density (OD) Units

Low contrast pattern Low contrast squares differ from the background density by 9% for the larger embedded squares

Resolution This is specified to the closest tenth of a line pair per mm. Optical density may vary slightly from film to film, but remains within a 0.03 OD of the specified value

Weight < 1 lb

Available model(s)

07-450 PACS Film Test Pattern

07-450-1024 PACS Digital Test Pattern (1024 x 768)

07-450-4000 PACS Digital Test Pattern (4 x 4 K)

07-450-1480 Additional Copies of PACS Digital Test Pattern

(Additional copies at same site)

Available in high resolution formats

NOTE: Digital PACS Test Pattern supplied on a single, 3.5 inch floppy disk

* The 5 lp/mm diagonal line pairs were not actually present. This area is visible as a matrix of fine dots, rather than true line pairs, due to the limitations of the laser printer.

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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07-450-ds rev 1 10 mar 03

Slit Cameras

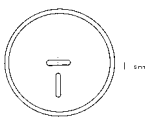
Model 07-624 Series

DI

Diagnostic Imaging

Double Slit Camera

- Designed to permit testing in compliance with IEC Standard 336...with a single image
- With two slits, you benefit from increased camera versatility and ease-of-use



Like our other two slit cameras, our unique Double Slit Camera is manufactured to the highest quality and performance standards. It is designed with two slits positioned perpendicular to each other so you get increased camera versatility, ease of use, convenience, and time-savings. The Double Slit Camera incorporates tungsten slit material and may be repaired if dropped and damaged.

Specifications

Number of slits Two, perpendicular

Slit width $10\ \mu\text{m} \pm 1\ \mu\text{m}$, with 4° relief angles on each jaw

Slit length 5.5 mm (± 0.1 mm)

Slit material/thickness Tungsten; 1.5 mm

Weight 0.35 lb (0.16 kg)

Available model(s)

07-624-2222 Double Slit Camera, with carrying case

- Three precision slit cameras available
- Evaluation of focal spot size, modular transfer function, and blooming
- A major breakthrough in slit camera manufacturing technology
- Compliance with IEC Standard 336 (double slit camera)

Single Slit Camera

Here is a versatile slit camera manufactured to the highest-quality standards and offered at a cost-effective price. It provides exceptional performance, accuracy, quality, and reliability. For added cost-effectiveness and convenience, the slit camera can be repaired to its original specification in the event it is dropped or damaged. This Slit Camera is ideal for use by equipment manufacturers, service engineers, and physicists.



Specifications

Number of slits One

Slit width $10\ \mu\text{m} \pm 1\ \mu\text{m}$, with 4° relief angles on each jaw

Slit length 5.5 mm (± 0.1 mm)

Slit material/thickness Tungsten; 1.5 mm

Weight 0.35 lb (0.16 kg)

Available model(s)

07-624-1000 Single Slit Camera, with carrying case

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.

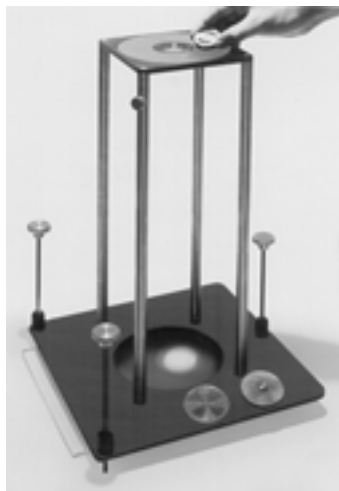
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07-624-ds rev 1 10 mar 03

Multipurpose Focal Spot/HVL Test Stand*

Model 07-622

- Can be used for half value layer measurements
- Designed for both over-table and under-table x-ray tube measurements



This versatile stand features extendible legs that provide the enlargement factors required by the NEMA® standard. Long leveling screws allow the positioning of a screen-film cassette under the base.

Specifications

Dimensions 12 x 12 inch at base; 6.15 x 6.15 inch at top

Height Adjustable from 16.94 to 31.38 inch

Weight 11 lb (5 kg)

Optional accessories

Carrying Case (Model 89-622)

Pinhole Assembly, 0.010 mm (Model 07-633)

Pinhole Assembly, 0.075 mm (Model 07-617)

Pinhole Assembly, 0.030 mm (Model 07-613)

Pinhole Assembly, 0.100 mm (Model 07-611)

Available model(s)

07-622 Multipurpose Focal Spot/HVL Test Stand

* Designed by Joel E. Gray, Ph.D., Professor Emeritus, Department of Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.



Mammography Focal Spot Measurement Test Stand**

Model 07-623

- Includes a magnification insert, alignment device, and fluorescent alignment screen

It is particularly important to verify the size of the focal spot during acceptance testing of new mammographic equipment or when a new x-ray tube is installed. This test stand is designed to make these important procedures easy to perform, and ensures accurate results.

