DIAGNOSTICO POR IMAGENES

RADIACION ONCOLOGICA

SEGURIDAD RADIOLOGICA

CATALOGO DE PRODUCTOS 2011

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FLUKE®

Biomedical

Diagnostic Imaging

Product Catalog

2011

TNT 12000 X-Ray
Test Device

35080M/199XRAY kVp Divider
and Medical ScopeMeter

07-QRX Wireless QA RADCHEX
CR QC Productivity Device

76-424-4156 Nested CT
Dose Phantom Kit for
Pediatric/Adult Head and Body

Fluke Biomedical.
Better products. More choices. One company.

Radiation Oncology Product Catalog

2011

Providing solutions, not just products
Today, biomeds, physicists, RSO's, other medical personnel must meet increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

Service
Fluke Biomedical is dedicated to providing the best service within the healthcare industry. Equipped with the best-credentialed facilities, onsite experts, and full asset-management capabilities, Fluke Biomedical's service team is always on call to take care of its customers. Fluke Biomedical's world-class staff leads the industry in post- and pre-sale support, including helping customers choose the best products and accessories for their needs, technical support, product calibration, and repairs.

Regulatory compliance
Fluke Biomedical's benchmark quality operates to the most rigorous standards in the industry, including compliance with ISO 9001:2000, ISO 13485:2003, FDA/QSR as applicable, and NRC/Part 50, Appendix B/Part 21 and adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA and CNSC. Many of the Fluke Biomedical products are CE-marked and CSA-certified. In addition, the Global Calibration Laboratory holds its NVLAP Lab Code 200566-0 certification and is traceable to both the NIST & PTB.

Legacy
You may be familiar with some of our legacy brand names, including:

- Victoreen®
- Nuclear Associates
- Keithley
- Metron
- DNI Nevada
- Bio-Tek Instruments

Fluke Biomedical has taken the best elements and products of these former brands and have incorporated them into the Fluke Biomedical culture and product line available today.

Our newest catalog
Thank you for requesting our Radiation Oncology catalog. Within these pages, you will find solutions to manage your quality assurance and maintain a safe, regulatory-compliant facility in the radiation oncology physics field.

If you are interested in receiving catalogs or information about any of Fluke Biomedical's other product-lines, please visit www.flukebiomedical.com/catalog.

Catalogs are available for the following product lines:

- Biomedical Test
- Diagnostic Imaging QA
- Radiation Safety
- Service

About Fluke Biomedical

Fluke Biomedical leads the world in the manufacture of biomedical test and simulation products, including standalone electrical safety testers to fully integrated and automated performance testing and documentation systems. Fluke Biomedical also provides some of the most trusted and accurate radiation safety, medical imaging, and oncology quality-assurance solutions for regulatory compliance.

About Fluke Corporation

Fluke Biomedical is a division of Fluke Corporation. Fluke Corporation is the world leader in the manufacture, distribution, and service of electronic test tools and software and is a wholly owned subsidiary of Danaher Corporation (NYSE:DHR).

Diagnostic Imaging Product Catalog

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Diagnostic X-Ray Quality Assurance Instruments

Radiography/Fluoroscopy Phantoms and Accessories

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Diagnostic Imaging Product Catalog

FLUKE® Biomedical

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Radiation Oncology Product Catalog

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Linear Accelerator Quality Assurance Instruments

Radiation Oncology Chambers

Phantoms and Accessories

Service and Calibration

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Radiation Safety Product Catalog

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TNT 12000

X-Ray Test Device

The TNT 12000 X-Ray Test Device is the newest and most versatile instrument available for measuring key x-ray imaging parameters. It sets up in seconds and measures kVp, dose, dose rate, time, and half value layer (HVL) in a single exposure. A totally-wireless ZigBee® interface enables quick and easy setup and the wireless detector can be used with the companion wireless display or a laptop computer.

X-ray imaging QA, calibration, and maintenance in today's demanding digital environment require very high productivity and compliance with local and regional regulations. The TNT 12000 delivers high productivity through 100 % wireless connectivity to either a display, which instantly responds with all values in a single exposure, or a laptop, where measured values are displayed and categorized in organized templates. Instant HVL with just a single exposure further enhances productivity.

Featuring all-in-one-exposure measurements and ZigBee wireless communication combined with the rugged, reliable, and accurate design that is a Fluke trademark, the TNT 12000 is truly a new breed of non-invasive x-ray test tool. TNT 12000 is ideal for use by OEM factory and field service engineers, independent service organizations, physicists, biomedical and clinical engineers, and local and regional field inspectors of x-ray imaging equipment. Its small, lightweight design enhances portability and 100 % wireless operation ensures setup can be accomplished in seconds. Because the TNT 12000 measures all parameters with every exposure, there is no need for complicated menu selection, further enhancing user productivity. TNT 12000 always defaults to the last use when powered on, so when used often for repetitive procedures it is truly a one-button (power-on) solution. The TNT 12000 has the expanded functionality needed for modern applications and can be managed with minimum keystrokes. Users can identify and select custom measurement protocols and save them for future use. Full test automation and documentation software is available for TNT 12000, creating the advantage of accurate, repeatable testing processes. Ansur Test Automation Software is only available from Fluke Biomedical.

Primary end benefit

Productivity and accuracy are central goals when performing any maintenance or QA process on diagnostic imaging equipment because image system uptime is critical to patient care objectives. TNT 12000 is small, portable, and wireless. It is easily transported to the imaging room, set up in seconds, and all results are instantly available on the hand-held display or on the user's laptop. The latter application places measured values into templates that are standard with the Excel software provided with TNT 12000. Because the TNT 12000 Excel package is a spreadsheet, users can customize their templates and create their own reports to send to others. Accuracy, reproducibility, and reliability are also critically important and Fluke Biomedical is the industry standard customers count on to deliver uncompromised performance.

Key features

- 100 % ZigBee wireless operation between detector and hand-held display or laptop
- Compact hand-held design for maximum portability and ease-of-use
- Simple user interface with minimum menu routines means setup in seconds
- Fluke Biomedical ruggedness provides reliable operation. It's tough!
- 40 kHz sampling rate to ensure accuracy with the most difficult applications
- Global support network delivering prompt service and peace-of-mind to Fluke Biomedical customers worldwide

TNT 12000

X-Ray Test Device

FLUKE® Biomedical

Specifications

kVp measurements	
Units	kVp Average (average of peaks during a specified interval) kVp Max (highest peak during a specified interval) PPV (peak practical voltage)
Ranges	
Radio/Fluoro modes	40 kV to 150 kV
Mammo modes	Mo/Mo: 22 kV to 35 kV (standard calibration)
	Rh/Rh: 25 kV to 49 kV (optional calibration)
	Mo/Rh: 22 kV to 40 kV (optional calibration)
	Mo/Al: 22 kV to 49 kV (optional calibration)
	Rh/Al: 25 kV to 49 kV (optional calibration)
	W/Rh: (optional calibration)
	W/Ag: (optional calibration)
Resolution	0.1 kV
Accuracy	Radio/Fluoro modes: ± 2 % or ± 1 kV, whichever is greater
	Mammo modes: ± 2 % or ± 0.7 kV, whichever is greater
Reproducibility	± 1 % (std of 5 readings)
Filtration correction range	Radio/Fluoro modes: 1 mm Al to 10 mm Al or equivalent
	Mammo mode: 0 mm Al to 0.4 mm Al added filtration
Dose/exposure measurements	
Units	Roentgens, grays
Range	0.5 mR to 999 R 5 µGy to 999 Gy
Resolution	1 µR 0.01 µGy
Accuracy	± 5 %
Reproducibility	± 0.5 % (std % of five readings)
Filtration correction range	Radio/Fluoro modes: 1 mm Al to 10 mm Al or equivalent
	Mammo mode: 0 mm Al to 0.4 mm Al added filtration
kV correction ranges	Radio/Fluoro modes: 40 kV to 150 kV
	Mammo mode: Mo/Mo: 22 kV to 35 kV
Dose/exposure rate measurements	
Units	Roentgens or grays per hour, minute, second, pulse
Range	8 mR/s to 10 R/s 70 µGy/s to 100 mGy/s 130 µR/pulse to 160 mR/pulse (@ 60 PPS) 12 µGy/pulse to 1.4 mGy/pulse (@ 60 PPS)
Resolution	1 µR/s 0.01 µGy/s 0.02 µR/pulse (@ 60 PPS) 0.2 nGy/pulse (@ 60 PPS)
Accuracy	± 5 %
Filtration correction range	Radio/Fluoro modes: 1 mm Al to 10 mm Al or equivalent
	Mammo mode: 0 mm Al to 0.4 mm Al added filtration
kV correction range	Radio/Fluoro modes: 40 kV to 150 kV
	Mammo mode: Mo/Mo: 22 kV to 35 kV
Exposure time—radiographic modes	
Units	Milliseconds, pulses
Range (@ stated accuracy)	Milliseconds: 10 ms to 9999 ms
	Pulses: 1 pulse to 999 pulses
Resolution	Milliseconds: 0.1 ms
	Pulses: 1 pulse

Optional accessories

35035 mA/mAs Meter
TNT 12000 Ansur Test Automation Software Plug-in

TNT 12000

X-Ray Test Device

FLUKE® Biomedical

Specifications

Accuracy	Milliseconds: 1 % or 0.5 ms
	Pulses: ± 1 pulse
Reproducibility	Milliseconds: 1 % or 0.5 ms
	Pulses: ± 1 pulse
Elapsed time—fluoro modes	
Range	10 sec to 9999 sec
Resolution	0.1 second
Accuracy	1 % or 0.5 sec
Average pulse rate—pulsed fluoro	
Range	1 pps to 999 pps (pulses per second)
Resolution	1 pps
Accuracy	1 pps
Average pulse width— pulsed fluoro	
Range	10 ms to 999 ms
Resolution	0.1 ms
Accuracy	1 % or 0.5 ms
HVL	
Range	Radio/Fluoro modes: 1.2 mm Al to 10 mm Al (equivalent)
	Mammo mode: 0.2 mm Al to 0.6 mm Al (equivalent)
Resolution	Radio/Fluoro modes: 0.1 mm Al (equivalent)
	Mammo mode: 0.01 mm Al (equivalent)
Accuracy	Radio/Fluoro modes: ± 10 % or 0.2 mm Al (equivalent)
	Mammo mode: ± 5 % or 0.05 mm Al (equivalent)
Electrical specifications	
Battery	Battery type: Lithium-ion, 3.7 V, 4000 mAh
	Battery charge time: Approx. 5 hr
	Battery discharge time: Approx. 8 hr
	Battery cutoff voltage: 2.75 V
AC adapter	Input voltage: 100 V ac to 240 V ac
	Input frequency: 50/60 Hz
	Input current: 0.5 A (rms)
	Output voltage: 6 V dc
Environmental specifications	
Operating temperature	0 °C to 35 °C (32 °F to 95 °F)
Storage temperature	-35 °C to 50 °C (-31 °F to 122 °F)
Operating humidity	20 % to 80 % RH (non-condensing)
Physical specifications	
Display	320 × 240 Color LCD
Size (WxDxH)	Display: 15.2 cm x 11.4 cm x 4.45 cm (6 in × 4.5 in × 1.75 in)
	Detector: 15.2 cm x 11.4 cm x 4.45 cm (6 in × 4.5 in × 1.75 in)
Weight	Display: 0.422 kg (0.93 lb)
	Detector: 0.68 kg (1.5 lb)

Optional accessories

3335538 TA-TNT12K, TNT 12000 with Test Automation

3340639 TA-TNT12KWD, TNT 12000 Wireless Detector with Test Automation

Ordering information

Kit #1

TNT 12000 X-Ray Test Device

Included accessories

1320005000 TNT 12000WD Wireless Detector
1330005000 TNT 12000D Wireless Display
14-445 (2) AC Adapters/Chargers
50-197 Cable, Type A to Mini B USB
50-198 Cable, Mini A to Mini B USB
1320003000 Excel Software/ User Manual on CD
1320033000 Carrying Case
90-183 ZigBee® USB Dongle
TNT12QRG Quick Start Reference Guide

Kit #2

3335774 TNT 12000WD Wireless Detector

Included accessories

1320005000 TNT 12000WD Wireless Detector
14-445 (1) AC Adapter/Charger
50-197 Cable, Type A to Mini B USB
1320003000 Excel Software/ User Manual on CD
1320033000 Carrying Case
90-183 ZigBee® USB Dongle
TNT12QRG Quick Start Reference Guide

Kit #3

3335795 TNT 12000D Wireless Display

Included accessories

1330005000 TNT 12000D Wireless Display
14-445 (1) AC Adapter/Charger
50-197 Cable, Type A to Mini B USB
50-198 Cable, Mini A to Mini B USB
1320003000 Excel Software/ User Manual on CD
TNT12QRG Quick Start Reference Guide

35080M/199XRAY

Non-Invasive kVp Divider and Medical ScopeMeter

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Biomedical

The winning combination.
The 35080M and 199XRAY are commonly used x-ray tools unmatched by traditional meters. This winning combination allows busy service engineers and biomedical personnel the ability to perform fast and accurate verification of kVp values for calibration or QA assessment. Fluke Biomedical offers this combination in a convenient kit with all the accessories you need to get started.

35080M Non-Invasive kVp Divider
The 35080M Non-Invasive kVp Divider quickly and accurately measures kVp for all modalities. The unit checks both above and below table tubes and displays the direct kVp values on either the 35050AT Dosimeter, the 199XRAY Medical ScopeMeter, or optional Excel Add-in software. The 35080M is highly portable and eliminates the need for bulky and heavy high-voltage divider tanks. In fact, it's so compact in size that it fits into a shirt pocket.

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

199XRAY Medical Scopemeter
The 199XRAY Medical ScopeMeter has all the normal oscilloscope functions, as well as the speed, performance, and analysis power for more-demanding applications. This high-performance oscilloscope offers the functionality of top-end bench instruments. With up to 200 MHz bandwidth, 2.5 GS/s real-time sampling, and a deep memory of 27,500 points per input, the 199XRAY is ideal for engineers who need the full capabilities of a high-performance oscilloscope in a handheld, battery-powered instrument.

In addition, the 199XRAY is specially designed for use with x-ray systems. This ScopeMeter displays kVp waveforms and direct kVp values simultaneously on an easy-to-read screen, eliminating time-wasting calculations of scope traces to derive kVp values.

Key features

35080M
- New miniaturized configuration for convenient transport to the job site
- Fast/easy non-invasive kVp values for calibration/QA
- Non-invasive technology eliminates the hazards of high-voltage cables and the need for bulky divider tanks
- Auto ON/OFF when connected/disconnected
- Optional filter packs enable testing in all modalities
- Rh/Rh measurement capability when 35080M is used with Cadmium K-Edge and Linear Mammo Filter Pack Pair
- Convenient storage/carrying case

199XRAY
- ScopeMeter displays kVp wave forms and direct kVp values simultaneously on an easy-to-read screen
- No more time spent calculating scope traces to derive kVp values
- Full medical oscilloscope scope functionality with color display
- ScopeMeter triggers on standard interlaced and high-resolution, non-interlaced video systems. Triggers on all lines nonselectively or select an individual video line—up to 2800 lines per frame
- mAs measurement calculates current over time
- Smart averaging capabilities
- Extended vertical offset
- Selectable persistence mode
- Extended video triggering
- FlukeView® for Windows® for documenting, enhancing, waveform analysis, and archiving results

35080M/199XRAY

Non-Invasive kVp Divider and Medical ScopeMeter

FLUKE® Biomedical

Specifications

35080M

Range	50 kVp to 150 kVp, using only the wide-range radiographic filter pack (37617). Range and versatility are extended with the use of special optional filter packs.
Accuracy	± 2 % of reading in the range of 50 kVp to 150 kVp, exclusive of linearity, filtration, and gain effects. Linearity corrections automatically applied when using 35080M with either 35050AT Dosimeter or 199XRAY.
Response time	150 µs (10 % to 90 %)
Calibration	Internally generated signal provides a calibration check
Minimum time for valid reading	1 ms, three-phase; one line cycle, single-phase
Tube current	Wide dynamic range from 4 mA to 3000 mA (three-phase), 2 mA to 1500 mA (single phase). Generator settings will vary in waveform and distance. Less than ± 1 kVp effect for wide-range radiographic filter pack covering 50 kVp to 150 kVp. Specialty filter packs may have different characteristics.
Environmental	Temperature range: 0 °C to 35 °C Relative humidity: 20 % to 80 % Storage temperature: -35 °C to 50 °C
Orientation	Long axis of the Model 35080M Non-invasive kVp Divider oriented perpendicular to axis of x-ray tube to eliminate heel effect.
Power requirements	9 V battery, 60 hours operation
Dimensions (LxWxH)	6 cm x 9 cm x 21 cm (2.38 in x 3.5 in x 8.25 in)
Weight	0.68 kg (1.5 lb)

MA190 Accessory Kit

The MA190 accessory set enables interconnection of the 199XRAY for use in the field of medical imaging and video systems. The kit is included with the 199XRAY as a standard accessory. The accessory kit includes the following:

- FlukeView for Windows software
- 50 Ω BNC feedthrough terminator, in insulated enclosure, to maintain proper termination of test connections during measurement
- 50 Ω BNC terminator with 10:1 signal attenuation, to keep test terminal properly loaded while getting optimum signal amplitude to benefit from the instrument's extended offset range
- 1 Ω current shunt for current measurements, in insulated enclosure
- Safety-designed BNC cable, 1.5 m (5 ft), with plastic connectors for safe connection to test terminals even when not at ground potential
- Insulated BNC (f) to 4 mm banana-plug adapter
- Dual 4 mm banana receptacles (1 red, 1 black)

35080M/199XRAY

Non-Invasive kVp Divider and Medical ScopeMeter

FLUKE® Biomedical

Specifications

199XRAY

Field applications	
Bandwidth	Dual input: 200, 100 or 60 MHz
Real-time sampling rate	Up to 2.5 GS/s
Trigger types	Connect-and-View™ automatic triggering and a full range of manual trigger modes
Extended video triggering	Along with its triggering capability for standard, interlaced TV signals, the instrument also triggers on high-resolution, non-interlaced video systems. The ScopeMeter 199XRAY will trigger on all lines (nonselective), or can select an individual video line from systems with up to 2800 lines per frame.
Persistence	Digital persistence for analyzing complex dynamic waveforms, similar to an analog scope.
Selectable persistence	Persistence mode with selectable decay time helps to find anomalies in the wave shape and optimizes the display for color information when working with composite color video.
Display	Fast-display update rate for seeing dynamic behavior instantaneously
	Automatic capture and replay of 100 screens
Maximum record length	27,500 points-per-input record length using ScopeRecord mode
Trend analysis	TrendPlot paperless chart recorder for trend analysis up to 22 days
Independently floating isolated inputs	Up to 1,000 V
Waveform compare	Waveform reference for visual comparisons and automatic pass/fail testing of waveforms
Vpwm	Vpwm function for motor drive and frequency inverter applications
mA	mAs measurement calculates current over time. Using the cursors, you can now measure directly the amount of radiation produced by x-ray systems, or the total amount of charge applied to a system.
Smart averaging	Smart averaging gives the averaged waveform over successive acquisitions, reducing noise in the displayed waveform. Thanks to smart averaging, you can now also see an incidental curve of a different wave shape with no effect on the averaged curve. This allows you to see the averaged curve of a sequence of video lines, for example, while still seeing the incidental flyback line flash by. The oscilloscope gives an immediate response when the signal makes large changes.
Extended offset	Vertical offset is now extended to a maximum of 16 divisions, allowing vertical zoom-in for study of small details of the signal.
Electrical safety	1000 V CAT II and 600 V CAT III safety certified
Power requirements	Rechargeable NiMH battery pack, four hours operation
Dimensions (LxWxH)	25.6 cm x 16.9 cm x 6.4 cm (10.1 in x 6.6 in x 2.5 in)
Weight	2.0 kg (4.4 lb)

FlukeView® for Windows®

Documenting	Transfer waveforms, screens, and measurement data from the ScopeMeter to a PC. Print or import the data into your report.
Enhancing	Add user text to individual ScopeMeter settings, providing guidance to the operator when recalling a setup.
Archiving	Create a library of waveforms with your comments for easy reference and comparison. Store complete replay cycles for analysis of waveform changes. Store complete memory content of the ScopeMeter on your PC for backup purposes.
Waveform comparison	Store reference waveforms, add operator instructions, and send both to the ScopeMeter for waveform comparison and "Pass/Fail" testing.
Analysis	Use cursors, perform spectrum analysis, or export data to other analysis programs.