Specifications

Dimensions 9 x 11.50 inch at base; 4 x 6 inch at top

Height Adjustable from 9 to 18 inches

Weight 11 lb (5 kg)

Optional accessories

Carrying Case (Model 89-622)

Pinhole Assembly, 0.100 mm (Model 07-611)

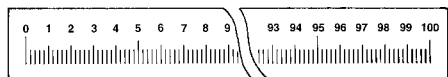
Available model(s)

07-623 Mammography Focal Spot Test Stand

** Designed by Joel E. Gray, Ph.D., Professor Emeritus, Department of Radiology, Mayo Clinic, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

Radiopaque Rulers

Model 07-533



Available model(s)

07-533 Radiopaque Ruler, 30 cm long, 2 mm divisions. Weight: 0.05 lb (0.04 kg)

07-533-1000 Radiopaque Ruler, 100 cm long, 2 mm divisions. Weight: 0.5 lb (0.24 kg)

07-533-1100 Radiopaque Ruler, 110 cm long, 2 mm divisions. Weight: 0.5 lb (0.24 kg)

07-533-3600 Radiopaque Ruler, 36 cm long, 2 mm divisions. Weight: 0.05 lb (0.04 kg)

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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X-Ray Pinhole Assemblies

Models 07-611 to 07-633

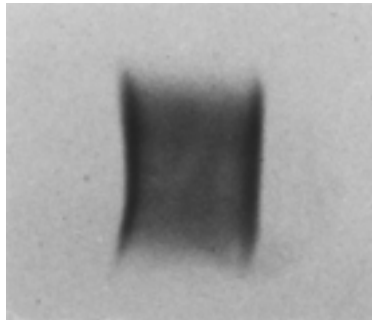
One of the specifications and chief features of an x-ray tube is its focal spot size, a very important factor in the resolution to be achieved during a radiologic examination. A small focal spot size will provide the maximum resolution. However, there are other factors in the construction of an x-ray tube, such as the heat dissipation within the target, which limits the minimum size of the target.

In order to determine the focal spot size of an x-ray tube, a small and precise pinhole is often used. Its size must be very small compared to the focal spot to be measured. Any of four precision pinholes can be used with our Model 07-623 and 07-622 test stands. The test stand height is adjustable in order to maintain the minimum magnification factor of two. A fluoroscopic screen is part of the test stand and is used for centering the focal spot before exposing the film.

The 0.010 mm pinhole diameter is for focal spot sizes from 0.5 to 0.10 mm; the 0.030 mm pinhole diameter is for focal spot sizes below 1.0 mm; the 0.075 mm diameter is for focal spots from 1.0 to 2.5 mm; the 0.1000 mm diameter is for sizes above 2.5 mm.

The pinhole diaphragm is made from a 90:10 gold-platinum alloy in accordance with the table and figure.

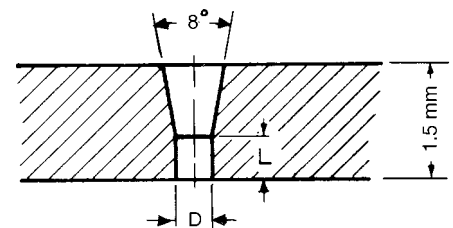
Model	Pinhole diaphragm dimensions (mm)		Nominal pinhole diameter (mm)
	D	L	
07-633	0.010 ± 0.005	0.020 ± 0.010	0.010
07-613	0.030 ± 0.005	0.075 ± 0.010	0.030
07-617	0.075 ± 0.005	0.350 ± 0.010	0.075
07-611	0.100 ± 0.005	0.500 ± 0.010	0.100



- For measuring the dimensions of focal spots of x-ray tubes
- Custom Pinholes Available on Request



Pinhole assemblies



Cross-sectional view of pinhole

High-Quality Comparators

Models 07-620 & 07-635

- For magnification and measuring focal spot sizes



Magnification 25X

Supplied with a 0-5 reticle. Features a knurled ring which adjusts the focal point to personal preference. Transparent body allows illumination to fall on magnified area. Supplied with protective storage case. An excellent, high-quality precision magnifier.

Weight 0.20 lb (0.10 kg)

Available model(s)

07-635 Comparator, 25X Magnification

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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Magnification 7X

Supplied with its own leather case. Fits in the palm of your hand. Transparent body allows illumination to fall on magnified area. Accurate, easy to use, versatile, and truly portable.

Weight 0.05 lb (0.04 kg)

Available model(s)

07-620 Comparator, 7X Magnification

Cervical Traction Board*

Model 17-430

- Ideal for trauma radiography applications
- Ensures high quality lateral radiographs of all seven cervical vertebrae
- Can be used with other restraining devices (cervical collars, head blocks, etc.)
- Effectively used on unconscious or incoherent patients
- Reduces the risk of additional injury to patient during evaluation
- Eliminates the risk of unnecessary exposure to attendant holding patient during x-ray
- Promotes clear positioning of the cervical vertebrae for increased accuracy during radiation therapy treatments



Photo showing the wrist straps being used to pull down the shoulders

Introduction

The Model 17-430 Cervical Traction Board[†] is the easiest, fastest, and safest way to visualize all seven vertebrae. The benefits of the Cervical Traction Board originates from its unique L-shaped design. Because the lower portion of the board fits directly under a standard trauma board, stretcher, or mattress, it greatly reduces the risk of additional injury to the patient. It can also be placed directly on top of the radiographic table with the patients's feet against the upper portion of the board.