Optional accessories

33551 CT filter pack
37351 Linear mammo filter pack
37355 Cadmium K-Edge filter pack
37946 Mobile filter pack
38237 Low range filter pack

Included accessories

35080M/199XRAY
35080M Non-Invasive kVp Divider
199XRAY Medical ScopeMeter
MA190 Medical ScopeMeter Accessory Kit
37617 Wide-range filter pack
121002900 Carrying Case

199XRAY
MA190 Medical ScopeMeter Accessory Kit

35080M
37617 Wide-range filter pack
1210029000 Carrying case

Ordering information

35080M/199XRAY kVp Divider and Medical ScopeMeter Kit
199XRAY Medical ScopeMeter with kVp capabilities
35080M Non-Invasive kVp Divider

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10100AT, 10500AT and 10500AMT

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

FLUKE® Biomedical

The TRIAD™ TnT X-Ray Field Service/Calibration/QA Kit is a full-function, x-ray dosimeter kit that performs fast, highly-sensitive measurements. It is ideal for government compliance testing, troubleshooting, repair of diagnostic x-ray equipment, installation and setup of new equipment, preventive maintenance, radiographic QA measurements, and measurements required for JCAHO accreditation. The kit performs measurements for all modalities: radiographic, fluoroscopic, mammographic (MQSA), CT, cine and dental.

The TRIAD TnT Kit comes in three popular configurations:

- 10100AT is the base-level dosimeter kit and features the 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.
- 10500AT includes all of the components from the 10100AT, in addition to the 35080M non-invasive kVp divider and 37617 wide-range filter pack (50 kVp to 150 kVp), for quick and accurate kV measurement.
- 10500AMT is equipped with all the components from the 10500AT, as well as the 35035 mA/mAs meter and CA-23 universal test-lead kit, allowing engineers to accurately measure mAs and fluoroscopic mA for diagnostic, radiographic, and fluoroscopic imaging equipment.

Key features

- Bright display with direct readout in user-selected units
- Image intensifier measurements at 0.1 µR and 0.1 µR/s resolution; cine in µR/frame
- Expanded kVp and exposure-time measurement capabilities
- Simplified controls include autoreset, autoranging, automatic offset and drift compensation, automatic power-down, and automatic pressure and temperature correction
- Optional TRIAD toolkit for Excel for remote operation, waveform capture, and calibration
- Multiple self-checking features to reduce testing time
- Battery-powered with auto power-down feature to extend battery life
- Automatic temperature and pressure correction for faster operation in any environment
- Timesaving scroll functionality
- Recognizes and ignores spurious background signals
- Very low dose rate: 20 nGy/s at a 1 nGy/s resolution
- Broader range of dental unit kV and time measurement

10100AT, 10500AT and 10500AMT

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

FLUKE® Biomedical

Specifications

10100AT TRIAD TnT Kit

Exposure and exposure rate accuracy	
Basic accuracy of 35050AT	± 1 % of reading ± 2 range resolution steps over range of 18 °C to 28 °C and ± 2 % of reading ± 2 range resolution steps over the full operating temperature range of 0 °C to 50 °C
Note: A 3 % NIST-traceable calibration is provided with each system and includes effects of 35050AT, 96035B, and 96020C.	
Exposure time measurement	
Exposure time accuracy	± 0.1 % of reading; ± 0.2 msec
Maximum exposure time	6.5 s
Measurement resolution	0.2 ms
Measurement modes	
kVp/Dose/Time	Single-shot ("all-in-one" exposure), direct-beam measurement of exposure, kVp, and time; autoranging across three-decade ranges; auto reset between exposures; display updates after each exposure
kVp/Rate	Simultaneous measurement of kVp and exposure rate
Full sensitivity dose	Autoranging across five decades of sensitive ranges; automatic drift and offset compensation; 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. Autoranging 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 are disabled. As a result, the system can display very low dose rates.	
Power requirements	
Battery life	~30 hours with six AA alkaline batteries; automatic power-down after user-selected period of unattended operation (5 min to 255 min); AC adapter supplied with each 35050AT
Note: 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 reselection at power-up	
Bias voltage supply	Fixed electronic bias (~300 V); bias voltage 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.
Connections	
35080M 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
General information	
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	6.4 kg (14 lb)
Dimensions (LxWxH)	46 cm x 33 cm x 15 cm (18 in x 13 in x 6 in)
Diagnostic Ionization Chambers (96035B and 96020C)	
Energy range	96035B: 30 kVp to 150 kVp; 20 kVp to 50 kVp for mammographic 96020C: 30 kVp to 150 kVp
Nominal sensitivity	96035B: 2.00 R/C x 108 R/C (1.75 Gy/C x 106 Gy/C) at 22 °C and 1013 hPa 2.21 R/C x 108 R/C (1.94 Gy/C x 106 Gy/C) at 22 °C and 1013 hPa (flat response suitable for conventional diagnostic radiography and mammography)
	96020C: 2.08 R/C x 10^7 R/C (1.82 Gy/C x 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 cm^3
	96020C: 150 cm^3

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

FLUKE® Biomedical

Specifications

10100AT TRIAD TnT Kit (continued)

Ion Chamber	Units	Effective Range ***	Resolution Step Size
15 cc	R	100 µ to 20	1 µ
	R/s	100 µ to 20	1 µ
	R/m	5 m to 1200	50 µ
	R/h	100 m 72 k	1 m
	R/f **	2 µ to 333 m	0.02 µ
	Gy	1 µ to 175 m	0.01 µ
	Gy/s	1 µ 174 m	0.01 µ
	Gy/m	50 µ to 10.5	0.5 µ
	Gy/h	1 m to 630	0.01 m
	Gy/f **	0.02 µ to 2.9 m	0.2 n
150 cc	R	10 µ to 2	0.1 µ
	R/s	10 to 2	0.1 µ
	R/m	0.5 m to 120	5 µ
	R/h	10 m to 7.2 k	0.1 m
	R/f **	0.2 µ to 33 m	0.002 µ
	Gy	0.1 µ to 17.5 m	0.001 µ
	Gy/s	0.1 µ to 17.5 m	0.001 µ
	Gy/m	5 µ to 1050 m	.05 µ
	Gy/h	0.1 m to 63	0.001 m
	Gy/f **	0.002 µ to 290 µ	0.02 n
150 cc VLDR	R/s	2 µ to 2*	0.1 µ
	R/m	0.1 m to 120*	5 µ
	R/h	2 m to 7.2 k*	0.1 m
	R/f **	0.04 µ to 33 m*	0.002 µ
	Gy/s	0.02 µ to 17.5 m*	0.001 µ
	Gy/m	1 µ to 1050 m*	0.05 µ
	Gy/h	0.02 m to 63*	0.001 m
	Gy/f **	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 x 10^8 R/C, 150 cc: 2.4 x 10^7 R/C
*Very Low Dose Rate effective range at 5 % resolution steps.
**At 60 f/s (1 to 120 frames/selectable).
***IEC 61674 effective range at 1 % resolution steps

96020C and 96035B Diagnostic Ion Chambers

Energy range	96020C: 30 kVp to 150 kVp
	96035B: 30 kVp to 150 kVp for diagnostic measurements; 20 kVp to 50 kVp for mammographic measurements
Nominal volume	96020C: 150 cm^3; 11.3 cm diameter by 1.5 cm thick active volume
	96035B: 15 cm^3; 3.96 cm diameter by 1.22 cm thick active volume
Nominal sensitivity	96020C: H60: 2.08 R/C x 10^7 R/C at 22 °C and 760 mmHg (optimized for low-level image intensifier and cine measurements)
	96035B: L100: 2.0 R/C x 10^8 R/C at 22 °C and 760 mmHg
	MV30 (PTB Mammo Point): 2.21 R/C x 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

96020C and 96035B
- Very low leakage and low noise
- Rugged mechanical construction
- Ionization chambers are supplied with triaxial BNC connectors

96020C and 96035B Diagnostic Ion Chambers

The 96020C and 96035B Diagnostic Ion Chambers are vented-volume, parallel-plate air ionization chambers with side-mounted BNC triaxial connectors. The 96020C Ion Chamber has a nominal volume of 150 cm^3, and the 96035B has a nominal volume of 15 cm^3. Both ion chambers have a fully-guarded, centrally-located collector plate that provides superior collection efficiency.

The patented* 96035B has a dual-energy range that enables both diagnostic and mammographic measurements. They are accomplished using the other side as the entrance window.

*Patent numbers 4,843,619, 4,916,727 and 5,508,526.

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

FLUKE® Biomedical

Specifications

96020C and 96035B Diagnostic Ion Chambers (continued)

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/cm^2
	96035B: 32 mg/cm^2
Active window area	96020C: 100 cm^2, 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 cm^2
Collector plate	96020C: 0.8 mm thick graphite-coated acrylic plate, 10.8 cm in diameter; 2.16 cm x 2.85 cm guard region electrically isolated from collector area
	96035B: 0.25 mm thick, centrally mounted, graphite-coated, polycarbonate plate, 3.18 cm, ± 0.01 cm in diameter; 1.27 cm 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: Standard calibration performed at H60 (NIST defined as 60 kVp, first HVL of 6.0 mm Al, homogeneity coefficient of 94)
	96035B Standard Calibration: Standard calibration performed at one diagnostic and one mammographic beam quality; calibration factors normalized to 22 °C and 760 mmHg
	Diagnostic Unattenuated Beam: Calibration on diagnostic side of 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 mammographic side 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)

35080M Non-Invasive kVp Divider

Range	50 kVp to150 kVp, using only the wide-range radiographic filter pack (37617); range and versatility extended with use of special optional filter packs
Accuracy	± 2 % of reading in the range of 50 kVp to 150 kVp, exclusive of linearity, filtration, and gain effects; linearity corrections automatically applied when using 35080M Non-invasive kVp Divider with either the 35050AT Dosimeter or the 199XRAY Medical Scopemeter
Response time	150 µs (10 % to 90 %)
Calibration	Internally generated signal provides calibration check
Minimum time for valid reading	1 ms, 3-phase; one line cycle, single-phase
Tube current	Wide Dynamic Range: From 4 mA to 3000 mA (3-phase), 2 mA to 1500 mA (single-phase)

Note: Generator settings will vary in waveform and distance. Less than ± 1 kV effect for wide-range radiographic filter pack, covering 50 kVp to 150 kVp.
Specialty filter packs may have different characteristics

Key features

35080M

- New pocket-size configuration
- Non-invasive technology eliminates the hazards of high-voltage cables and need for bulky divider tanks
- Auto ON/OFF when connected/disconnected
- Optional filter packs enable testing in all modalities
- Rh/Rh measurement capability when 35080M Non-Invasive kVp Divider is used with cadmium K-Edge and linear mammo filter pack pair

35080M Non-Invasive kVp Divider

The 35080M Non-Invasive kVp Divider quickly and accurately measures kV for all modalities. The unit checks both above and below table tubes, and the direct kV values are displayed on either the 35050AT Dosimeter or the 199XRAY Medical ScopeMeter. Derived kV can also be calculated using a storage oscilloscope. The 35080M Non-Invasive kVp Divider is highly portable and eliminates the need for bulky and heavy high-voltage divider tanks—so compact in size that it fits into a shirt pocket.

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

Specifications

35080M Non-Invasive kVp Divider (continued)

Environmental requirements	Temperature range: 0 °C to 35 °C
	Relative humidity: 20 % to 80 %
	Storage temperature: –35 °C to 50 °C
Orientation	Long axis of the 35080M Non–invasive kVp Divider oriented perpendicular to axis of x-ray tube to eliminate heel effect
Power requirements	9 V battery, 50 hours operation; battery–check function connects battery to output terminals for voltage measurement
Dimensions (LxWxH)	6 cm x 9 cm x 21 cm (2.375 in x 3.5 in x 8.25 in)
Weight	0.68 kg (1.5 lb)

35035 mA/mAs Meter

Controls	1) Power mA/mAs switch, 2) Reset switch, 3) Range switch: 200 mA/mAs, 2000 mA/mAs and 20 mA range settings, 4) ac/dc switch
Accuracy	1 % of reading ± two least significant digits for all ranges
Environmental requirements	Temperature range: 5 °C to 35 °C
	Relative humidity: 0 % to 80 %
	Storage temperature: –20 °C to 50 °C
Display	Liquid crystal display (LCD), 3.5 digit, .5 in H (13 mm)
Input	Two banana jacks
Power requirements	9 V alkaline battery with easy replacement
Dimensions (LxWxH)	15 cm x 5.0 cm x 8.75 cm (2 in x 2 in x 3.50 in)
Weight	0.35 kg (0.78 lb)
Please refer to charts at the right for Miliamp, current and signal Input limit specifications for the 35035 mA/mAs Meter	

Milliamp seconds (mAS)		
Range	**Resolution**	**Input impedance***
200 mAs	0.1 mAs	10 Ω
2000 mAs	1.0 mAs	1 Ω
*Does not include fuse resistance. Also, does not include effect of bridge rectifier present when unit is set for ac specifications		
Current (mA)		
Range	**Resolution**	**Input impedance***
20 mA	0.01 mA	100 Ω
200 mA	0.1 mA	10 Ω
2000 mA	1 mA	1 Ω
*Does not include fuse resistance. Also, does not include effect of bridge rectifier present when unit is set for ac specifications		
Signal input limits		
Function	**Range**	**Max 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)
*Limits set by power dissipation rating of shunt resistors		

10100AT, 10500AT and 10500AMT

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

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

Included accessories

10100AT
35050AT Dosimeter
96035B 15 cm^3 Ion Chamber
96020C 150 cm^3 Ion Chamber
38208 Coax/triaxial Cable, 6 m (20 ft)
37594 Programming Kit (37594), includes customization software on CD, two- meter RS-232 interface cable and adapters
37581 Test Stand (37581), ion chamber stem, HVL filter tray
37688 HVL filter set (37668)
35050ATCD User/service manual
37500D Kit Carrying Case

10500AT
Components in 10100AT Kit plus
35080M Non-Invasive kVp Divider
37617 Wide-range Filter Pack (50 kVp to 150 kVp)

10500AMT
Components in 10500AT Kit plus
35035 mA/mAs Meter
A-23 Universal Test Lead Kit

Ordering information

10100AT TRIAD TnT Dosimeter Kit
10500AT TRIAD TnT X-Ray Field Kit Service/Calibration/ QA Kit
10500AMT TRIAD TnT X-Ray Field Kit Service/Calibration/ QA Kit

Optional accessories

All Kits
500-100 CT Ion Chamber 3.2 cm^3
500-200 CT Ion Chamber High Sensitivity, 10 cm^3, for Multislice CT
07-434 Ultra-high Purity HVL Attenuators (for mammo set of six)
10500EXL TRIAD Toolkit for Excel
38617 USB to RS-232 Adapter
199XRAY Medical ScopeMeter with kVp Capabilities (includes the MA190 Medical ScopeMeter accessory kit)

10500AT and 10500AMT Kits
37355/37351 Mammographic Filter Pack Pair includes: Cadmium k-edge mammo filter pack (27.5 kVp to 29.5 kVp) ± 0.5 kV accuracy, linear mammo filter pack (22 kVp to 40 kVp) ± 1.0 kV accuracy

Note: Mammo filter packs are designed for molybdenum anode, beryllium window generators.

37946 Mobile Filter Pack (50 kVp to 135 kVp) ± 2 % accuracy
33551 CT Filter Pack (70 kVp to 140 kVp) ± 2 % accuracy kVp) ± 2 % accuracy
38237 Low Range Filter Pack (30 kVp to 90 kVp) ± 2 % accuracy

Available ac adapters
9 V, 200 mA
(specify with order)
14-106 USA and Japan
14-107 Europe
14-108 UK
14-109 Australia

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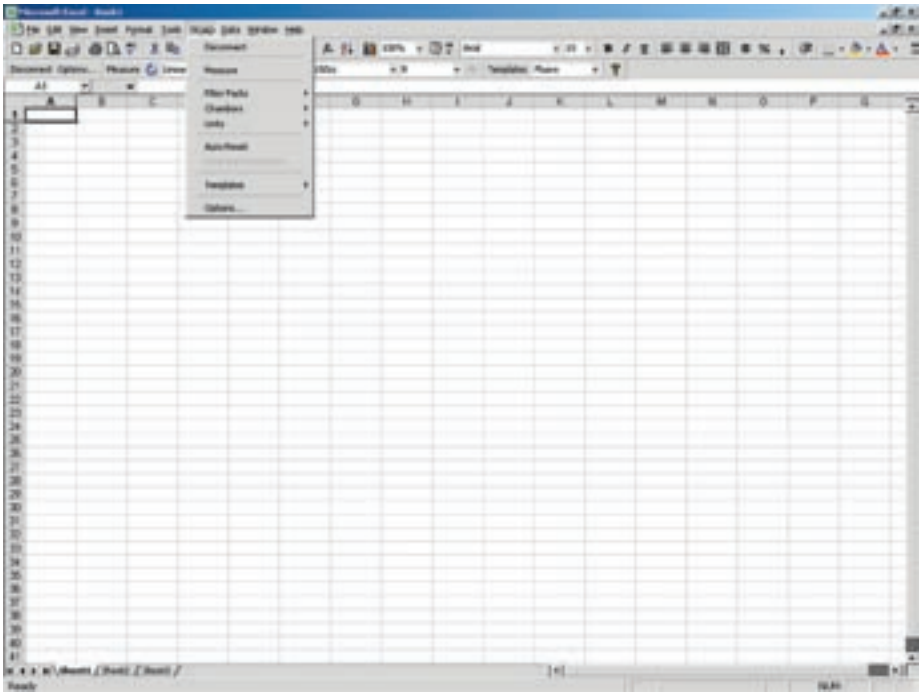
10500EXL

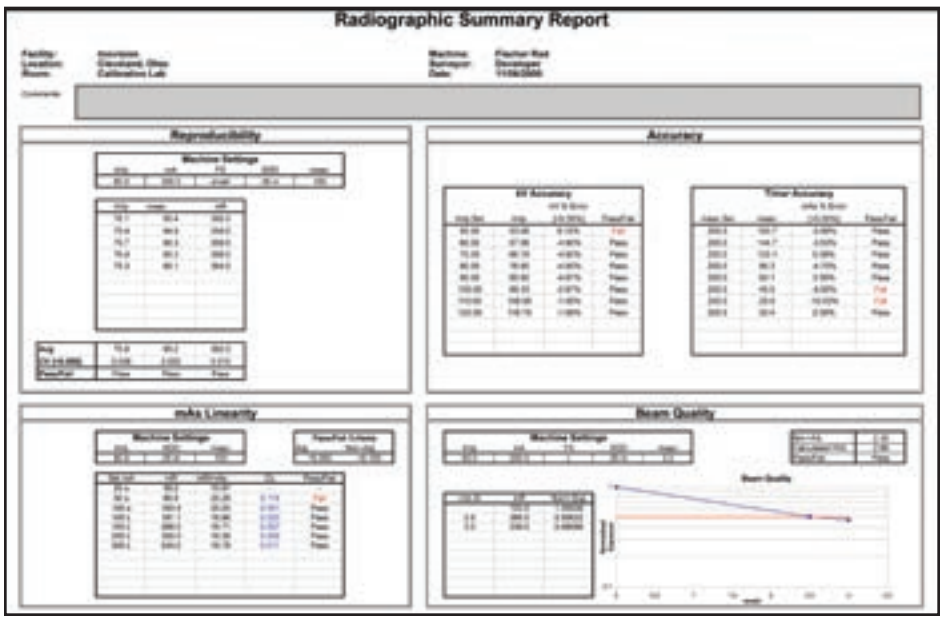
TRIAD™ Toolkit for Excel



Key features

- 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 mammo-graphic x-ray machines
- Templates may be modified to perform user-specific tests and generate customized reports
- Allows complete remote control of the TRIAD
- Automatically downloads Model 35050A and 35050AT Dosimeter configuration settings
- Compatible with Windows® 2000 and above, and Microsoft® Excel 97, 2000

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 used to evaluate the performance of radiographic, mammographic, and fluoroscopic x-ray machines. The TRIAD Tool collects measured results from the 35050A and 35050AT 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.