Photo showing shoulder straps used when there is trauma to the upper extremity

Applications

To use, simply secure the straps around the patient's wrists and gently pull to move the shoulders down. Then attach the other end of the strap to the back of the board with the attached Velcro®. The Cervical Traction Board totally eliminates the risk of unnecessary exposure or physical injury to the attendant during x-ray. It even eliminates the complications faced when examining an incoherent or unconscious patient, as correct positioning can be quickly obtained without the patient's cooperation.

Using the Cervical Traction Board will eliminate frustrating and costly exams...saving you valuable time, effort, and expense.

Radiation therapy

The Cervical Traction Board is a restraining device that makes reproducible positioning of the patient fast and easy. By promoting precise placement of the head and neck without causing additional patient discomfort, lateral radiotherapy beams will have increased accuracy.

Specifications

Dimensions 20 x 14 x 9.5 in (51 x 36 x 24 cm)

Weight 12.43 lb (5.65 kg)

Available model(s)

17-430 Cervical Traction Board

* US Patent No. 5342290.

† Designed by Steven Schuellein, BBA, RT, Morton Plant Hospital, Clearwater, Florida.

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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Posi-Tot® Infant Immobilizer and Positioner

Model 17-550



Diagnostic Imaging

Introduction

The state-of-the-art in pediatric positioning has taken a giant step forward with the Posi-Tot Infant Immobilizer. Posi-Tot eliminates the struggle to restrain very young patients for diagnostic radiography.

NO MORE tapes, buckles, props and gimmicks that don't always work.

NO MORE excessive exertion and fussing to position and restrain the child.

NO MORE letting a parent try to hold the child motionless and subjecting both to unnecessary radiation exposure.

NO MORE retakes because the child's movements distorted the film image.

NO MORE limitations on x-ray procedures because of inefficient restraint equipment or uncooperative children.



- The MOST advanced positioning system for infant and toddler chest and abdominal radiography
- Rotates and slants to all erect, semi-erect and supine positions for PA, AP, lateral and oblique projections
- Precise repositioning for multi-view studies is completed in seconds
- All positioning is done by manipulating the equipment, NOT the child

Applications

Posi-Tot is the most advanced immobilizer for pediatric chest and abdominal x-rays, especially for children up to age two. It provides the only complete restraint of young children in ANY position, even for extended periods. Repositioning for multi-view studies is done in seconds, and all positions can be reproduced precisely.

Fields of view are unobstructed. An adjustable cassette-holder slides along the carriage frame and accepts cassettes up to 11 x 17 inch. To eliminate magnification, the cassette holder can be positioned very close to the patient. The plastic tabletop can serve as a standard x-ray table, making the system ideal for procedures such as intravenous pyelography.

Rapid, easy operation...

This easy-to-use system frees the technologist from most of the ordeal associated with pediatric positioning. Only one to two minutes are needed to adjust the equipment so that the child is adequately restrained, which gives the operator full control. The child can be moved quickly to any x-ray position, for any period of time, with little effort. And, any view can be reproduced by recording and repeating the angle settings for that position.

Safe...

Infant safety is another important factor. The less the child moves, the less chance of injury. Once the infant has been immobilized, all positioning is done by manipulating the equipment, not the child. There are no sharp edges or points, and the locking devices can't come loose accidentally. The rugged steel frame and wide base provide balance and stability in all positions. The child cannot free himself from the nylon body net and Velcro® restraints, but if he must be removed from the unit quickly, the technologist can do so in seconds.

Comfortable...

The system lessens the child's discomfort associated with the involuntary restraint of movement. Because the technologist is in control, the procedures are faster and less traumatic. Positive immobilization means fewer retakes and less radiation exposure.



Posi-Tot can be rotated and slanted to all erect, semi-erect and supine positions for PA, AP, lateral and oblique projections

How Posi-Tot operates

The system consists of a heavy-duty steel frame that supports a clear plastic tabletop, a series of arm, head and body restraints, and an adjustable cassette holder. Since the tabletop and restraints are radiolucent, artifacts are eliminated. Compression locks and indexers allow patients to be angled and rotated to any radiography position. Easy-rolling, lockable casters ensure maneuverability as well as immobility.

With the system in a horizontal plane, the child is placed on the table. The padded saddle-seat, located between the patient's legs, is adjusted to the child's size. It prevents horizontal movement and serves as a seat during erect positioning. A nylon-mesh body net, connected to one edge of the plastic table, is stretched over the patient and hooked to the opposite edge. There are no time-consuming belts, buckles or tying; the infant's torso and legs are restrained in seconds. The child's upper extremities are also quickly immobilized with padded, adjustable skull restraints and Velcro fasteners for the arms, forehead and chin. The reproductive organs can be protected using a gonad shield.

An adjustable cassette holder slides to any point parallel to the child. It can also be moved perpendicular to the body and positioned very close to the patient to eliminate magnification. Any cassette up to 11 x 17 inch is accepted.

The table can be angled and/or rotated for any erect, semi-erect or supine position. All PA, AP, oblique and lateral projections are easily set and each position is reproducible. The vertical rotation lock system is calibrated from 0° to 90° in 3° increments; the lateral rotation range is 0° to 360° in units of 3°.