10500EXL

TRIAD™ Toolkit for Excel

FLUKE® Biomedical

Specifications

Controls	
The TRIAD Tools menu provides an interface 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 is enabled after an exposure is made and before the TRIAD is set up for another exposure. When the Waveform button is pressed, a dialog box prompts 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 is then 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, and beam quality
The TRIAD mammographic template	May be used to perform mammography tests required for ACR and MQSA. Measured data from the 35050A Dosimeter may be automatically collected in the following worksheets: kVp accuracy, kVp reproducibility, Beam quality, Breast entrance exposure, AEC reproducibility, average glandular dose, and radiation output rate
The TRIAD fluoroscopic template	Is used to perform the following fluoroscopic tests: kVp accuracy, beam quality, and fluoro exposure rate
These templates are easy to use and can be modified to fit the user's needs.	

System requirements

Windows 2000 and above
Microsoft Excel 97, 2000
One serial port (COM1 through COM4)

Ordering information

10500EXL TRIAD Toolkit for Excel

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NERO® mAx X-Ray Test Device

The NERO® mAx, Non-invasive NERO mAx X-Ray Test Device, tests the spectrum of x-ray machines on the market today. Offering evaluation of pulsed fluoro, cine, computed tomography (CT), portable, mammographic, dental, radiographic, fluoroscopic, low-, medium-, and high-frequency machines with a single device, the NERO mAx is a benchmark instrument for quality and accuracy. This fifth generation quality assurance tool features 100 kHz sampling speed and direct mA/mAs measurements. The NERO mAx's innovative Easy Flow Menu (EFM) system and flexible soft keys 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 soft keys 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 they may only be inserted properly. The W/Al filter card and the Mammo filter card are clearly labeled to the x-ray tube targets for which they are calibrated.

Key features

- Non-invasive evaluation of radiation outputs
- 100 kHz sampling speed captures data from the most difficult machines
- 0.5 kV or 1 % accuracy from 22 kV 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

External chambers

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

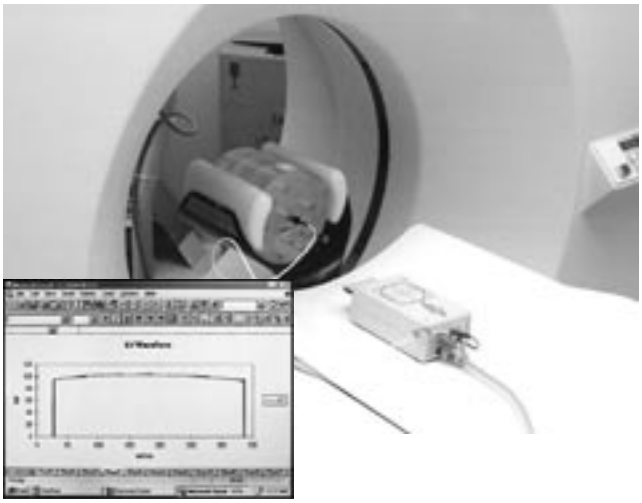
Chamber calibration factors can be stored in the NERO mAx for direct readout of measurements.

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

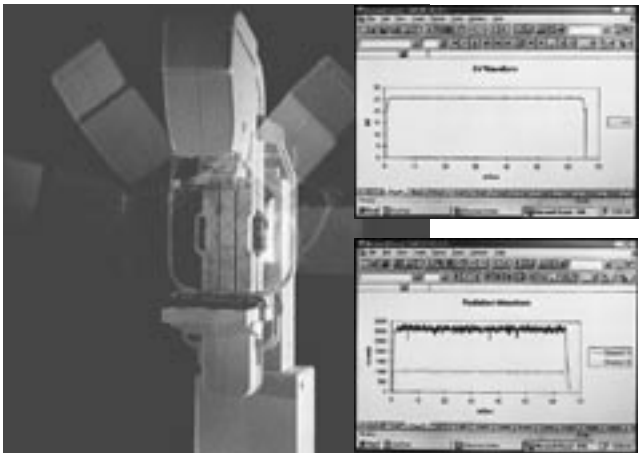
8000

NERO® mAx X-Ray Test Device

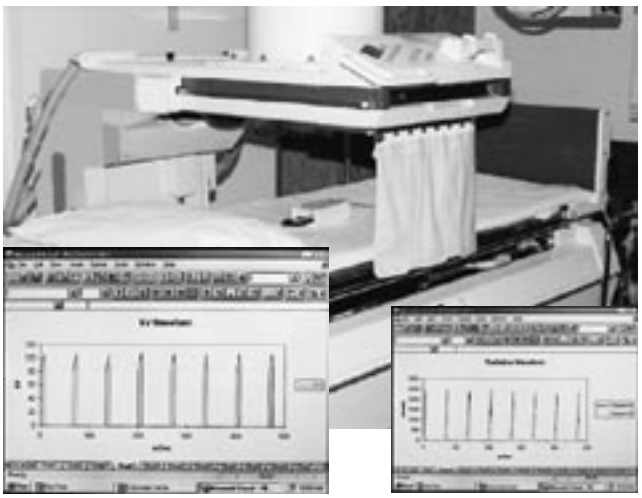
Real-time CT

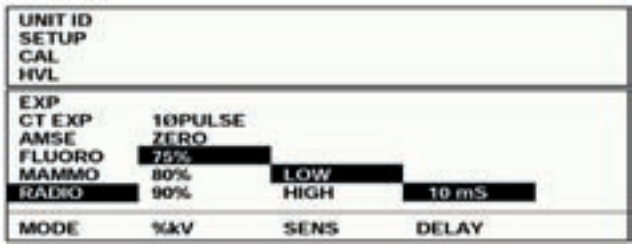


High-frequency mammography



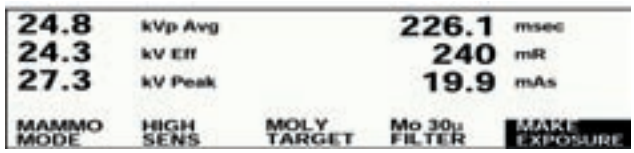
Pulsed fluoro/AMSE





Easy Flow menu, Mode Select screen.

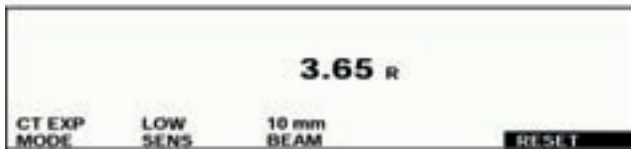
Easy Flow menu, Radio screen.



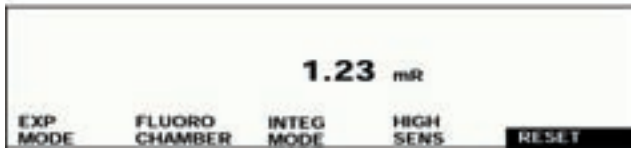
Easy Flow menu, Mammo screen.

Easy Flow menu, Pulsed Fluoro display.

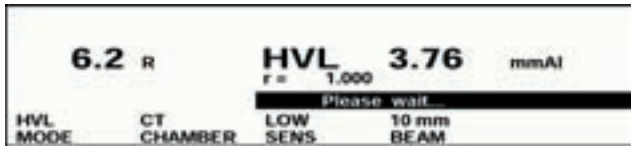
Easy Flow menu, AMSE screen.



Easy Flow menu, CT EXP screen.



Easy Flow menu, EXP screen.



Easy Flow menu, HVL screen.

Specifications

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, kV Peak, and 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, and 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, kV Eff, exposure rate (R/min), mA, and kV Peak
	In the pulsed fluoro mode, the NERO mAx measures: kVp Avg, kV Eff, Exposure rate (R/min and mR/pulse), mAs/pulse, and 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, and Time/frame (ms/frame)
CT exposure mode	CT Exposure mode is used to make CT exposure measurements using the 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 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.

Optional external chamber accessories	
6000-528	30 cm^3; Energy response: within 7 % from 30 kVp to 150 kVp (15 keV to 65 keV); Cable: 4.5 m (15 ft); Chamber dimensions: 10.2 cm x 10.2 cm x 1.4 cm (4 in x 4 in x 0.54 in thick)
6000-529	3.3 cm^3; Energy response: within 5 % from 0.2 mm to 5.0 mm Al HVL (16 kVp to 90 kVp); Cable: 4.5 m (15 ft); Chamber dimensions: 4 cm Ø x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber.
6000-530B	150 cm^3; Energy response: ± 10 % from 1.8 mm to 10 mm Al HVL; Cable: 3 m (10 ft); Chamber dimensions: 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in)
6000-532B	400 cm^3; Energy response: ± 5 % from 32 keV to 662 keV; Cable 3 m (10 ft); Chamber dimensions: 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in)
6000-100 and 500-100 CT	3.2 cm^3; Energy response: ± 5 % from 1 mm to 10 mm Al HVL; Cable: 0.9 m (3 ft); Sensitive length: 10 cm (4 in); chamber inside Ø: 6.4 mm (0.25 in)
6000-200 and 500-200 CT	10 cm^3, for multislice CT; Energy response: ± 5 % from 1 mm to 10 mm Al HVL; Cable: 0.9 m (3 ft); Sensitive length: 10 cm (4 in); Chamber inside Ø: 11.44 mm (0.45 in)

8000

NERO® mAx X-Ray Test Device

Specifications

Kilovoltage (Measured during the first 480 ms of exposure)			
Measured quantity	kVp Avg, kV Eff, kV Peak		
Accuracy	0.5 kV or ± 1%		
Reproducibility	0.5 kV or ± 1%		
Range	**Target/Filter**	**Range**	**Filtration**
	W/Al	30 kV to 60 kV	
		50 kV to 100 kV	
		80 kV to 160 kV	1.2 mm of Al
	Mo/Mo	22 kV to 35 kV	30 µ of Mo
	Mo/Rh	22 kV to 40 kV	25 µ of Rh
	Mo/Al	22 kV to 49 kV	1 mm of Al
	Rh/Rh	25 kV to 49 kV	25 µ of Rh
	Rh/Al	25 kV to 49 kV	1 mm of Al
All calibrations performed with NIST traceable calibration beam.			
Analyze/display cycle time			
Radio and mammo	Three seconds for 0.1 second exposure, ine second for each 32 ms of exposure time		
Fluoro and 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	1 ms		
Resolution	0.1 ms		
Range	All diagnostic exposures from 1 ms to 60 seconds		
Exposure and rate (Measured during entire exposure with automatic energy, temperature, and pressure correction)			
Measured quantity	Roentgens or grays		
Accuracy	± 5 %		
Reproducibility	Radio and mammo modes: ± 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	± 1 % or 0.2 mAs		
Range	0.1 mAs to 9999 mAs, 0 to 1000 mA		
HVL			
Accuracy	± 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/cm^2 Polycarbonate		
HVL set	2.30 mm, 1.0 mm, 0.3 mm Al		
Power requirements	12 V dc 1 A external supply. Rechargeable internal batteries supply more than 4 hours of continuous service with overnight charge		
Size	Volume: 0.065 m^3 (3960 in^3) Console: 22.86 x 23.17 x 8.26 cm (9.00 x 9.12 x 3.25 in) Detector: 16.66 x 9.4 x 6.55 cm (6.56 x 3.70 x 2.58 in) Filter cards: 6.1 x 15.88 x 0.8 cm (2.4 x 6.25 x 0.31 in)		
Weight	Shipping: 10.43 kg (23 lb) Console: 2.067 kg (4.56 lb) Detector (with card): 0.747 kg (1.65 lb) Filter cards: 0.090 kg and 0.094 kg (2.9 oz and 3.2 oz)		

Optional accessories

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

External chamber accessories

6000-528 Radiographic Ion Chamber

6000-529 Mammographic Ion Chamber

6000-529-95 Probe Holder for BRH2 Test Stand

6000-530B Image Intensifier Ion Chamber

6000-532B Scatter Ion Chamber

6000-100 and 500-100 CT Ion Chamber

6000-200 and 500-200 CT High Sensitivity Ion Chamber

Available ac adapters for (specify with order)

14-328 110 V ac, 12 V dc, 1000 mA, USA and Japan

14-401 230 V ac, 12 V dc, 1000 mA, Europe

14-414 230 V ac, 12 V dc, 1000 mA, UK

14-414 and14-416 adapter 230 V ac, 12 V dc, 1000 mA, Australia

Included accessories

8000-100-5 Control Console

8000-101-5 Detector

105-252 Detector Cable

105-253 and **105-254** mAs Leads

8000MAX Excel Add-in

38667 HVL Plates

8000-200-1 Instruction Manual

8000-70 Carrying Case

Ordering information

8000 NERO mAx X-Ray Test Device

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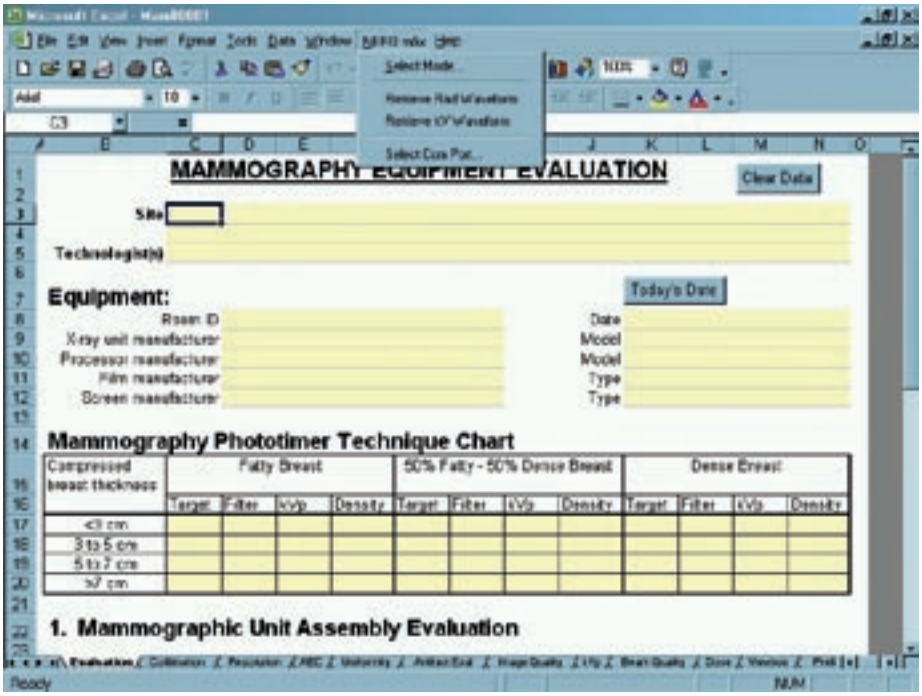
8000mAx

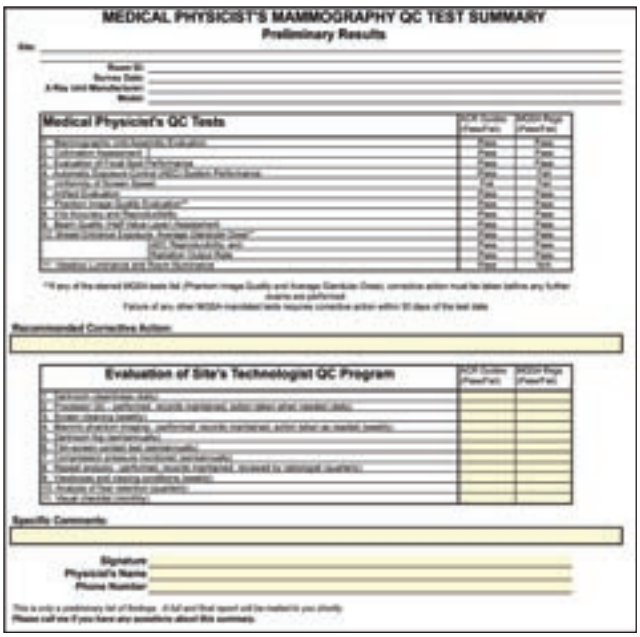
NERO® mAx Toolkit for Excel



Key features

- 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 customized reports
- Allows complete remote control of the NERO mAx
- Complete online help speeds learning
- Compatible with Microsoft® Windows® 2000 and above, and Excel 97, 2000

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.



8000mAx

NERO® mAx Toolkit for Excel

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 to be charted. If a portion of the waveform is desired, the user is 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 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.	
NERO mAx radiographic template	Used to perform the following radiographic tests: reproducibility, kVp accuracy, timer accuracy, linearity, and beam quality
NERO mAx mammographic template	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, and radiation output rate
NERO mAx fluoroscopic template	Used to perform the following fluoroscopic tests: kVp accuracy, beam quality, and fluoro exposure rate
These templates are easy to use and can be modified to fit the user's needs.	

System requirements

Windows 2000 and above
Microsoft Excel 97, 2000
One serial port (COM1 through COM4)

Ordering information

8000mAx NERO mAx Toolkit for Excel

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4000M+

X-Ray Test Device

The 4000M+ X-Ray Test Device 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 provides 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.

Key features

- 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

Specifications

Kilovoltage	
Accuracy	1 kV Mo/Mo (22 kVp to 35 kVp) (Mammo generators w/30 µ Mo)
Range	38 mg/cm^2 Polycarbonate
	W/Al tubes: 27 kVp to 155 kVp
	Mo/Mo tubes: 21 kVp 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 at 90 % rise/fall of waveform	
Accuracy	± 5 %
Range	10 mR to 10 R
Fluoroscopic	
Measured over one second intervals during fluoro exposure	
Accuracy	± 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 cm^3
Window	38 mg/cm^2, 18.9 cm^2 polycarbonate
Calibration	Reference to a NIST traceable voltage divider and a calibrated exposure monitor during irradiation

4000M+

X-Ray Test Device

FLUKE® Biomedical

Specifications

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/Al: Select anode/filter of x-ray tube
Connectors	Power: 9 V dc, 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 V dc 500 mA external supply. Rechargeable internal Ni-Cd batteries supply more than six hours of continuous service with overnight charge
Dimensions (WxDxH)	21.5 cm x 23 cm x 7.6 cm (8.5 in x 9 in x 3 in)
Weight	Approximately 1.59 kg (3.5 lb)
HVL set	Aluminum filters: 2.3 mm, 1.0 mm, and 0.3 mm

Optional external chamber accessories	
6000-528	30 cm^3; Energy response: within 7 % from 30 kVp to 150 kVp (15 keV to 65 keV); Cable: 4.5 m (15 ft); Chamber dimensions (HxWxT): 10.2 cm x 10.2 cm x 1.4 cm (4 in x 4 in x 0.54 in)
6000-529	3.3 cm^3; Energy response: within 5 % from 0.2 mm to 5.0 mm Al HVL (16 kVp to 90 kVp); Cable: 4.5 m (15 ft); Chamber dimensions: 4 cm Ø x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber.
6000-530B	150 cm^3; Energy response: ± 10 % from 1.8 mm to 10 mm Al HVL; Cable: 3 m (10 ft); Chamber dimensions (HxWxT): 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 x 0.63 in)
6000-532B	400 cm^3; Energy response: ± 5 % from 32 keV to 662 keV; Cable 3 m (10 ft); Chamber dimensions (HxWxT): 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in)
6000-100 and 500-100 CT	3.2 cm^3; Energy response: ± 5 % from 1 mm to 10 mm Al HVL; Cable: 0.9 m (3 ft); Sensitive length: 10 cm (4 in); chamber inside Ø: 6.4 mm (0.25 in)
6000-200 and 500-200 CT	10 cm^3, for multislice CT; Energy response: ± 5 % from 1 mm to 10 mm Al HVL; Cable: 0.9 m (3 ft); Sensitive length: 10 cm (4 in); Chamber inside Ø: 11.44 mm (0.45 in)

Optional accessories

4000EXL 4000 Toolkit for Excel
07-434 Ultra-High Purity HVL Attenuators for mammo, set of 6
4000-69 Carrying Case
190004 RS-232 Cable 7.6 m (25 ft), 9-pin to 9-pin

External chamber accessories

6000-528 Radiographic Ion Chamber
6000-529 Mammographic Ion Chamber
6000-529-95 Probe Holder for BRH2 test stand
6000-530B Image Intensifier Ion Chamber
6000-532B Scatter Ion Chamber
6000-100 and 500-100 CT Ion Chamber
6000-200 and 500-200 CT High Sensitivity Ion Chamber

Available ac adapters for (specify with order)

14-301 110 V ac, 9 V dc, 500 mA, USA and Japan
14-399 230 V ac, 9 V dc, 500 mA, Europe
14-415 230 V ac, 9 V dc, 500 mA, UK
14-415 and 14-416 adapter 230 V ac, 9 V dc, 500 mA, Australia

Ordering information

4000M+ X-Ray Test Device

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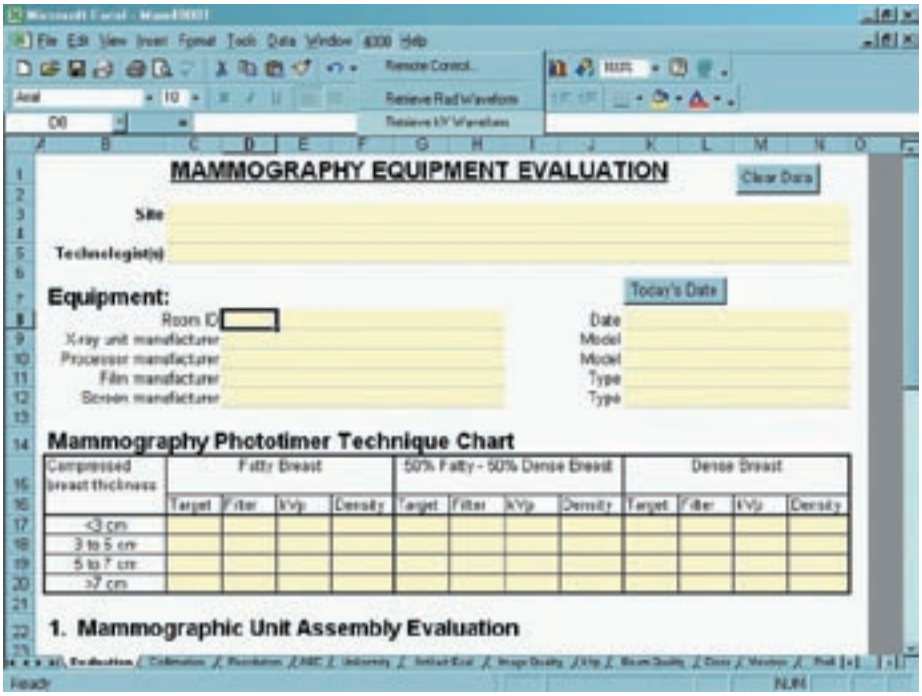
4000EXL

4000 Toolkit for Excel

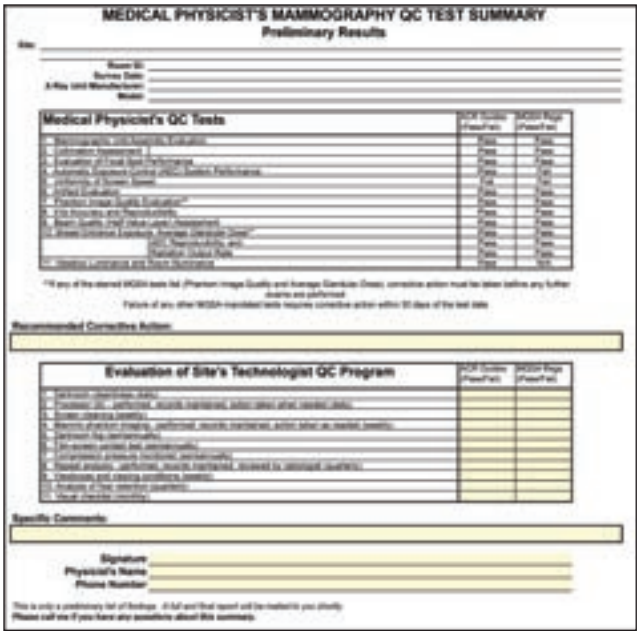
FLUKE® Biomedical



Key features

- 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 customized reports
- Allows complete remote control of the 4000M+ NERO
- Complete online help speeds learning
- Compatible with Microsoft® Windows® 2000 and above, and Excel 95, 97, 2000
- Automatically detects the presence of 4000M+ NERO

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.



4000EXL

4000 Toolkit for Excel

FLUKE® Biomedical

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.	
4000 radiographic template	Used to perform the following radiographic tests: Reproducibility, kVp accuracy, Timer accuracy, Linearity, and Beam quality
4000 mammographic template	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, and Radiation output rate
NERO mAx fluoroscopic template	Used to perform the following fluoroscopic tests: kVp accuracy, Beam quality, and Fluoro exposure rate
These templates are easy to use and can be modified to fit the user's needs.	

System requirements

Windows 2000 and above
Microsoft Excel 97, 2000
One serial port (COM1 through COM4)

Ordering information

4000EXL 4000 Toolkit for Excel

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07-CRXW and 07-QRX

Wireless CR RADCHEX and QA RADCHEX

The wireless 07-CRXW CR RADCHEX and 07-QRX QA RADCHEX are factory radiation-calibrated, NISTtraceable light meters that can be used to calibrate (balance) CR plate readers (also radiation-calibrated light meters) in the field. The CR plate reader in the field will be calibrated and traceable to the Fluke Biomedical factory radiation-calibrated and traceable x-ray-produced light exposure.

CE

Both 07-CRXW and 07-QRX have the same x-ray energy response as a CR system (x-ray-to-light conversion efficiency is the same for various beam conditions). This enables them to be used as accurate and precise replacements for the plate reader's light measurement value (exposure index value).

Most importantly, the 07-CRXW and 07-QRX can save valuable time when calibrating or accessing CR readers and AEC used with multiple x-ray systems. These x-ray systems may have different filtration and beam characteristics even when located in the same department or imaging center. Balancing system performance and dose is an important QA requirement best satisfied with either the 07-CRXW or 07-QRX.

Applications

The wireless 07-CRXW is ideal for use by service engineers to initially calibrate and troubleshoot the CR plate reader, AEC, and density selector settings. Physicists use 07-CRXW to assess the performance of CR-AEC for compliance to clinical system speed objectives and patient dose. Radiology managers can use 07-CRXW to assist in the establishment of technique charts and training to determine ALARA techniques for various exam types. QA personnel can use 07-CRXW to periodically document the performance of the CR system and to compare CR to film/screen systems regarding desired ALARA objectives. The 07-CRXW uses Bluetooth® to communicate with a laptop computer so that the CRLU (CR Light Units), EI (Exposure Index) and estimated mR values measured by the electronic cassette are automatically recorded and displayed on the laptop screen.

Benefits

Using the 07-CRXW to calibrate x-ray system AEC and CR plate readers instead of a dosimeter can improve productivity significantly. A full system AEC and CR plate reader calibration process can take as much as six hours. Employing the 07-CRXW the process can be completed in under two hours. A substantial productivity gain for service, biomedical or physics professionals.

Essentially, the wireless 07-QRX performs all of the functions of the 07-CRXW, however CRLU and speed numbers (representing the relative system speed of the CR system compared to a film/screen system) are displayed on a LCD readout built into the electronic cassette. A pressure sensitive On/Off switch activates the 07-QRX and is used to reset the meter between exposures. The values may be manually entered into the software program on a laptop or PC if desired but a laptop is not required to use the 07-QRX. The 07-CRXW and 07-QRX are designed to work with all major brands of CR equipment.

The 07-QRX QA RADCHEX is ideally suited for fast and easy daily checks of AEC and CR system exposure continuity. Data obtained from daily checks can be used for trend analysis of individual systems as well as a way to monitor the balanced performance of CR systems throughout the healthcare enterprise.

Key features

- Calibrates computed radiography (CR) plate readers and automatic exposure control (AEC)
- Assesses ongoing performance of CR plate reader, AEC, and automatic programmed radiography (APR)
- Sets and maintains desired clinical system speed (dose) of the CR system
- Calibrates CR plate readers in the field to be traceable to a factory radiation-produced light condition
- Links radiation exposure (mR) to the front of the plate accurately and predictably to a CR light measurement value (CRLU)
- Provides a reliable and reproducible method of accurately maintaining a CR manufacturers' specific factory calibration
- Provides three different tube-head filtration choices for users who desire a non-filtered beam condition for field plate reader calibration
- Software selections of multiple beam conditions for different CR manufacturers
- Ideal tools for service engineers, physicists, and quality assurance personnel

07-CRXW

Wireless CR RADCHEX

FLUKE® Biomedical

Specifications

X-ray energy dependence	Simulates relative light output of photostimulatable phosphor plate (PSP) within ± 3 % over kVp range of 60 kVp to 120 kVp and a patient equivalent thickness range of 5 cm to 35 cm (within specified operating rates)
Digital range	Computed radiography light units: CRLU (AEC#); 0 to 500 CRLU (AEC#); 0 to 5000 (07-QRX)
Minimum CRLU rate	1.5/sec (approx. 0.15 mR/sec entrance exposure rate), 7/sec (approx. 0.7 mR/sec entrance exposure rate) (07-QRX)
Maximum CRLU rate	2500/sec (approx. 250 mR/sec entrance exposure rate), 25000/sec (approx. 2500 mR/sec entrance exposure rate) (07-QRX)
Power on/off	Manual switch
Controls	Wireless communications with computer software; Bluetooth wireless communications (07-CRX only)
Functions	Measures CRLU (AEC#); converts CRLU to CR manufacturers specific CR plate reader light exposure index value (EI); user selectable; calculates cassette input exposure values for various x-ray beam conditions (exposure in mR plus backscatter)
Power requirements	Built-in NiMH rechargeable battery pack (9.6 V)
Typical battery life between charging	5 hours, 20 hours (07-QRX)
X-ray beam filter	1.5 mm copper (B152-110); 6 in x 6 in complete with velcro straps to attach to x-ray tube collimator housing
Environmental requirements	Operating temperature: 15 °C to 35 °C (59 °F to 95 °F)
General information	
Electronic cassette dimensions (WxDxH)	30 cm x 24 cm x 1.3 cm (12 in x 10 in x 0.5 in)
Weight	1.8 kg (3.9 lb)
Computer software	CD-ROM containing Microsoft® Excel program
Computer requirements	Computer capable of running Windows® 98 or higher with Microsoft Excel, Computer not required to operate (07-QRX). Software is provided with (07-QRX) to manually enter values if desired

Optional accessories

07-AEC6 For film/screen applications to assess and calibrate automatic exposure control (AEC) – radiographic and mammographic systems

07-AEC6M For film/screen applications to assess and calibrate automatic exposure control (AEC) – mammographic systems

Ordering information

07-CRXW Wireless CR RADCHEX, including PC-based Excel documentation software

07-QRX Wireless QA RADCHEX, including PC-based Excel documentation software

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07-MAS5

mAs Meter

FLUKE® Biomedical

The 07-MAS5 mAs Meter simultaneously provide mAs, exposure time, and mA, as well as mA waveform information. This intelligent meter displays three 50-milliseconds mA waveform samples so radiographic and mammographic pre-heat circuits can be analyzed and adjusted without using an oscilloscope. Based on feedback from field service engineers, the 07-MAS5 also features a button that causes the meter to ignore the first 10-milliseconds of the mA waveform. Featuring a microcontroller to analyze the digital mA waveform, the 07-MAS5 mAs Meter accurately display the values essential for analyzing and calibrating radiographic and mammographic equipment.

CE

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

Key features

- An intelligent meter that measures mAs, exposure time, and mA all at the same time
- Provides mA waveform information
- At a button press, the 07-MAS5 meter ignores the first 10 milliseconds of exposure
- AC and DC inputs
- 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 mA to 2000 mA; 0.1 mAs to 999.9 mAs; 1 ms to 6.535 sec
Accuracy	mAs: ± 0.1 mAs or 1 % (whichever is greater)
	mA: ± 1.0 mA or 0.5 % (whichever is greater)
	Time: ± 1 ms or 1 % (whichever is greater)
Operating temperature	15 °C to 35 °C (59 °F to 95 °F)
Power requirements	One 9 V battery
Typical battery life	> 40 hours
Size	10.16 cm x 16.51 cm x 0.84 cm (4 in x 6.5 in x 0.33 in)
Weight	0.28 kg (0.625 lb)

Ordering information

07-MAS5 mAs Meter

FLUKE®
Biomedical

06-526

RAD-CHECK® Plus Dosimeter

The 06-526 RAD-CHECK Plus uses proven technology specifically designed to provide you with the ultimate in versatility and cost-effective operation.

Accurate, lightweight, portable; this industry-standard dosimeter enables you to gain the critical edge in your QC program.

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.

Key features

- 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
- Fast and easy 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 ± 5 % from 30 kVp to 150 kVp for the RAD-CHECK PLUS internal chamber
- Optional remote chambers for mammographic and cine imaging systems
- Extremely compact 15 cm x 15.9 cm x 7 cm (6 in x 6.25 in x 2.75 in); weighs only 0.51 kg (1.125 lb)

Specifications

Ranges	0.001 R to 2 R, 0.01 R/min to 20 R/min
Internal chamber	30 cc volume, energy response ± 5 % from 15 keV to 65 keV (30 kVp to 150 kVp filtered). 20.5 cm^2 (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 mGy to 20 mGy)
Electrometer drift	0.5 to 1 mR/min typical; 6 mR/min maximum (5 µGy 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 °C to 40 °C
Relative humidity	0 to 90 %, non-condensing
Display	3.5 in x 0.5 in 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	9 V alkaline battery, > 100 hours operation (50 hours in manual reset mode)
Dimensions (WxDxH)	15.25 cm x 15.9 cm x 7 cm (6 in x 6.25 in x 2.75 in)
Weight	0.51 kg (1.125 lb)

Optional external chamber accessories	
6000-528	30 cm^3; Energy response: within 7 % from 30 kVp to 150 kVp (15 keV to 65 keV); Cable: 4.5 m (15 ft); Chamber dimensions: 10.2 cm x 10.2 cm x 1.4 cm (4 in x 4 in x 0.54 in thick)
6000-529	3.3 cm^3; Energy response: within 5 % from 0.2 mm to 5.0 mm Al HVL (16 kVp to 90 kVp); Cable: 4.5 m (15 ft); Chamber dimensions: 4 cm Ø x 1.5 cm thick. This chamber meets the needs of the MQSA for an external transparent chamber.
6000-530B	150 cm^3; Energy response: ± 10 % from 1.8 mm to 10 mm Al HVL; Cable: 3 m (10 ft); Chamber dimensions: 15.9 cm x 20.6 cm x 1.6 cm (6.26 in x 8 in x 0.63 in)
6000-100	3.2 cm^3; Energy response: ± 5 % from 1 mm to 10 mm Al HVL; Cable: 0.9 m (3 ft); Sensitive length: 10 cm (4 in); Chamber inside Ø: 6.4 mm (0.25 in)

Optional accessories

6000-528 Radiographic Ion Chamber
6000-529 Mammographic Ion Chamber
6000-100 CT Ion Chamber
6000-530B Image Intensifier Ion Chamber
89-525 Carrying Case, holds RAD-CHECK Plus and accessories

Ordering information

06-526 RAD-CHECK Plus Dosimter
06-526-2200 RAD-CHECK Plus Dosimeter, SI Units

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06-526-5240

RAD-CHECK® MICRO-R

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.

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 tiltstand for convenient adjustment of display visibility.

Key features

- 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
- Fast and easy use
- Dual-range for high and low dose-rate fluoroscopy
- Optimized for use with our 100 cm^3 Image Intensifier Ion Chamber (06-524-3000)
- Portable, no ac power cords

Specifications

Ranges	Low: 0.01 mR to 19.99 mR; 0.1 R/min to 199.9 R/min
	High: 0.01 R to 19.99 R; 0.1 R/min to 1999 R/min
Standard calibration	At 75 kVp with 4 mm Al filtration at 22 °C and one atmosphere using 06-524-3000 chamber
Reproducibility	Within 2 % short-term over 100 mR to 2 R range (1 mGy 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	10 °C to 40 °C (50 °F to 104 °F)
Relative humidity	0 % to 90 %
Display	3.5 in x 0.5 in 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 (WxDxH)	15.25 cm x 6.25 cm x 7 cm (6 in x 6.25 in x 2.75 in)
Weight	0.51 kg (1.125 lb)

Optional accessories

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

Ordering information

06-526-5240 RAD-CHECK MICRO-R
(Must have 06-524-3000 chamber and must be calibrated at the same time)

18-526 Series

Service and Quality Control Kits

18-526-3000 Cardiac Cath/ Special Procedures QC Kit
Contains the essential non-invasive test tools for special procedures.

18-526-1000 Mammography QC Kit
Everything you need to make compliance with ACR and MQSA regulations easy.