Specifications

Dimensions 23 (w) x 46 (d) x 40 in (h) (58.42 x 116.84 x 101.6 cm)

Shipping weight 120 lb (55 kg)

Available model(s)

17-550 Posi-Tot Infant Immobilizer and Positioner

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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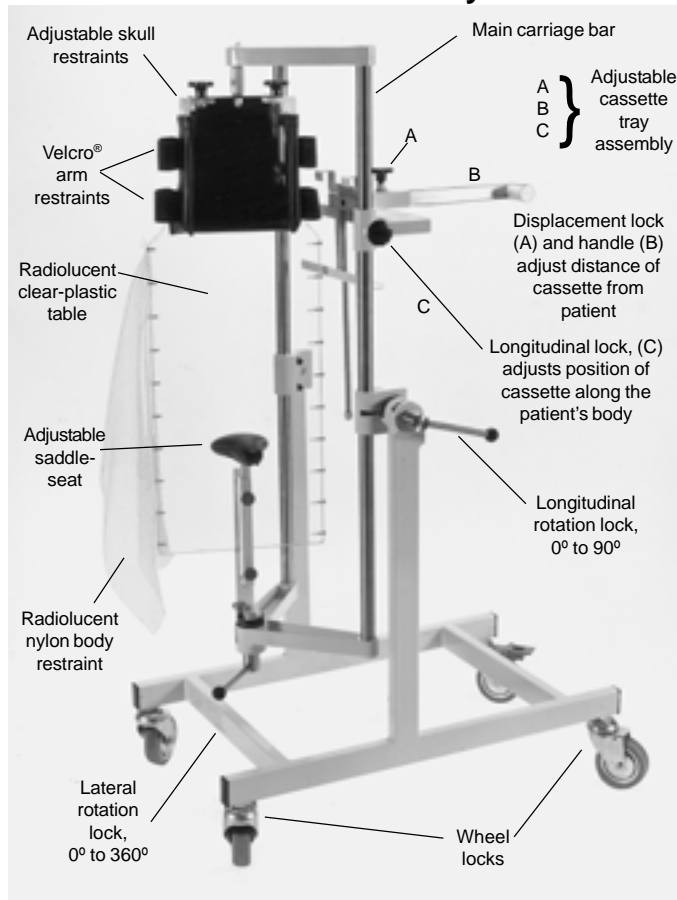
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17-550-ds rev 1 10 mar 03

Features of Posi-Tot system



TransMat®

Patient Transfer Mattress

Model 17-355



Diagnostic Imaging



- Increased efficiency of patient transfer procedures
- Travels with the patient

This lightweight, durable mat is designed to facilitate movement of patients to and from gurneys, stretchers, and examination tables. Except when going to and from the hospital bed, the patient never has to leave the mat...it travels with the patient. The mat's 26 x 72 inch size makes it compatible with all stretchers, tables, and beds. Its fully-washable surface permits easy removal of stains, including spilled contrast media.



Allows the patient to be lowered gently. No pushing, pulling or patient discomfort. Reduces technologist fatigue

Specifications

Dimensions 26 x 72 in (66 x 183 cm)

Weight 6.8 lb (3.1 kg)

Available model(s)

17-355 TransMat Patient Transfer Mattress

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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17-355-ds rev 1 10 mar 03

Features

- **Comfortable**

Laminated leatherette mat is padded with a 1 inch cushion of soft polyurethane foam. Patient can remain on mat at all times, reducing fatigue and possible ill effects from excessive movements

- **Radiolucent**

Patient stays on mat during x-ray and nuclear medicine procedures

- **Easy-to-use**

Features eight plastic-lined grip-holes. Design minimizes physical exertion for technologist

PIXY Anthropomorphic Patient Phantom

Nuclear Associates Model 76-610

- Ideal training aid for teaching the basic principles of radiography
- Lightweight and easy to maneuver
- Can be positioned for most views
- Permits evaluation of student performance
- Hollow organs accept contrast media
- Available in opaque or transparent models
- Tissue-equivalent materials simulate human attenuation characteristics over the full radiography range

Introduction

PIXY is a small, anthropomorphic phantom designed for training radiologic technologists. PIXY measures 5 foot 1 inch tall and weighs 105 pounds. She is made of tissue-equivalent materials and has lifelike articulations. Students will have no difficulty maneuvering PIXY into virtually all radiography positions. PIXY also permits unlimited exposures.

Applications

The versatile PIXY is designed to be used to demonstrate anatomy and evaluate positioning and imaging technique, including: kVp, mAs, contrast, optical density, OFD and TFD. Radiographs of PIXY are optically-equivalent in density and contrast to human patients.

The phantom is shipped in a rugged container which also serves as a permanent storage case.

PIXY anatomy

PIXY shoulders have ball-and-socket joints; elbows and knees flex 90° to 100°. Hips flex 130° with 30° hyperextension. A "frog position" is made possible by lateral flexion at the hips. The right hand is molded with fingers positioned for an AP view, while the left hand is in an oblique-lateral position. The left foot is in full plantarflexion; the right foot is in a neutral position.

C1, C2, C6, and C7 were converted to mechanical nylon joints because educators in the field prefer full positioning capabilities for the head. The design permits the remaining neck vertebrae to be fixed in a normal position, while assuring a full range of head motion.

PIXY contains the following abdominal and pelvic organs: stomach, gall bladder, urinary bladder, kidneys, rectum and sigmoid flexure. These accept air, water, or contrast media, and can be easily flushed after use.



PIXY materials

Soft tissues Pixy is available in opaque or transparent tissue-equivalent materials. The transparent PIXY has visible organs and skeleton at the hips, knees, and elbows, which are opaque. On both the transparent and the opaque PIXY, latex coverings are needed to retain tissue-equivalent gels for soft-tissue continuity at these articulations. Two-ply coverings protect against gel leakage.

Lungs Standard PIXY lungs are tissue-equivalent foam with a mass density of inflated human lungs (0.30 g/cc). They are connected to the oro-nasal cavity by the stem bronchi and trachea. The oro-nasal pharynx is filled with a nearly air-equivalent foam.

Optional animal lungs, which duplicate the intricate detail of the vascular trees, are also available.

Skeletons PIXY contains polymer skeletons which reproduce the shape, mass density and attenuation coefficients of the cortical bone and spongiosa. These skeletons, with trabecular patterns, fit precisely within the soft-tissue molds. The bones of a single individual, who matched PIXY molds very closely, were used in making these skeletal molds. Skeletons have a fixed chemical composition (no osteoporosis or contamination). The medullary cavities were reproduced, with only minor simplification, to make molds for the spongiosa, about which the cortical bone is molded. Both cortical bone and spongiosa are radio-equivalent to natural bone. The matching of skeletons to soft-tissues permits external and bony landmarks to coincide. The position of bones within the soft tissues is anatomically correct.

PIXY Phantoms are unique in their sculptural detail. The skull, for example, has frontal and sphenoidal sinuses, ethmoidal and mastoid air cells, and the auditory ossicles. Bone sutures are radiographically visible.



Arterial tree (optional)

A simplified, integral hollow network is included within the trunk, with ducts to the surface. Like the organs, the Arterial Tree may be eliminated from radiographs (with water filling) or made visible (with contrast media). This option is factory-installed and must be requested at time of purchase of PIXY.

Specifications

Weight 265 lb (122 kg)

Optional accessories

Arterial Tree, factory-installed (Model 76-617)

Animal Lungs (Model 76-010-2000)

Available model(s)

76-610 PIXY Opaque Patient Phantom, includes hollow organs and storage case

76-010 PIXY Transparent Patient Phantom, includes hollow organs and storage case

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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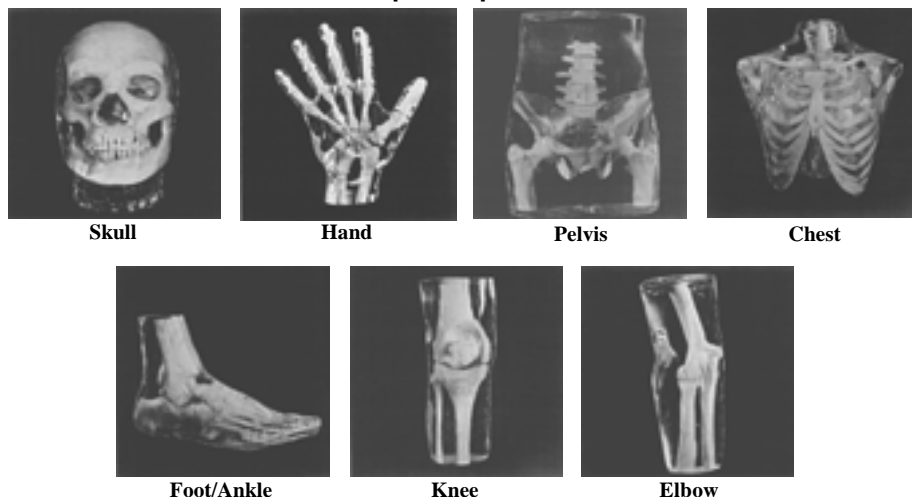
X-Ray Anatomical Phantoms

Models 76-618 to 76-683

DI

Diagnostic Imaging

Transparent phantoms



Introduction

Real Bone X-Ray Anatomical Phantoms are comprised of human skeletal parts embedded in anatomically accurate, tissue-equivalent material. The simulated X-Ray Anatomical Phantoms consist of simulated bones embedded in transparent, non-granular plastic or opaque isocyanate rubber. The materials have the same absorption and secondary radiation-emitting characteristics as living tissue. They are homogeneous and cast shadows similar to those produced by tissue. There are no spongy portions in the phantoms. All bone marrow has been simulated with tissue-equivalent material, which permits critical detail study of bone structure and sharpness comparisons using x-rays. The user can get virtually the same response to radiation from an x-ray phantom as from a human subject. Experiments can be repeated (regardless of dosage) as often as necessary, with no danger of excess radiation.

Applications

Designed originally for determining optimum exposure techniques, the x-ray phantoms have become accepted tools in many laboratories, medical schools and hospitals.