18-526-2000 Radiography/ Fluoroscopy QC Kit
All the test devices necessary to perform QC in radiographic and fluoroscopic suites.

18-526-4000 Dental QC Kit
Service and QC are easier and more cost effective than ever with this comprehensive kit.

Key features

- 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 selected for 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

Included accessories

89-426 Carrying Case

18-526-3000
06-526-5240 RAD-CHECK® MICRO-R
07-494 Wide-Range Digital kVp Meter
07-453 Digital X-Ray Pulse Counter/Timer
06-524-3000 Image Intensifier Ionization Chamber, 100 cm^3

18-526-1000
06-526 RAD-CHECK PLUS
07-492 Mammographic Digital kVp Meter
07-453 Digital X-Ray Pulse-Counter/Timer
6000-529 Mammographic Ion Chamber, 3.3 cm^3

18-526-2000
06-526 RAD-CHECK PLUS
07-494 Wide-Range Digital kVp Meter
07-453 Digital X-Ray Pulse-Counter/Timer
6000-528 Radiographic Ion Chamber, 30 cm^3

18-526-4000
06-526 RAD-CHECK PLUS
07-479 Dental Digital kVp Meter
07-453 Digital X-Ray Pulse-Counter/Timer
07-453-2000 Remote Sensor for use with 07-453
6000-528 Radiographic Ion Chamber, 30 cm^3

Ordering information

18-526-3000 Cardiac Cath/ Special Procedures QC Kit
18-526-1000 Mammography QC Kit
18-526-2000 Radiography/ Fluoroscopy QC Kit
18-526-4000 Dental QC Kit

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07-453

Digital X-Ray Pulse Counter/Timer

FLUKE® Biomedical

Poor or inconsistent quality of x-ray images is caused by an inaccurate generator timer. This results in repeat examinations, which cost time and money. A poorly maintained system is also hazardous to the patient. When a malfunction in the timer occurs, the patient may receive unnecessary radiation doses. Regular monitoring of x-ray systems and timers is an essential part of a good quality-assurance program.

07-453 Digital X-Ray Pulse Counter/Timer is a non-invasive, solid-state instrument to measure the exposure time of either ac or dc x-rays as well as 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, 07-453 measures the exposure time in milliseconds. When testing x-ray timers and controls, the time of relay contact closure is measured using the ac input feature.

An output connector on the side of 07-453 allows the user to view a radiation output waveform on an oscilloscope to diagnose and troubleshoot problems with x-ray generators.

Key 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
- Saves time and money by reducing repeat examinations
- Easy-to-read digital display
- Automatic reset; holds a reading until the next exposure
- Battery-operated, lightweight; 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
- The optional remote sensor can be used when the user has the unit in their hand. 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

Specifications

Accuracy	AC input ± 1 count, dc input 2 %, ± 1 count, X-ray detection ± 1 count
Sensitivity	AC input: 90 V ac 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 ms
Display	0.3 inch liquid crystal
Power requirements	9 V battery, alkaline or equivalent, 48 hours minimum; typically six months of normal use
AC input jacks	130 V ac maximum; 90 V ac minimum; input circuit not affected by reversed polarity
Output signal	BNC connector for waveform analysis
Connections	None required for direct exposure measurement
Controls/indicators	Three-position switch: Pulse, Off, Milliseconds
	Four-digit LCD (0.4 in character)
	Low battery indicator
	"Low Batt" appears in display when battery voltage reaches 5.3 V ± 0.3 V
	Power-on: LED (green); oscilloscope output
Dimensions (LxWxH)	14.7 cm x 8 cm x 4 cm (5.8 in x 3.15 in x 1.6 in)
Weight	0.21 kg (0.5 lb)

Optional accessories

07-453-2000 Remote Sensor with 10 ft cable
88-453 Oscilloscope Leads
89-453 Carrying Case

Ordering information

07-453 Digital X-Ray Pulse Counter Timer

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07-487

Dual-Range Digital mAs Meter

The 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 mAs to 199.9 mAs; push a button and the range expands to 0 mAs to 1999 mAs.

The greatest use for the 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.

Key features

- 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
- Handheld, battery-operated, and lightweight

Specifications

Ranges	0 mAs to 199.9 mAs ("+" overrange indicator above 160 mAs). Also 0 mAs to 1999 mAs ("+" overrange indicator above 1600 mAs)
Accuracy	± 2 % of reading
Input	25 mA to 1000 mA
Drift	Zero
Operating temperature	15 °C to 30 °C (50 °F to 100 °F)
Controls	POWER (on/off), RANGE (highlow), and RESET
Power requirements	Single 9 V alkaline battery; typical life 80 hours
Input jack	Uses two banana jacks
Dimensions (WxDxH)	8.9 cm x 16.8 cm x 3.5 cm (3.50 in x 6.63 in x 1.38 in)
Weight	0.2 kg (0.44 lb)

Included accessories

177002 24 inch Cable with banana plugs and insulated alligator clips on opposite ends

Ordering information

07-487 Dual-Range Digital mAs Meter

FLUKE®
Biomedical

07-469

Wave Precision High-Voltage Divider

07-469 Wave Precision High-Voltage Divider provides two ranges that allows it to be used with a variety of readout devices. One range of 07-469 is 10,000:1, when operated into a 1 MΩ load, such as the direct input of an oscilloscope. The other mode of operation provides the 1000:1 ratio into a 10 MΩ load. In this mode, it can be used as a replacement for the GE divider when connected in a similar manner. It can also be connected to 10 MΩ input impedance dc digital voltmeters or 10 M 10 X scope probes. The three anode connections are individually wired for use on the latest GE CT Scanners.

07-469 is designed with the same dc resistance values as the General Electric C1515A and 46-15496681. Those voltage dividers have a frequency response valid to 1000 Hz. 07-469 performs as a frequency-compensated replacement for those dividers and is usable at high frequencies as well as short exposures. With a well-characterized rise time, 07-469 is suitable for use in radiographic, cine, pulsed, and mammographic applications.

Key features

- Replacement for GE divider
- Can be used with oscilloscopes or dc digital voltmeters
- Three individually-wired anode connectors for use with the latest GE CT scanners

Specifications

DC accuracy when operated into rated load impedance	1 %
Divider ratio	Switch selectable 10,000:1 or 1,000:1
Divider resistance	100 megohm
Load impedance	1 megohm @ 10,000:1 or 10 megohm @ 1,000:1
Voltage range	0 kVp to 150 kVp
DC accuracy	1 % or better, 10 kV to 75 kV per side
Frequency response	DC to 1 kHz ± 3 %, to 100 kHz ± 5 %
Insulation	Oil filled, may be operated continuously
HV terminals	Federal standard 3 pin. 4 pin optional for cathode
Output terminals	BNC. Oil tight selector switch
Dimensions (LxH)	25 cm x 30.5 cm (10 in x 12 in)
Weight	14.5 kg (32 lb)

Optional accessories

87-476 Carrying Case
07-478 High-Voltage Cable, 5 ft

Ordering information

07-469 Wave Precision High-Voltage Divider, without cables
07-469-4780 The Wave Precision High-Voltage Divider, with two cables

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FLUKE®
Biomedical

18-116

VeriLUM® Color Dual Mode Pod 5.2

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

VeriLUM can be used for acceptance testing of a CRT or LCD display system.

It also provides a quick visual check for the user. A SMPTE test pattern is displayed on each monitor. If the gray scale range and stability is adequate and if all the monitors have essentially the same look and feel, then the display system is ready for use. Bitmaps, DICOM® images (e.g. AAPM TG-18) can be displayed.

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® 2000, XP®, ME®, or Vista 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 USB port on the PC, thus a simple extension cable (provided) allows for simple connection.

Key features

- 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 Microsoft® Windows 2000, XP, and Vista operating systems
- Each VeriLUM package includes: pod and cd-rom with version 5.2 software and user guide
- Applicable to CRT and LCD displays

Specifications

Minimum computer requirements	Intel® PC, CD-Rom, Microsoft Windows 2000, Vista, 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	± 2 %
Luminance repeatability	± 1 %
Luminance range	0.05 cd/sqm to 1000 cd/sqm
Weight	0.45 kg (1 lb)

Ordering information

18-116 VeriLUM Color Dual Mode Pod

Complies with European restrictions on hazardous substances (RoHS).

(please specify serial or USB connector)

FLUKE®
Biomedical

07-621

Precision Photometer

Photometers are required for medical, scientific, and laboratory applications. The 07-621 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 07-621 is a highly accurate instrument designed to measure both illuminance (the amount of light falling on a surface) in lux (lumens per m^2) and luminance (the amount of light emitted from a surface) in nit (candela per m^2).

CE

The 07-621 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.

Key features

- 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
- 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 in 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 two 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 (WxDxH)	7 cm x 3 cm x 10 cm (2.8 in x 1.2 in x 4 in)
Weight	0.11 kg (0.25 lb)

Optional accessories

07-634 Fiber-Optic Probe, Flexible 12 in (must be calibrated with meter)
07-634-1000 Fiber-optic Probe, Rigid 1 inch (must be calibrated with meter)
07-634-1100 Rotating Illuminance Receptor (must be calibrated with meter)
89-621 Carrying Case

Ordering information

07-621 Precision Photometer
07-621-6341 Precision Photometer with rotating illuminance receptor
07-621-6342 Precision Photometer with rigid 1 inch fiber-optic probe
07-621-6343 Precision Photometer with flexible 12 inch fiber-optic probe
Factory recalibration available

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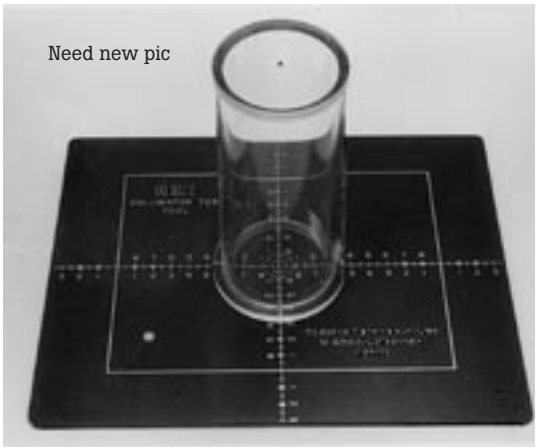
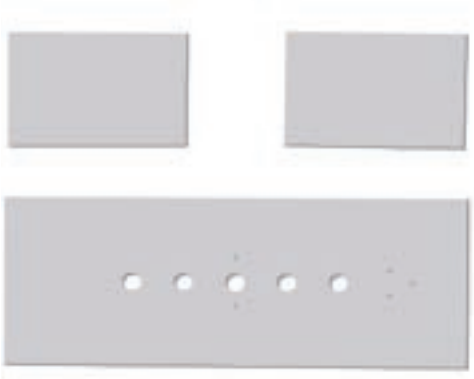
07-661-7662 and 07-644

Collimator/Beam Alignment Test Tool and Grid Alignment Test Tool

FLUKE® Biomedical



07-661-662 Collimator/Beam Alignment Test Tool



07-644 Grid Alignment Test Tool

07-661-7662 Collimator/ Beam Alignment Test Tool

In radiographic quality control, it is essential to verify proper alignment of the collimator light field with the x-ray field. The 07-661-7662 readily indicates a 1 % or 2 % misalignment at a 40 in focal-film distance (FFD), but it may be used at any FFD.

It consists of a flat 8 in x 10 in plate with a 14 cm x 18 cm pattern etched on its surface. It can also be used to check fluoroscopy alignment and collimation.

Improper central-ray alignment will distort a radiographic image. The 07-661-7662 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.

Key features

07-661-7662

- Verifies proper alignment of collimator light field to x-ray field
- Verifies alignment of central ray is perpendicular to image receptor

07-644

- Checks focused grid alignment with relation to central ray
- Checks focused grid alignment to the center of a film cassette

07-644 Grid Alignment Test Tool

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 07-644 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. The easy-to-use 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

07-661-7662

Dimensions beam alignment	15 cm (h) x 006.3 OD cm (5.9 in x 2.5 in)
Weight beam alignment	0.24 kg (0.54 lb)
Weight collimator	0.19 kg (0.41 lb)

07-644

Lead plates	Three plastic-covered, 0.062 inch thick lead plates
	(1) 9.125 in x 3.625 in test plate
	(2) 3.56 in x 2.375 in blocker plates
Test plate	(5) 0.375 inch test holes and (5) 0.062 in orientation holes
Weight	0.68 kg (01.5 lb)

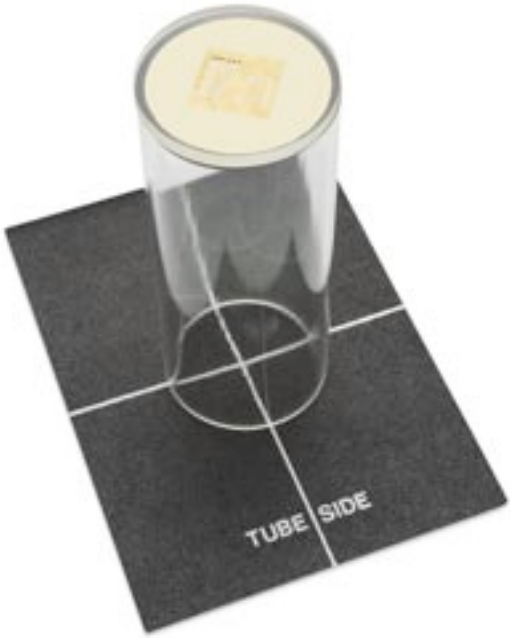
Ordering information

07-661-7662 Collimator/Beam Alignment Test Tool

07-644 Grid Alignment Test Tool, including three lead plates

07-591

Focal Spot Test Tool



The 07-591 Focal Spot Test Tool provides a simple pass-fail test to determine if an x-ray tube focal spot has been damaged. This tool consists of a 6-inch-high stand with a thirteen-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 0.63 line pairs/mm (2 mm) to 2.52 line pairs/mm (0.8 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.

Optional accessories

07-800-5007 Flex Film Cassette, 5 in x 7 in

Specifications

Dimensions (stand) (WxH)	6.35 cm x 15.24 cm (2.50 in Ø x 6 in)
Weight	0.11 kg (0.25 lb)

Ordering information

07-591 Focal Spot Test Tool

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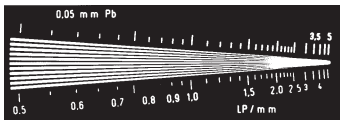
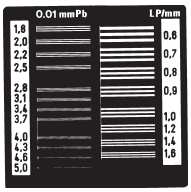
07-501 to 07-555

Test Patterns

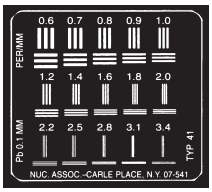
Shown in Model 07-501-2000



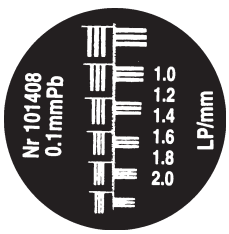
Shown in Model 07-523 1000/2000



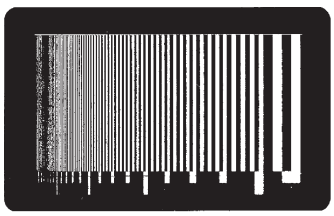
Shown in Model 07-527



Shown in Model 07-541-2000



Shown in Model 07-506


Shown in Model 07-553

X-Ray Test Patterns for measuring resolution
Fluke Biomedical offers a range of patterns for use in a variety of desired applications. 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.

Specifications and ordering information

Model	Range of resolution in LP/mm	Number of groups	Lead-foil thickness in mm	Dimensions in mm
X-Ray Test Patterns for measuring resolution				
07-501-2000	1.0 to 4.8	16	0.1	110 x 40
07-501-1000	Ultra-High Precision Pattern (same specifications as 07-501-2000)			
07-521	2.0 to 10.0	15	0.05	94 x 50
07-525	3.15 to 16.6	15	0.03	94 x 50
07-555	5.0 to 20.0	13	0.02*	25 x 10
07-515	1.0 to 10.0	1	0.05	80 x 40
07-523-2000	0.5 to 5.0	1	0.1	157 x 50
07-523-1000	Ultra-High Precision Pattern (same specifications as 07-523-2000)			
07-539	1.5 to 20.0	1	0.025	60 x 30
07-526	0.6 to 10.0	26	0.05	65 x 55
07-527	0.6 to 5.0	20	0.01	50 x 50
07-535	0.6 to 5.0	20	0.05	50 x 50
07-538-2000	0.6 to 5.0	20	0.1	50 x 50
07-538-1000	Ultra-High Precision Pattern (same specifications as 07-538-2000)			
07-541-2000	0.6 to 3.4	2 x 15	0.1	50 x 50
07-541-1000	Ultra-High Precision Pattern (same specifications as 07-541-2000)			
07-548	2.0 to 6.0	2 x 14	0.08	50 x 50
X-Ray Test Patterns for measuring resolution of image intensifiers and video systems				
07-506	1.0 to 2.0	2 x 6	0.1	32
07-507	3.0 to 4.0	2 x 6	0.1	32
07-511	2.0 to 3.0	2 x 6	0.1	32
07-519	1.8 to 3.15	2 x 6	0.1	32
07-529	2.8 to 5.0	2 x 6	0.1	32
07-532	5.0 to 6.0	2 x 6	0.05	32
07-537	5.0 to 7.0	2 x 6	0.05	32
07-526	0.6 to 10.0	26	0.05	65 x 55

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 mm x 44 mm.

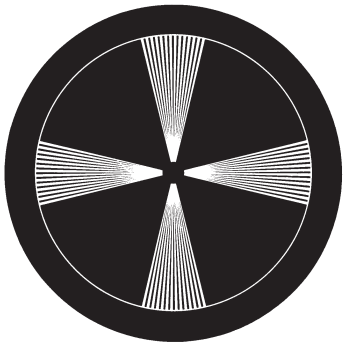
Group	1	2	3	4	5	6	7	8	9	10	11
LP/mm	0.25	0.5	0.6	0.7	0.85	1	1.2	1.4	1.7	2.0	2.4
Group	12	13	14	15	16	17	18	19	20	21	22
LP/mm	2.9	3.5	4.2	5	6	7	8.5	10	8.5	7	6

Ordering information
07-553 Ultra-High Precision Test Pattern

07-503 to 07-551, 07-456

Star Patterns
High-Purity Aluminum Step Wedges

FLUKE® Biomedical



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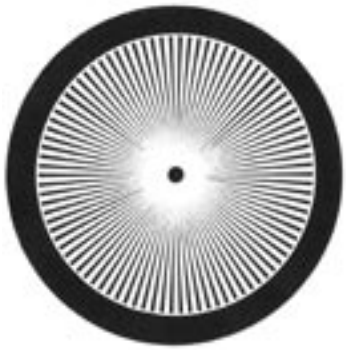

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Star x-ray test patterns

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.