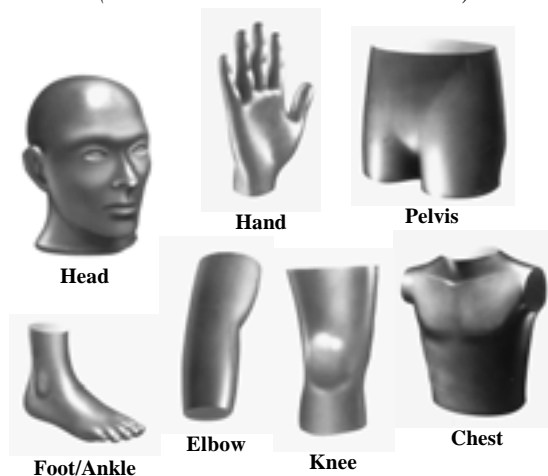
X-ray anatomical phantoms can be used for:

1. Making studies which normally require radiation exposure to human beings. There are no variables with these phantoms and no danger of excess radiation.
2. Teaching skeletal anatomy and its relation to surface landmarks.
3. Determining optimum exposure techniques—especially cineradiographic, planographic, photofluorographic and seriographic.
4. Determining and teaching preferred radiographic positions.
5. Testing x-ray apparatus and accessories, including grids, films, screens and processing equipment.

The phantoms are crafted with special attention to accuracy and completeness. The exterior of each phantom conforms closely to natural contours. All bones are positioned accurately in relation to each other and to surface landmarks.

Opaque phantoms

(Available in simulated and real bone)



Simulated anatomical phantoms

Sections	Opaque Model	Transparent Model
Skull	76-618	76-018
Hand	76-634	76-034
Pelvis	76-642	76-042
Foot/Ankle	76-659	76-059
Elbow	76-667	76-067
Knee	76-675	76-075
Chest	76-683	76-083

Real bone phantoms (opaque only)

Human skeletal parts embedded in anatomically-accurate, tissue-equivalent material

Real Bone sections	Model	Weight*
Skull	76-618-3000	18 lb (8.3 kg)
Hand	76-634-3000	2 lb (0.92 kg)
Pelvis	76-642-3000	49 lb (22 kg)
Foot/Ankle	76-659-3000	2.7 lb (1.22 kg)
Elbow	76-667-3000	4 lb (1.8 kg)
Knee	76-675-3000	8.7 lb (4 kg)
Chest	76-683-3000	50 lb (22.6 kg)

* Weights are approximate and apply to all simulated and real bone phantoms.

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.

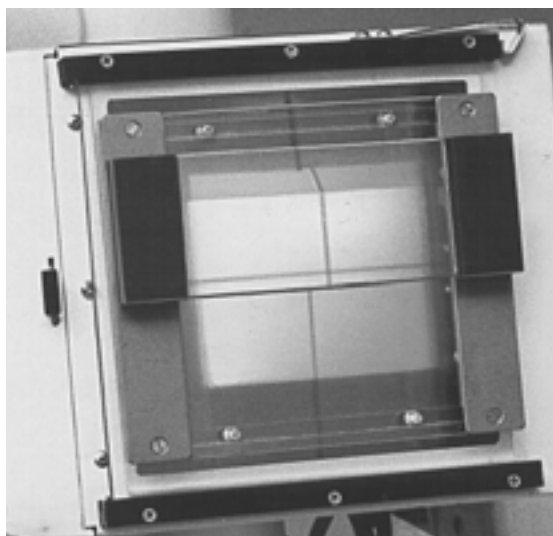
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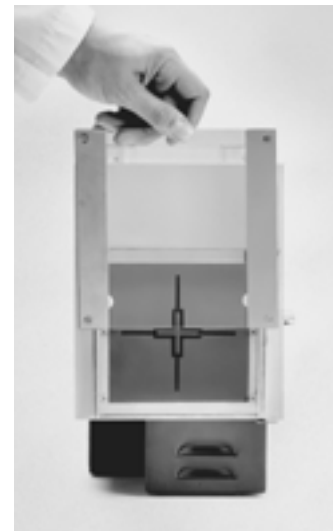
CLEAR-Pb[®] Compensation Filters*

Nuclear Associates Model 57-4 Series

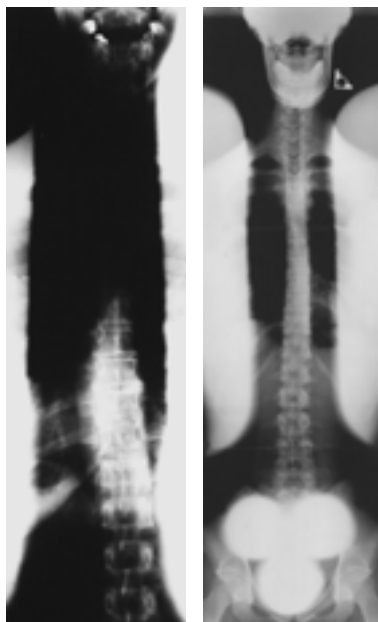
- Improve image quality
- Filters are 30% lead by weight
- Reduce the need for multiple exposures
- Ensure a more uniform image density
- Reduce patient exposure by selectively attenuating the x-ray beam
- Lightweight, easy to use
- Mounts to any collimator
- Collimator light field is never blocked



Lightweight CLEAR-Pb lead-plastic filter is fully transparent



Installation of filter holder into collimator accessory tray



Single-exposure spinal radiographs: the radiograph at left was obtained without a CLEAR-Pb filter. Notice "burnout" in cervical and thoracic areas. At right is radiograph obtained with a CLEAR-Pb AP/PA filter. Note uniform density throughout the spinal column

CLEAR-Pb Compensation Filters eliminate the problems inherent in imaging a wide range of densities on one radiograph. Because they are far superior, they replace the bulky, heavy aluminum filters that block the collimator light field. In addition, CLEAR-Pb filters are only one-fifth as heavy as aluminum filters. And, they eliminate the use of gradient-speed intensifying screens.

CLEAR-Pb filters are made of lightweight plastic that is 30% lead by weight. A unique "quick-stik" magnetic mounting system plus a filter holder that slides into the collimator tray ensure that the filter is held firmly in place. It also permits instant repositioning as the area and/or degree of filter coverage changes.



Single-exposure AP view of the foot: radiograph at left was taken without a CLEAR-Pb filter. Notice "burnout" at the toes due to increased technique needed to properly expose the dense tarsal bones. The radiograph on the right was taken with a CLEAR-Pb filter. The image density is uniform from instep to toes

* Patents Nos. 4,129,524 and 4,182,821.

Full-Spine Scoliosis Filter

Tested and proven in FDA and specialized radiography studies...enables scoliosis radiography with more diagnostic detail and less radiation exposure.

Chest X-Ray Compensation Filter

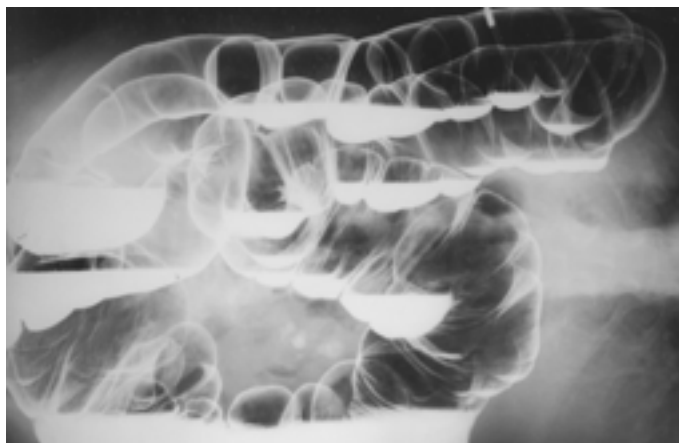
For greater diagnostic detail over entire lung with fewer repeats.

Reveals details that conventional x-rays usually miss.

The CLEAR-Pb Chest X-Ray Filter eliminates a problem commonly encountered in chest x-rays: a portion of the lung field is usually severely underexposed because it is hidden behind the hilum. With the CLEAR-Pb filter, you can increase the beam intensity sufficiently so that all details of the lung and the posterior mediastinal field are clearly revealed. The CLEAR-Pb filter attenuates the x-ray beam while protecting the rest of the field from overexposure. You get clear diagnostic detail of the lungs, heart and spine.

Lateral Decubitus X-Ray Compensation Filter

Excellent diagnostic detail in double-contrast barium enema examinations.



Lead-Plastic Filters

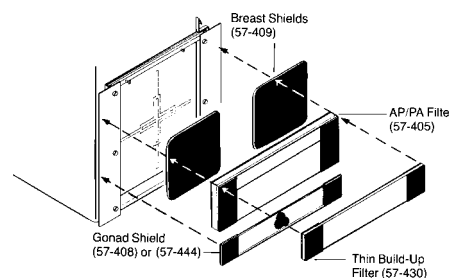
Optional accessories recommended for use with Full-Spine Scoliosis Filters:

Breast Shields (Model 57-409) Provides protection to the radiosensitive breast and lung parenchyma adjacent to the spine. Fully adjustable; may be used on the Filter Holder Assembly (57-426) with or without a compensation filter. Consists of two 3 x 3 inch steel/lead shields with magnetic tape on one side.

Adult Gonad Shield (Model 57-408) Shamrock-shaped insert has three overlapping lead circles (each 0.50 inch Ø) cemented to clear plastic.

Pediatric Gonad Shield (Model 57-444) For imaging children and the sacroiliac joints of adults. Overlapping lead circles are 0.25 inch Ø.

Thin Buildup Filter (Model 57-430) Used with AP/PA filters for patients with measurements from 14 to 25 cm. Provides additional filtration in the cervical area to compensate for the added exposure that may be needed in the thoracic/lumbar area.



Thick Buildup Filter (Model 57-434): same as Model 57-430 filter (above), but for patients whose measurements exceed 25 cm

To obtain the optimum diagnostic detail, the AP/PA Wedge Filter (Model 57-405) should be used when performing full-spine examinations. First the Breast Shields (Model 57-409) are placed on the filter holder. The AP/PA Wedge Filter (Model 57-405) is placed on top of the Breast Shields. The Gonad Shield (Model 57-408) is placed below the AP/PA Wedge Filter. Buildup filters are used to provide additional filtration in the cervical area to compensate for the added exposure that may be needed in the lumbar area. Buildup filters are placed on the AP/PA Wedge Filter.