07-456 High-Purity Aluminum Step Wedges

- 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

07-503-2000 **07-503-1000** **07-550** **07-551**	Dimension: 55 mm Ø For measuring focal spots from 0.1 mm to 0.3 mm Sectors: (4) 15° patterned sectors with a 0.5° angle of a single line within a sector Sectors (07-550): (4) 45° patterned sectors, for easier interpretation Sectors (07-551): (4) 15° patterned sectors with a 0.25° angle Thickness: Lead-foil thickness 0.03 mm
07-509-2000 **07-509-1000**	Dimension: 55 mm Ø For measuring focal spots from 1 mm and up Sectors: (4) 45° sectors with a 2° angle of a single line within a sector Thickness: Lead-foil thickness 0.05 mm
07-542-2000 **07-542-1000**	Dimension: 55 mm Ø For measuring focal spots from 0.3 mm to 0.6 mm Sectors: (4) 28° patterned sectors with a 1° angle of a single line within a sector Thickness: Lead-foil thickness 0.03 mm
07-543-2000 **07-543-1000**	Dimension: 55 mm Ø For measuring focal spots from 0.8 mm to 1.5 mm Sectors: (4) 35° patterned sections with a 1.5° angle of a single line within a sector Thickness: Lead-foil thickness 0.03 mm
07-510-2000 **07-510-1000**	Dimension: 55 mm Ø For measuring focal spots from 1 mm and up Sectors: (1) 35° 360° pattern sector with a 2° angle of a single line within a sector Thickness: Lead-foil thickness 0.05 mm

07-456 High-Purity Aluminum Step Wedges

07-456

11 steps	
Dimensions	Step wedge: 2.5 in x 5.5 in x 1.375 in Each step: 0.5 in surface; 3 mm rise
Weight	0.50 kg (1.10 lb)
21 steps	
Dimensions	Step wedge: 3 in x 10.3 in x 1.85 in Each step: 12 mm surface; 2.1 mm rise
Weight	1.45 kg (3.20 lb)

Ordering information

07-503-2000 High-Precision Star X-Ray Test Pattern
07-503-1000 Ultra-High Precision Star X-Ray Test Pattern
07-509-2000 High-Precision Star X-Ray Test Pattern
07-509-1000 Ultra-High Precision Star X-Ray Test Pattern
07-542-2000 Precision Star X-Ray Test Pattern
07-542-1000 Ultra-High Precision Star X-Ray Test Pattern
07-543-2000 High-Precision Star X-Ray Test Pattern
07-543-1000 Ultra-High Precision Star X-Ray Patterns
07-550 Ultra-High Precision Star X-Ray Patterns
07-551 Ultra-High Precision Star X-Ray Pattern
07-510-2000 High-Precision Star X-Ray Test Pattern
07-510-1000 Ultra-High Precision Star X-Ray Test Pattern
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

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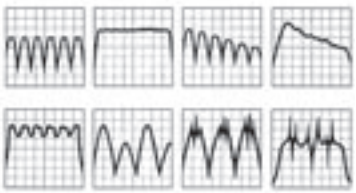
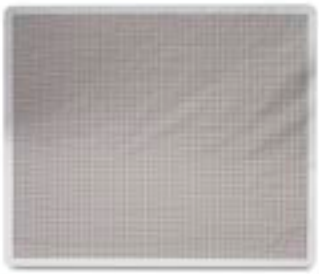
07-451, 07-608 and 07-706

X-Ray Output Detector, Screen/Film Contact Mesh, and Phantom/Penetrometer System

FLUKE® Biomedical

07-451





07-608

07-706

07-451 X-Ray Output Detector

The 07-451 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 ms, no alteration of the true x-ray output pulse shape is introduced.

07-608 Screen/Film Contact Mesh

The 07-608 Film/Screen Contact Mesh 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 35.6 cm x 43 cm (14 in x 17 in) copper screen, with 0.3 cm (0.125 in) 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.

07-706 Patient Phantom/Penetrometer System

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 07-706 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.

Key features

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

Optional accessories

07-451

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

07-706

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

Included accessories

07-706

(a) Two 7 in x 7 in x 0.75 in 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 in x 7 in x 0.125 in lead beam-stop plate. When placed in the beam, this plate allows automatic brightness-control machines to deliver maximum output.
(c) One 7 in x 7 in x 0.03125 in aluminum penetrometer plate with 0.25 in, 0.176 in, 0.125 in, 0.088 in, and 0.0625 in 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 in long and one 10.375 in long.

Ordering information

07-451 X-Ray Output Detector, includes BNC Output Connector
07-706 Patient Phantom/Penetrometer System
07-608 Screen/Film Contact Mesh

Specifications

07-451: Shock-resistant, solid-state diode detector

Power source	None required
Rise time	Less than 1 µsec
Dimensions (WxDxH)	3.175 cm x 3.175 cm x 1.27 cm (1.25 in x 1.25 in x 0.5 in)
Weight	16.6 g (0.58 oz)

07-706

Dimensions (WxDxH)	17.8 cm x 17.8 cm x 4.2 cm (7 in x 7 in x 1.656 in)
Weight	4.3 kg (9.5 lb)

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07-622, 07-623, and 07-533

Multipurpose Test Stand, Mammography Test Stand, and Radiopaque Rulers

FLUKE® Biomedical

07-622

07-622 Multipurpose Focal Spot/HVL Test Stand

The 07-622 Multipurpose Focal Spot/HVL Test Stand* can be used for half-value layer measurements and features extendible legs that provide the enlargement factors required by the NEMA® standard. It's designed for both over-table and under-table x-ray tube measurements. Long leveling screws allow the positioning of a screen-film cassette under the base.

07-623 Mammography Focal Spot Test Stand

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. The 07-623 Mammography Focal Spot Measurement Test Stand** test stand is designed to make these important procedures easy to perform, and ensures accurate results. The test stand includes a magnification insert, alignment device, and fluorescent alignment screen.

**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.

07-533 Radiopaque Rulers

All versions of the radiopaque rulers provide an anatomic landmark measurement scale on the radiographic image. Other applications where object firm distance (magnification) corrected measurement is needed.

07-623

07-533

*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.

Specifications

07-622

Dimensions	12 in x 12 in at base; 6.15 in x 6.15 inch at top
Height	Adjustable from 16.94 in to 31.38 in
Weight	5 kg (11 lb)

07-623

Dimensions	9 in x 11.50 in at base; 4 in x 6 in at top
Height	Adjustable from 9 in to 18 in
Weight	5 kg (11 lb)

07-533

Model	07-533	07-533-1000	07-533-1100	07-533-3600
Dimensions	30 cm long, 2 mm divisions	100 cm long, 2 mm divisions	110 cm long, 2 mm divisions	36 cm long, 2 mm divisions
Weight	0.04 kg (0.05 lb)	0.24 kg (0.5 lb)	0.24 kg (0.5 lb)	0.04 kg (0.05 lb)

Optional accessories

07-622

89-622 Carrying Case
07-633 Pinhole Assembly, 0.010 mm
07-617 Pinhole Assembly, 0.075 mm
07-613 Pinhole Assembly, 0.030 mm
07-611 Pinhole Assembly, 0.100 mm

07-623

89-622 Carrying Case
07-611 Pinhole Assembly, 0.100 mm

Ordering information

07-622 Multipurpose Focal Spot/HVL Test Stand
07-623 Mammography Focal Spot Test Stand
07-533 Radiopaque Ruler
07-533-1000 Radiopaque Ruler
07-533-1100 Radiopaque Ruler
07-533-3600 Radiopaque Ruler

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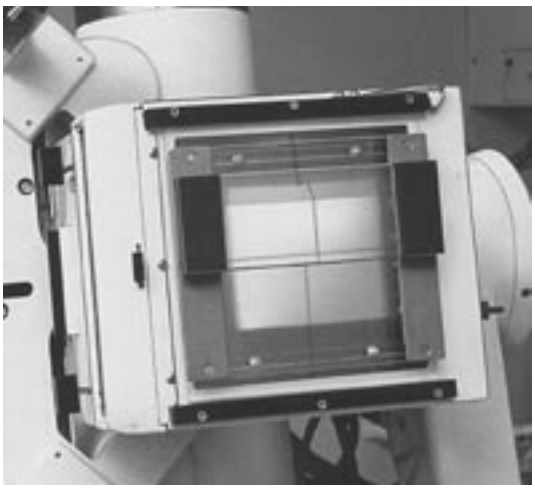
57-4 Series

CLEAR-Pb® Compensation Filters

FLUKE® Biomedical



Lightweight CLEAR-Pb lead-plastic filter is fully transparent

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.

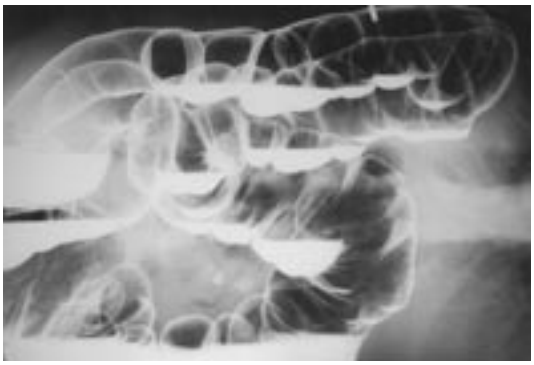
CLEAR-Pb filters are made of lightweight plastic that is 30 % lead by weight. A unique "quick-stik" magnetic mounting system plus a filter holder that slides into the collimator tray ensure that the filter is held firmly in place. It also permits instant repositioning as the area and/or degree of filter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

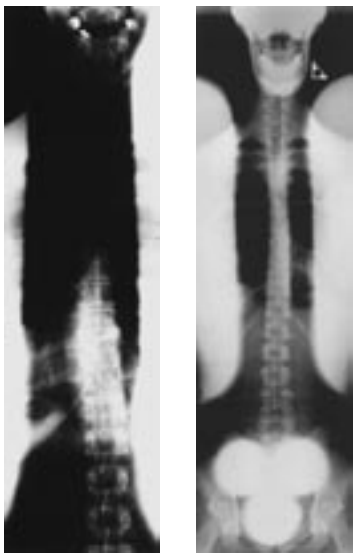
Full-Spine Scoliosis Filter
Tested and proven in FDA and specialized radiography studies, enables scoliosis radiography with more diagnostic detail and less radiation exposure.

Key features

- 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

Single-exposure AP view of the foot: radiograph at left wastaken without a CLEAR-Pb filter. Notice "burnout" at the toesdue 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.





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.

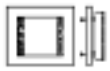
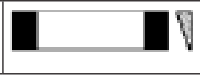
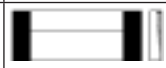
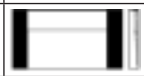
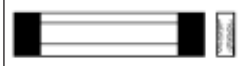
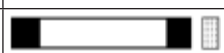
57-4 Series

CLEAR-Pb® Compensation Filters

FLUKE® Biomedical

Specifications

CLEAR-PB Compensation Filters

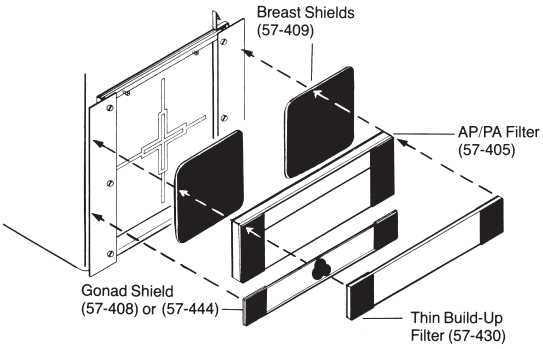
Model	Filter	Weight	Length	Width	Filter holder required	Application	Configuration
57-429	Chest	16 oz	5.125 in	5.125 in	No	PA View (72 in FFD)	
57-432	2 inch Wedge Lateral Decubitus at 40 in FFD	3.4 oz	6.5 in	2 in	Yes (see 57-426)	• All lateral decubitus position views • Angiography of neck and head (use 2 filters)	
57-433	3 inch Wedge Lateral Decubitus at 40 in FFD	5.5 oz	6.5 in	3 in	Yes (see 57-426)	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, (WxD) 1 in x 5.5 in, for positioning filters and shields. Only one F lter Holder is needed per x-ray machine. Comes with a Plexiglas cutter		
57-440	Foot and Ankle Filter	3.9 oz	6.5 in	2 in	No	• AP foot • Podiatric equipment	
57-441	2 in Wedge AP Foot at 40 in FFD	2 oz	6.5 in	2 in	Yes (see 57-426)	• Lateral and oblique • Axial view of calcaneus	
57-414	Wall Rack	8 oz	12 in	1 in	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	Attaches to filter holder with screws. Easily cut to fit collimator assembly. Set of two.		
57-405*	AP/PA (72 in FFD)	5 oz	6.5 in	2.5 in	Yes (see 57-426)	Lateral chest	
57-415	AP/PA (40 in FFD)	9 oz	6.5 in	4.125 in	Yes (see 57-426)	Sectional, AP cervical thoracic	
57-406*	Lateral Cervical (72 in FFD)	3.2 oz	6.5 in	1.25 in	Yes (see 57-426)	• 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)	• Oblique or AP esophagram (obese patients) • Lateral chest tomography • Routine 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	1.25 in	Yes (see 57-426)		
57-437**	Thin Wedge; for conventional machines	8 oz	6.5 in	4.5 in	Yes (see 57-426)	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)	• Full-leg radiography (under bodyweight load) • Orthopedic angiographic • Cross table lateral hips	
57-408	Adult Gonad Shield	0.5 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: 1.4 kg (3 lb)						
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: 1.4 kg (3 lb)						
57-404	X-Ray Protection System. Includes Adult Gonad Shield (57-408), Breast Shield Set (57-409), Filter Holder (57-426), and Pediatric Gonad Shield (57-444).						

*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
Magnetic Tape
Plastic
Lead-Plastic

57-4 Series

CLEAR-Pb® Compensation Filters



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

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 under-exposed 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. To obtain the optimum diagnostic detail, the AP/PA Wedge Filter (57-405) should be used when performing fullspine examinations. First the Breast Shields (57-409) are placed on the filter holder. The AP/PA Wedge Filter (57-405) is placed on top of the Breast Shields. The Gonad Shield (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

1. Gray J.E., Hoffman, A.D., Peterson H.A., Mayo Clinic: "Dose Reduction in Radiography for Scoliosis." J. Bone Joint Surg., (January, 1983), 5-12.
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.

Optional accessories

Lead-Plastic Filters

57-409 Breast Shields 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 in x 3 in steel/lead shields with magnetic tape on one side.

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

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

57-430 Thin Buildup Filter Used with AP/PA filters for patients with measurements from 14 cm 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.

Included accessories

57-402
57-405 AP/PA Filter
57-406 Lateral Cervical Filter
57-407 Lateral Thoracic Filter
57-408 Adult Gonad Shield
57-409 Breast Shield Set
57-426 Filter Holder

57-445
57-405 AP/PA Filter
57-406 Lateral Cervical Filter
57-407 Lateral Thoracic Filter
57-430 Thin Buildup Filter
57-434 Thick Buildup Filter
57-408 Adult Gonad Shield
57-444 Pediatric Gonad Shield
57-409 Breast Shield Set
57-426 Filter Holder

57-404
57-408 Adult Gonad Shield
57-409 Breast Shield Set
57-426 Filter Holder
57-444 Pediatric Gonad Shield

Ordering information

57-429 Chest Filter
57-432 2-inch Wedge Lateral Decubitus at 40-inch FFD
57-433 3-inch Wedge Lateral Decubitus at 40-inch FFD
57-426 Filter Holder (set of mounting plates included)
57-440 Foot and Ankle Filter
57-441 2-inch Wedge AP Foot at 40-inch FFD
57-414 Wall Rack
57-411 Replacement Mounting Plate
57-405 AP/PA (72-inch FFD)
57-415 AP/PA (40-inch FFD)
57-406 Lateral Cervical (72-inch FFD)
57-407 Lateral Thoracic (72-inch FFD)
57-430 Thin Buildup
57-434 Thick Buildup
57-437 Thin Wedge for conventional machines
57-438 Thick Wedge for conventional machines
57-408 Adult Gonad Shield
57-444 Pediatric Gonan Shield (72-inch FFD)
57-402 Basic Full-Spine Filter Set
57-445 Deluxe Full-Spine Filter Set
57-404 X-Ray Protection System

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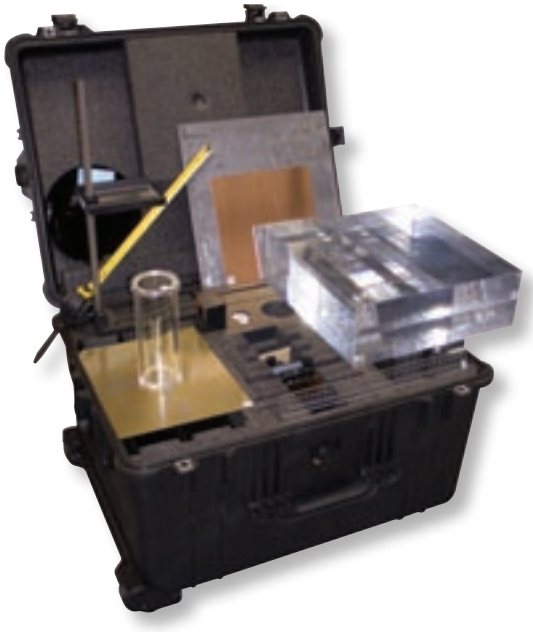
07-600QC/07-600QCN

Quality Control Kit



Fluke Biomedical's 07-600QC Quality Control Kit is ideal for performing quality-assurance inspections in conventional radiography applications. The 07-600QC is best used in conjunction with a dosimeter kit, enabling the user to measure and verify the quality of x-ray tube voltage accuracy, linearity, and reproducibility of the x-ray beam, as well as the dose rate. Originally designed to meet French regulations. The kit is ideal for use anywhere comprehensive quality assurance is needed.

The 07-600QC Quality Control Kit comes in two configurations:

The 07-600QC is the standard quality-control kit and includes all of the recommended phantoms and test objects for quality control to meet regulatory requirements. This kit is best paired with Fluke Biomedical's 10500AMT TRIAD™ TnT x-ray test device, allowing users to accurately test the integrity of their x-ray tube.

The 07-600QCN is also designed to work with Fluke Biomedical's 8000 NERO® mAx x-ray test device. This kit version includes all the components of the 07-600QC, as well as several additional accessories to improve the setup and ease-of-use while testing with the 8000 NERO mAx.

Both kits come in a rugged carrying case, designed to easily transport and protect all of the phantoms and test object. The carrying case also doubles as a safe storage compartment, conveniently holding all of the delicate components.

Key features

- Includes all of the phantoms and test objects needed for quality control in conventional radiography applications
- Ideal for QC measurements of beam geometry, kilovoltage, and radiation quality, spatial resolution, automatic exposure control (AEC) function, and half-value layer (HVL) to meet regulatory requirements
- Custom carrying and storage case with sturdy wheels and extendable pull handle allows users to easily transport components from site to site

Included accessories

07-600QC

Al plate (1 mm^2 x 100 mm^2)
Two Al plates (2 mm^2 x 100 mm^2)
Two Cu plates (1 mm^2 x 200 mm^2)
Pb assembly (2 mm^2 x 300 mm^2 between two pieces of 2 mm PMMA)
Four PMMA plates (50 mm^2 x 300 mm^2 with four polyethylene spacers)
Leeds TOR 18FG phantom
Leeds TOR Cu plate
07-661-7662 Three-piece Collimator Alignment Tool
07-533 Radiopaque Ruler
07-523-2000 Test Pattern
07-620 Magnifier
Metric Tape Measure (3 m)

07-600QCN

All components from the 07-600QC kit plus
37596 8000 NERO mAx stand base
37589 Stand Vertical Rod
37586 HVL Holder
One stand for external ion chamber

Ordering information

07-600QC Quality Control Kit
07-600QCN Quality Control Kit for Fluke Biomedical 8000 NERO mAx system

FLUKE®
Biomedical

07-680

NEMA® Cardiology Phantom

Figure 1. The NEMA Cardiology phantom

The 07-680 NEMA Cardiology Phantom was designed by collaboration with SCA&I to provide a cardiovascular fluoroscopy benchmark phantom. It is used to test systems under conditions simulating normal clinical use for fluoroscopically-guided invasive and interventional procedures.