Reference

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2. "Patient Exposure Reduction During Scoliosis Radiography," FDA Publication: 85-8251, August, 1985. **Request Reprint No. 361B.**
3. American Academy of Orthopedic Surgeons Bulletin 32:1, January, 1984.
4. Downey, E.F., Jr., Butler, P. "Less Radiation and Better Images: a New Scoliosis Radiography System," *Milit. Med.*, 149 (September, 1984), 526-528.
5. Butler, P.F., Thomas, A.W., Thompson, W.E., Wollerton, M.A., Rachlin, J.A., "Simple Methods to Reduce Patient Exposure During Scoliosis Radiography," *Radiologic Technology*, 57:5 (1986).
6. Petersen, T.D., Rohr, W. "Improved Assessment of Lower Extremity Alignment Utilizing New Radiographic Techniques," *Clinical Orthopedics*, (June, 1987).
7. Feczko PJ, et al. "Compensation Filtration for Decubitus Radiography During Double-Contrast Barium Enema Examinations," *Radiology*, 149:3 (December, 1983), 848-850.

CLEAR-PB Compensation Filters

Model	Filter	Weight	Length	Width	Filter holder required	Application	Configuration
57-429	Chest	16 oz	5.125 in	5.125 in	No	PA View (72 inch FFD)	
57-432	2 inch Wedge Lateral Decubitus at 40 inch FFD	3.4 oz	6.5 in	2 in	Yes (see 57-426)	<ul style="list-style-type: none">All lateral decubitus position viewsAngiography of neck and head (use 2 filters)	
57-433	3 inch Wedge Lateral Decubitus at 40 inch FFD	5.5 oz	6.5 in	3 in	Yes (see 57-426)	<ul style="list-style-type: none">Suggested for children	
57-426 (Required for 57-432, 57-433, & 57-441)	Filter Holder (set of mounting plates included)	24 oz	6.5 in	6.5 in	Has two steel rails, 1 (w) x 5.50 in (d), for positioning filters and shields. Only one Filter Holder is needed per x-ray machine. Comes with a Plexiglas cutter		
57-440	Foot & Ankle Filter	3.9 oz	6.5 in	2 in	No	<ul style="list-style-type: none">AP footPodiatric equipment	
57-441	2 inch Wedge AP Foot at 40 inch FFD	2 oz	6.5 in	2 in	Yes (see 57-426)	<ul style="list-style-type: none">Lateral and obliqueAxial view of calcaneus	
57-414	Wall Rack	8 oz	12 in	1 in	<ul style="list-style-type: none">Can hold a complete Filter Set plus 3 to 5 extra filters. Two-sided foam tape holds the rack to the wall		
57-411	Replacement Mounting Plate	6.5 oz	9 in	9 in	<ul style="list-style-type: none">Attaches to filter holder with screwsEasily cut to fit collimator assembly.Set of two		
57-405*	AP/PA (72 inch FFD)	5 oz	6.5 in	2.5 in	Yes (see 57-426)	<ul style="list-style-type: none">Lateral chest	
57-415	AP/PA (40 inch FFD)	9 oz	6.5 in	4.125 in	Yes (see 57-426)	<ul style="list-style-type: none">Sectional, AP cervical thoracic	
57-406*	Lateral Cervical (72 inch FFD)	3.2 oz	6.5 in	1.25 in	Yes (see 57-426)	<ul style="list-style-type: none">Lateral full spine (with 57-407 filter)Lateral aortic arch	
57-407*	Lateral Thoracic (72 inch FFD)	2.6 oz	6.5 in	1.25 in	Yes (see 57-426)	<ul style="list-style-type: none">Oblique or AP esophagram (obese patients)Lateral chest tomographyRoutine lateral thoracic	
57-430	Thin Buildup	2.5 oz	6.5 in	2.5 in	Yes (see 57-426)		
57-434	Thick Buildup	3.5 oz	6.5 in	2.5 in	Yes (see 57-426)		
57-437**	Thin Wedge; for conventional machines	8 oz	6.5 in	4.5 in	Yes (see 57-426)	<ul style="list-style-type: none">AP scanograms, for determination of long-leg length discrepancies	
57-438**	Thick Wedge; for conventional machines	13 oz	6.5 in	4.5 in	Yes (see 57-426)	<ul style="list-style-type: none">Full-leg radiography (under bodyweight load)Orthopedic angiographicCross table lateral hips	
57-408	Adult Gonad Shield	0.50 oz	6.5 in	1 in	Yes (see 57-426)		
57-444	Pediatric Gonad Shield (72 inch FFD)	0.25 oz	6.5 in	1 in	Yes (see 57-426)		
57-402	Basic Full-Spine Filter Set. Includes CLEAR-Pb AP/PA Filter (57-405), CLEAR-Pb Lateral Cervical Filter (57-406), Lateral Thoracic Filter (57-407), Adult Gonad Shield (57-408), Breast Shield Set (57-409), and Filter Holder (57-426). Weight: 3 lb (1.4 kg)						
57-445	Deluxe Full-Spine Filter Set. Includes CLEAR-Pb AP/PA Filter (57-405), CLEAR-Pb Lateral Cervical Filter (57-406), Lateral Thoracic Filter (57-407), Thin Buildup Filter (57-430), Thick Buildup Filter (57-434), Adult Gonad Shield (57-408), Pediatric Gonad Shield (57-444), Breast Shield Set (57-409), and Filter Holder (57-426). Weight: 3 lb (1.4 kg)						
* These models manufactured under licensing agreement with the Mayo Clinic ® Mayo Foundation.							
** These models manufactured under licensing agreement with Alvarado Orthopedic Research Company.							

Lead-Steel Sandwich
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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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