The phantom test ensemble includes: tests for imaging-field geometry, spatial resolution, low-contrast iodine detectability, working thickness range, motion unsharpness and phantom entrance dose.

Key features

- Independent confirmation: Reassurance of an optimally working system
- Quick evaluation: The machine is tested in its clinical configuration
- Verification: That the system actually needs to be serviced, allowing you to save time, money and avoid more serious problems later on
- Ease-of-use: Anyone with technical knowledge can do the tests to determine if corrective action is necessary
- Peace of mind: To make sure that you are getting just what you paid for

Applications

Test objects are positioned at the center of the NEMA Cardiology Phantom. This simulates the location of clinically important organs. The NEMA Cardiology Phantom, positioned with its center at the x-ray system's isocenter, simulates clinical imaging geometry. Therefore, the geometric magnification of the test objects is similar to that of the clinical target. The receptor blur, focal spot penumbra blur and x-ray scatter are also similar in test and clinical conditions. The entrance surface of a thick phantom is closer to the x-ray tube than the entrance surface of a thin phantom. This is an additional reason why patient (phantom) dose increases with phantom thickness.

- Visualized field size: A plate is placed on the entrance surface of the image receptor. The plate is fluorographed to determine the actual field of view (FOV).
- Congruence of irradiated and visualized fields: This test is not needed if the shutters are fully seen in the FOV under test. (CAUTION: digitally synthesized shutters may simulate this effect without actual beam collimation.)
- Spatial resolution: A standard bar pattern insert is included in the central test plate. The test plate is placed with the bars at 45° to the video lines or digital image matrix. This produces the smallest change in the moiré pattern, resulting from a small change in angle. See Figures 2 and 3.

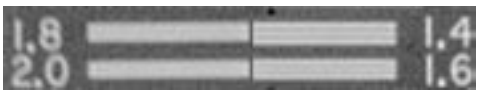


Figure 2. Spatial Resolution: the 1.4 and 1.6 line-pair/mm targets are resolved. The 1.8 and 2 targets are not resolved.

07-680

NEMA® Cardiology Phantom

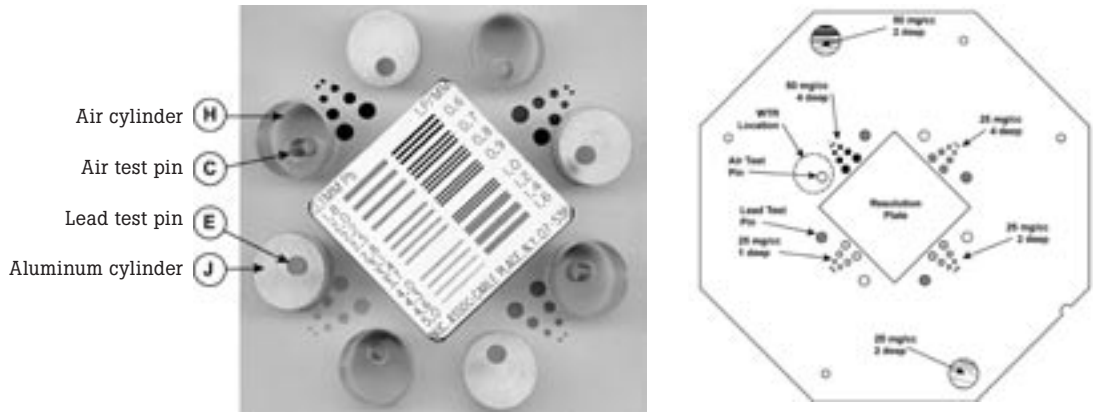


Figure 3. Photograph and diagram of the central test plate. Note the resolution test plate, iodine contrast-detail targets, and working thickness range targets.

- Low-contrast detectability: Four sets of holes with diameters of 4 mm, 3 mm, 2 mm, and 1 mm are filled with elemental iodine dispersed in epoxy. The relative areal concentration of iodine in the four patterns is 20, 10, 5, 2.5 mg/cm^2. The test operator is required to identify the smallest visible pair of targets in each pattern. See Figure 4.
- Visibility of moving structures: A rotating spoke target allows visual evaluation of motion unsharpness and the effects of temporal averaging. The device contains five steel wires of different diameters (0.022 in, 0.016 in, 0.012 in, 0.009 in and 0.005 in or 0.56 mm, 0.41 mm, 0.30 mm, 0.23 mm, 0.13 mm). Two lead dots are used to evaluate lag and recursive filtering. Rotation speed is 30 revolutions/min. The linear velocity of the outer lead dot is 200 mm/sec. The rotating disk replaces the central test plate at the isocenter. See Figure 5.
- Dosimetry tools: The NEMA Cardiology Phantom entrance exposure rate is measured at a standardized position in front of the entrance surface of the phantom (25 mm). This position is considered an acceptable choice for this particular benchmarking phantom. The phantom can also be configured to generate the FDA measuring point (30 cm in front of the image receptor). See Figure 6.
- Working thickness range: The ability to image structures overlaid by bone or air. Systems with inadequate single-image latitude are unable to do this in bright (air) or dark (bone) portions of the image. The NEMA Cardiology Phantom contains eight cylinders composed of different heights of air, aluminum and plastic. These cylinders are calibrated for a total 20 cm phantom thickness. A 50 mm deep air challenge target overlaps the four air cylinders. The bright side dynamic range is determined by how many of these targets are seen. A 5 mm lead challenge target overlaps the four aluminum cylinders. The dark side dynamic range is determined by counting these targets. See Figure 4.

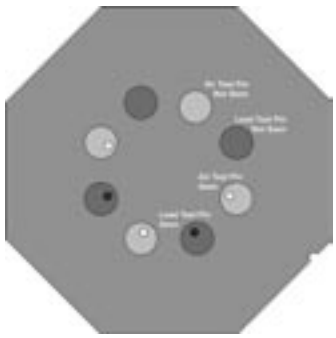


Figure 4. Working thickness range. Three examples of white clipping and two examples of black clipping

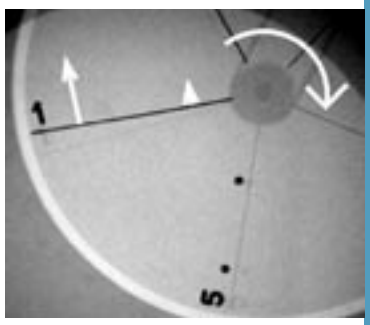


Figure 5. Motion target

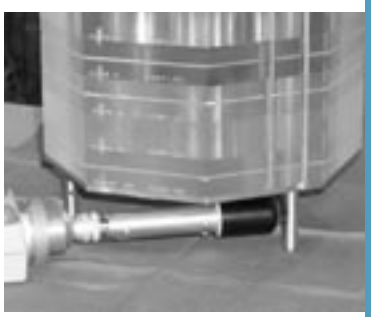


Figure 6. Example of typical dosimetry measurement Geometry. Dosimetry center is always 25 mm below bottom of phantom

07-680

NEMA® Cardiology Phantom

How does the NEMA Cardiology Phantom actually work?

The field size plate is placed on top of the phantom. A second plate with a centered radiopaque dot is placed in the base. The imaging gantry is adjusted until the cross wires intersect the approximate center of the disk. See Figure 7.

Fluorographs A and B demonstrate acceptable alignment of the NEMA phantom.

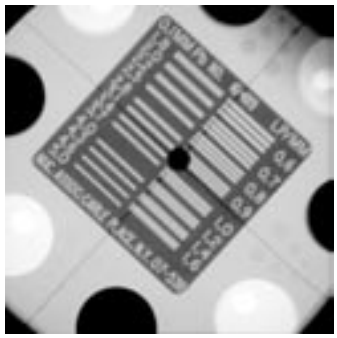
In fluorograph A, the spatial resolution test plate and several of the low contrast detectability targets are shown. Both lines cross at the dot.

Fluorograph B shows both lines crossing at the dot. (The test plates have been removed.)

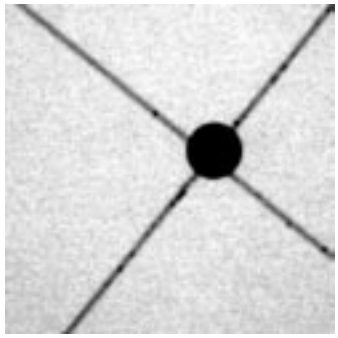
Fluorographs C and D demonstrate poor alignment of the NEMA phantom.

In fluorograph C, the spatial resolution test plate and several of the low contrast detectability targets are also seen in this image. The intersection of the two lines is outside the dot.

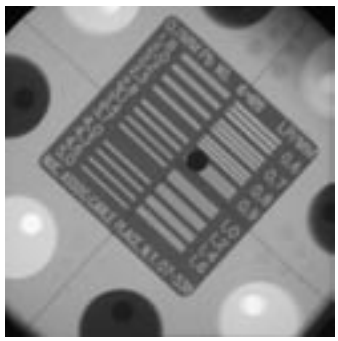
Fluorograph D shows the intersection of the two lines outside the dot. (The test plates have been removed.)



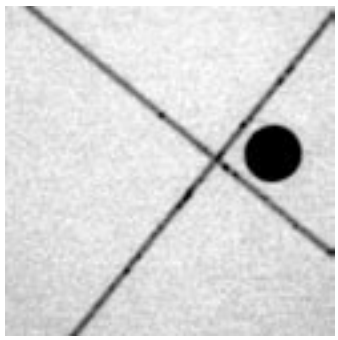
A



B

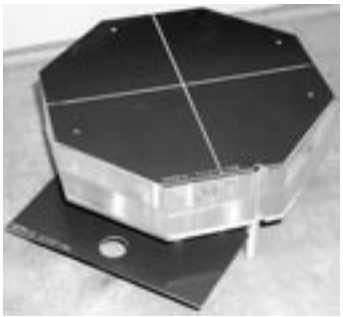


C

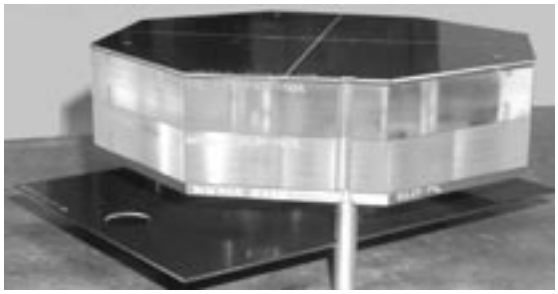


D

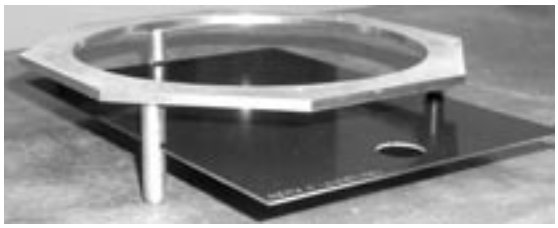
Figure 7. Alignment Tools



*NEMA Base with both lower (dot) and upper (cross) alignment plates in position



*NEMA Base with both lower (dot) and upper (cross) alignment plates in position. Note that the grooves on the side of each plate ensure the correct orientation of the plates

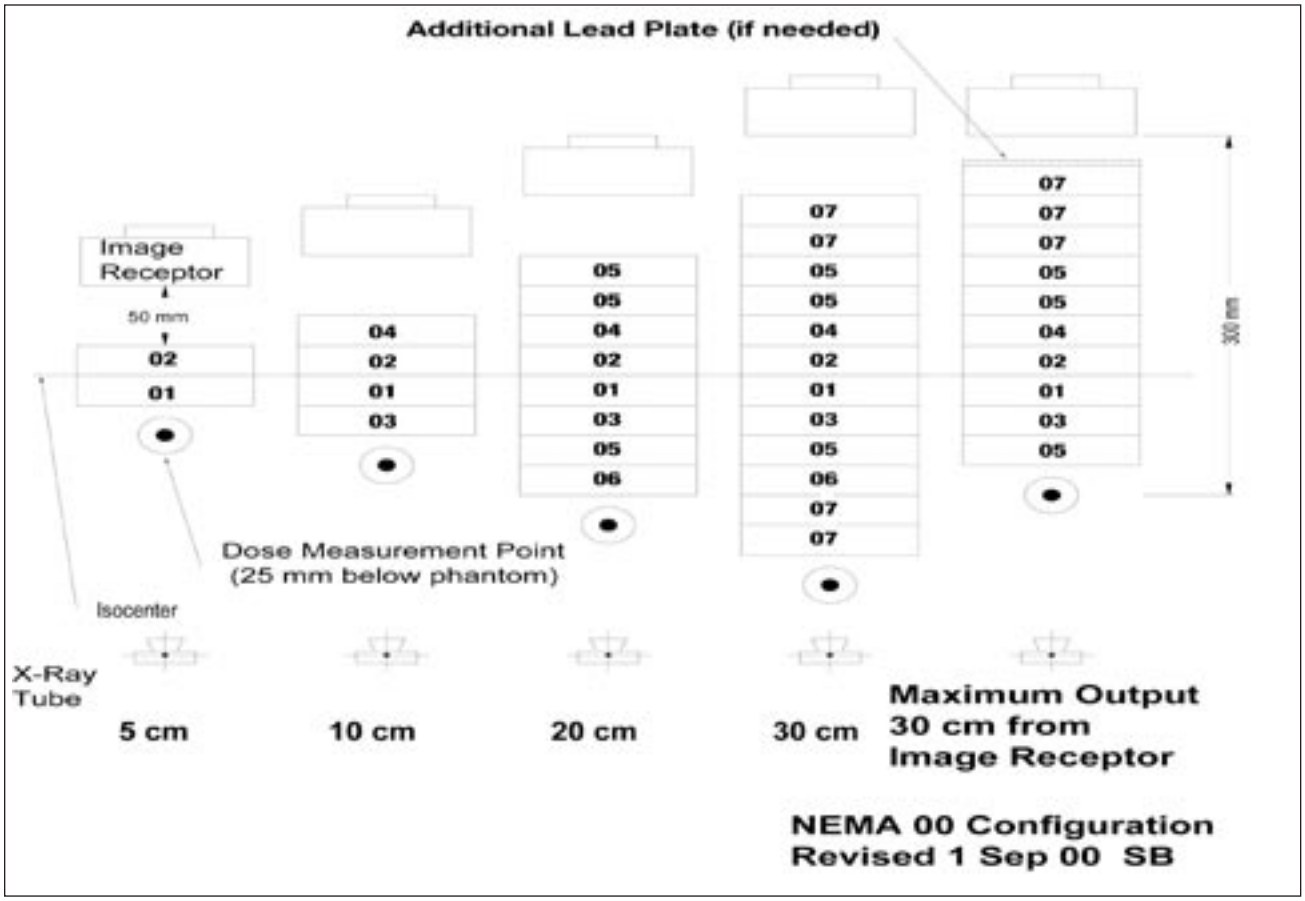


NEMA Base with lower alignment plate (dot plate) in position. Note that the leading edge of the plate fully engages the cutout in the rear leg

07-680

NEMA® Cardiology Phantom

Plate identification and stacking order



Specifications

Material	Thickness tolerance	Comments
PMMA plates	± 1 mm	
Aluminum	± 0.5 mm	Type-1100
Piano wires	Commercial steel	These are "standard" items
Lead pins	± 1 mm	
Lead plate	± 0.1 mm	
Copper plate	± 0.1 mm	
Iodine	± 5 %	Reagent grade tolerance is concentration in epoxy
PC boards		Solder-covered traces thick enough to be seen through 30 cm of PMMA

Included accessories

Phantom, rotating target (110 V or 220 V), test stand, alignment pins, x-ray test pattern, and carrying case

Ordering information

07-680 NEMA Cardiology Phantom

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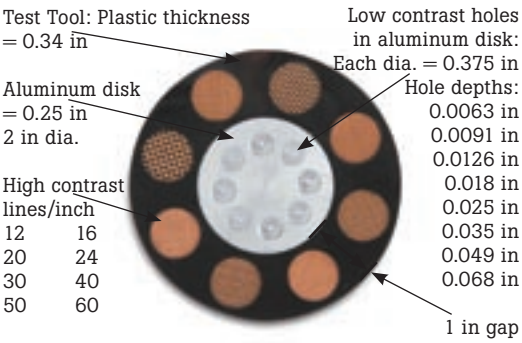
07-649

CDRH Fluoroscopic Phantom

FLUKE® Biomedical



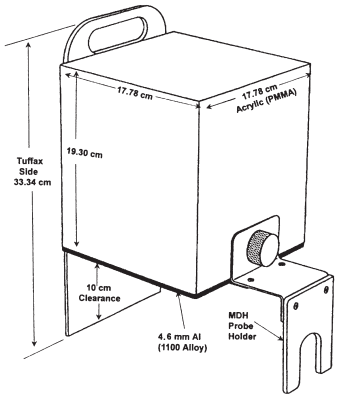
The Nationwide Evaluation of X-Ray Trends (NEXT*) fluoroscopy protocol has been issued to provide guidelines for quality control procedures for diagnostic fluoroscopy. In order to perform these procedures, a suitable phantom was developed: the 07-649 CDRH Fluoroscopic Phantom.

In a survey of fluoroscopic facilities for the NEXT program, it was determined that a substantial proportion of facilities could not visualize low-contrast test objects; this strongly suggests image quality problems. Measurements for this survey were performed using the 07-649 CDRH Fluoroscopic Phantom. In addition to air kerma rate (free in air) measurements, imaging performance was assessed using the Fluoroscopic Image Quality Test Object (included with phantom). The phantom also contains a lead stop plate and copper attenuation plate.

By using the 07-649 CDRH Fluoroscopic Phantom, doses at fluoroscopy can be reduced, and fluoroscopic image quality can be improved.

Key features

- Conforms to Center for Devices and Radiological Health (CDRH) specifications
- This phantom is now required in order to comply with QC tests recommended in the ACR's Barium Enema QC Manual
- Recommended in AAPM Report No. 60, "Instrumentation Requirements of Diagnostic Radiological Physicists"
- Optimized for both under- and over-table fluoroscopic tubes
- Compact, and easy to use



*The Conference of Radiation Control Program Directors (CRCPD), the professional organization of state and local radiation control agencies, along with the Food and Drug Administration (FDA) of the federal government, conducts the Nationwide Evaluation of X-Ray Trends (NEXT) survey program.

Specifications

This patient-equivalent phantom of uniform thickness consists of a 7 inch thick acrylic block, one Fluoroscopic Image Quality Test Object, one lead stop plate and one copper attenuation plate.	
Base	(2) type-1100 aluminum plates, each 2.3 mm thick
Phantom	(4) lead beads embedded on top, to be used as collimation orientation points
Lead stop plate	This 3.2 mm (0.125 in) plate simulates maximum attenuation, and can be used to measure the maximum air kerma rate (free in air)
Copper attenuation plate	This 1.6 mm (0.06 in) copper filter simulates the presence of a 2 mm thick layer of barium sulfate, and can be used to measure the air kerma rate (free in air).
Fluoroscopic image quality test object	This is comprised of eight low-contrast test holes (each 0.375 in Ø, and ranging in depth from 0.0063 in to 0.068 in) and eight wire meshes (ranging from 12 to 60 lines per inch). The test object is used for the assessment of spatial resolution, and can easily be taken on and off the phantom.
Dimensions (LxWxH)	17. 8 cm x 17.8 cm x 19.3 cm (7 in x 7 in x 8 in)
	It stands on two legs, approximately 4 inches off the tabletop. One leg is specially designed as a probe holder.
Weight	9.55 kg (21 lb)

Optional accessories

07-649-1169 Fluoroscopic Image Quality Test Object

Included accessories

Fluoroscopic image quality test object, lead stop plate, and copper attenuation plate

Ordering information

07-649 CDRH Fluoroscopic Phantom

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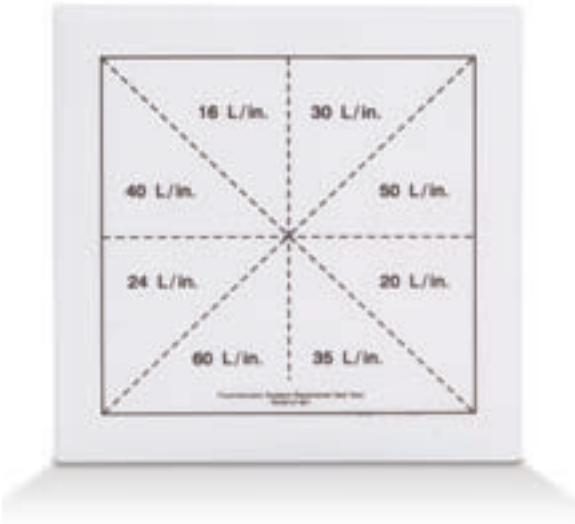
07-601 and 07-800 Series

Fluoroscopic System Resolution Test Tools and Flex Film Cassettes

FLUKE® Biomedical



07-601 Fluoroscopic System Resolution Test Tools
The Fluke Biomedical Flouroscopic Resolution Tools are 7.5-inch square, plastic plates that each have a 7-inch square area containing eight groups of copper or brass mesh screening in the following mesh-size ranges: 16 to 60 lines/inch, 30 to 100 lines/inch or 60 to 150 lines/inch. The screens are arranged in an irregular rotation to permit discrete visualization of groups. They can also be used to optimize television system focus as well as mirror optics and image intensifier settings.

07-800 Series Flex Film Cassettes
The 07-800 Series Flex Film Cassettes are flexible vinyl x-ray film holders that provide unsurpassed detail and resolution. Unlike conventional cassettes, Flex Film Cassettes contain no screen, so you get direct exposure of the x-ray film and a better image. Flex Film Cassettes offer an ideal combination of firmness and flexibility for a variety of medical and industrial applications; that's why they are the most widely used flexible film cassettes in the industry.

Flex Film Cassettes are the best choice for QC testing of imaging equipment. They are ideal for use with such test tools as: the Mini CT QC Phantom, all X-Ray Test Patterns, and all Focal Spot Imaging Test Tools, as well as many others.

Key features

07-601

- For resolution checks of fluoroscopic imaging systems

07-800

- Convenient to use: an alignment grid is printed on one side
- Easy-to-load: they fit easily around contoured items
- Durable: use them again and again
- Resistant to moisture and dirt: they're easy to clean
- Available in custom sizes: cassettes have been manufactured in sizes up to 68 inches long. Metric sizes are also available on special order

Specifications

07-601	
Dimensions (WxDxH)	19 cm x 19 cm x 0.3 cm (7.5 in x 7.5 in x 0.35 in)
Weight	0.225 kg (0.5 lb)
07-800 Series	
Weight	Less than 1 lb

Ordering information

07-601 Fluoroscopic Resolution Tool, 16-60 mesh
07-619 Fluoroscopic Resolution Tool, 30-100 mesh
07-618 Fluoroscopic Resolution Tool, 60-150 mesh
07-601-1414 Fluoroscopic Resolution Tool, 16-60 mesh, 14 in x 14 in
07-800-5007 Flex Film Cassette, 5 in x 7 in
07-800-8010 Flex Film Cassette, 8 in x 10 in
07-800-8012 Flex Film Cassette, 8 in x 12 in
07-800-1012 Flex Film Cassette, 10 in x 12 in
07-800-1417 Flex Film Cassette, 14 in x 17 in

07-600 and 07-678+

Fluoroscopic Beam Alignment Device and DXR Direct X-Ray Ruler

FLUKE® Biomedical

Key features

07-600

- Reduces exposure to the patient

07-678+

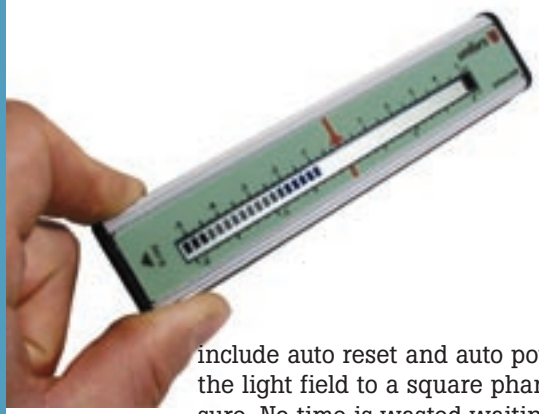
- Fully automatic
- 10 ms exposure time
- Auto power on
- Auto power off
- 6 years to 8 years battery life

07-600 Fluoroscopic Beam Alignment Device

In misaligned fluoroscopic image intensifier systems, the portion of the field that falls outside the visible area of the image receptor does not contribute to the useful fluoroscopic image and can result in unnecessary exposure to the patient.

If corrective measures are required, the 07-600 Fluoroscopic Beam Alignment Device will provide a measurement of optimum beam alignment.

It consists of an aluminum plate with four sliding brass strips set in recessed channels. The strips define the visible area of the image receptor and are adjustable with respect to the center of the measurement plate. A transparent plastic overlay on the aluminum plate prevents the vertical displacement of the brass strips. Holes drilled at 0.5 inch intervals through the center of each channel are filled with high density plugs. The visibility of the plugs in the fluoroscopic image permits their use as a means of centering the device.



07-678+ DXR Direct X-Ray Ruler

The 07-678+ DXR, Direct X-Ray Ruler, represents the latest in today's technology for alignment of the light and radiation field.

The 07-678+ DXR is extremely easy to use as it is powered on by simply exposing the meter. Features include auto reset and auto power off. There is no need to adjust the light field to a square phantom before making an exposure. No time is wasted waiting for films to be developed. The pocket-sized DXR gives an objective, reproducible and immediate read-out.

Specifications

07-600	
Dimensions (WxDxH)	23 cm x 23 cm x 1.6 cm (9 in x 9 in x 0.625 in)
Weight	2.27 kg (5 lb)
07-678+	
Range (Mammo)	30 kVp, 50 kVp, 70 kVp, 100 kVp
	>100 mA, >200 mA, >100 mA, >100 mA
Dimensions (WxDxH)	15 mm x 30 mm x 145 mm (0.59 in x 1.18 in x 5.71 in)
Weight	75 gr (2.6 oz)

Ordering information

07-600 Fluoroscopic Beam Alignment Device

07-678+ Direct X-Ray Ruler

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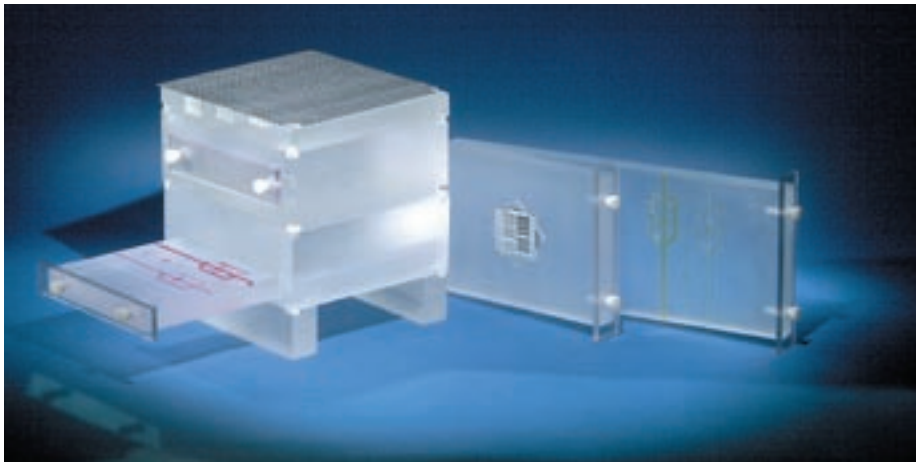
FLUKE®
Biomedical

76-710

Digital Subtraction Angiography (DSA) Phantom*



This 76-710 Digital Subtraction Angiography (DSA) Phantom† conforms to the recommendation in Report No. 15 by the American Association of Physicists in Medicine (AAPM)—Digital Radiology/Fluorography Task Group of the Diagnostic X-Ray Imaging Committee.

Dramatic improvement in the quality of the subtracted image due to improved phantom stability and increased homogeneity of bone material in bone blocks.

This phantom eliminates occurrence of mis-registration artifacts caused by inadvertent movement of the phantom components during image acquisition

Key features

- Conforms to Report #15 by the American Association of Physicists in Medicine (AAPM)
- Checks contrast range, resolution, linearity, uniformity, amplifier dynamic range, registration accuracy and subtraction effectiveness
- Provides easy-to-interpret results
- Quantitatively measures high- and low-contrast spatial resolution
- Retaining hasps ensure a tight fit between the step blocks, for reduced motion artifacts
- Specially-designed "stop" on the end of the slot blocks improves the positional accuracy of the insert material during image acquisition, and reduces the number of DSA frames that must be acquired
- The U-block provides a very sturdy support when entrance exposures are being measured with a dosimeter ion chamber
- Two artery blocks in two concentrations of iodine: 15 mg/ml and 150 mg/ml, for increased clinical relevance
- A 300 mg/ml iodine artery block is available as an option

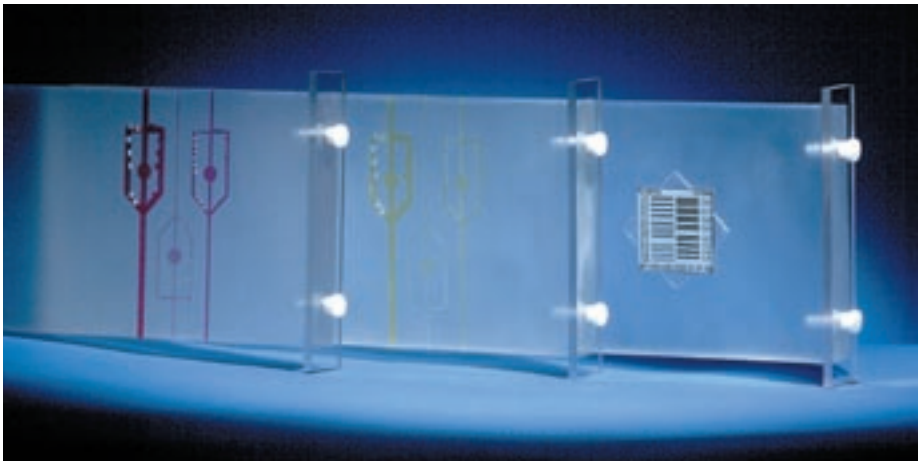
* Designed by Joel E. Gray, Ph.D., Professor Emeritus, Mayo Graduate School of Medicine and Jerome P. Taubel, R.T., Department of Diagnostic Radiology, Mayo Clinic® and Foundation. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

† This phantom conforms to the recommendation in Report #15 by the American Association of Physicists in Medicine (AAPM)-Digital Radiography/Fluoroscopy Task Group of the Diagnostic X-Ray Imaging Committee.

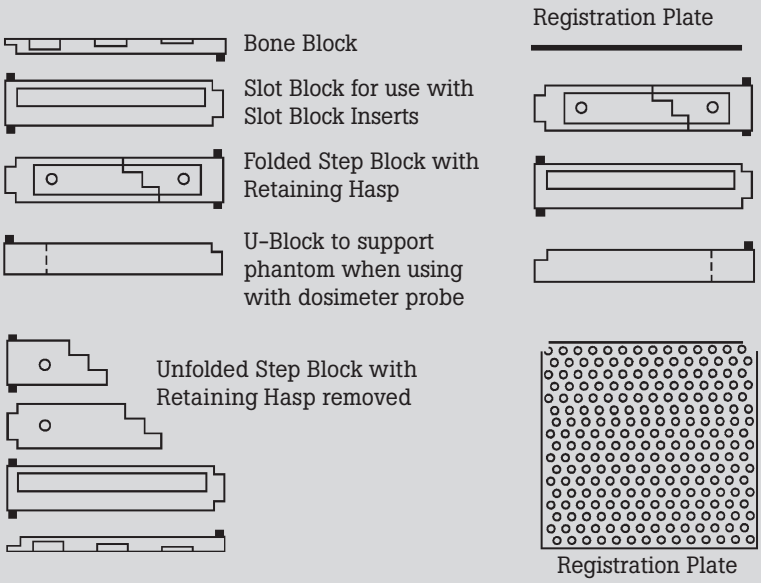
76-710

Digital Subtraction Angiography (DSA) Phantom

FLUKE® Biomedical



Possible DSA phantom configurations



Optional accessories

76-705 Artery Block, with 15 mg per ML venous concentration
76-705-1150 Artery Block (from 76-700-1150 phantom), with 150 mg per ML arterial concentration
76-705-1300 Artery Block (from 76-700-1300 phantom), with 300 mg per ML arterial concentration
76-711 Step Wedge
76-712 Slot Block
76-713 Bone Block
76-714 Blank Insert
76-715 Low-Contrast Artery Insert
76-716 Low-Contrast Iodine Line Pair Insert
76-717 High-Contrast Resolution Pattern Insert, does not include test pattern(s)
76-718 Registration Plate
76-719 Linearity Insert

Optional high-contrast resolution test patterns

07-527 High-Precision Test Pattern, 0.01 mm thick
07-538-1000 High-Precision Test Pattern, 0.1 mm thick
07-538-2000 Ultra-High Precision Test Pattern, 0.1 mm thick

Specifications

Physical	
Weight	13.9 kg (30.7 lb)

Included accessories

Registration Plate, 150 mg/ml Artery Block, Bone Block, U-Block Base, Slot Block, 15 mg/ml Artery Block, Step Block, Retaining Hasps

Ordering information

76-710 DSA Phantom

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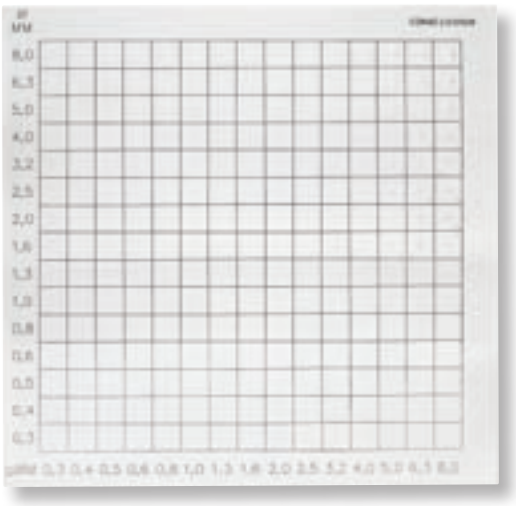
FLUKE®
Biomedical

07-652

CDRAD Contrast Detail Digital and Conventional Radiography Phantom



Most definitions of image quality in radiology are based on characterizing the physical properties of the image chain. However, medical diagnosis is not made by the image alone; observer perception greatly affects the result.

Digital radiography

The 07-652 CDRAD Phantom is an excellent tool for evaluating the imaging characteristics of digital radiographic systems, including stimulable phosphor computed radiography systems and teleradiography systems.

One of the principle concerns with the use of digital radiography is the potential reduction in the visibility of detail due to the blurring introduced at various places within the system, such as the film digitizers, display monitors, and the sampling of the image into discrete pixels. Loss of detail is the image characteristic which can have an adverse affect on diagnosis. Resolution (bar phantom) test objects which are used to evaluate conventional x-ray imaging systems are generally not appropriate for evaluating digital systems. The 07-652 CDRAD Phantom provides a reliable and objective evaluation of the loss of detail from blurring at any point within the system.

Key features

- Optimized for evaluation of digital systems
- Improves diagnostic accuracy
- Can also be used for conventional radiography systems

Used to evaluate loss of detail in:

- Film digitizers
- Computed Radiography (CR) systems
- Display monitors
- Laser printers

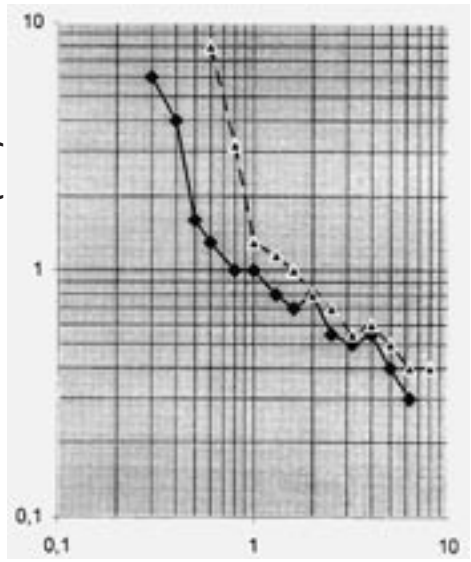
Used to adjust and optimize:

- Image processing parameters
- Viewing conditions

FLUKE®
Biomedical

07-652

CDRAD Contrast Detail Digital and Conventional Radiography Phantom



Contrast detail lines of monitor image (◆) and the hard copy image (①) from the same digital equipment

Image evaluation

- To evaluate the phantom image, the observer indicates the location of the second spot in each square. Correct indication proves that a contrast is actually seen.
- At the transition from visible to invisible, it is difficult to decide in which corner the second spot is located, and the response equals pure chance.
- The line connecting the central spots with the smallest visible diameter and contrast is called the Contrast Detail (CD) curve.
- For comparison of the imaging performance of different systems, phantom images are made under identical conditions and evaluated by the same observer at the same time. The better system will produce an image in which smaller contrasts and details are visible. This results in a shift of the CD curve to the lower left part of the image. (See graph)
- In the detail (vertical) direction, the diameter of the holes increases step-wise and logarithmically from 0.3 mm to 8 mm. The image shows 15 rows of spots with increasing detail.

Specifications

Plexiglas® tablet	Cylindrical holes of exact diameter and depth (tolerances: 0.02 mm)
Radiographic image	Provides information about the imaging performance of the whole system
	225 squares: 15 rows and 15 columns
	In each square, either one or two spots (the images of the holes) are present. The first three rows show only one spot, while the other rows have two identical spots; one in the middle and one in a randomly chosen corner. (See graph)
	The optical densities of the spots are higher than the uniform background
	In the contrast (horizontal) direction, the depth of the holes increases logarithmically, and the image shows 15 columns of spots with increasing contrast
Performance comparison	Comparison of the performance of several observers is also possible. The better performing observer produces a CD curve more to the lower left part of the image
Dimensions (WxDxH)	26.4 cm x 26.4 cm x 0.76 cm (10.4 in x 10.4 in x 0.3 in thick)
Weight	1.34 kg (3 lb)

Ordering information

07-652 CDRAD Contrast Detail Digital and Conventional Radiography Phantom

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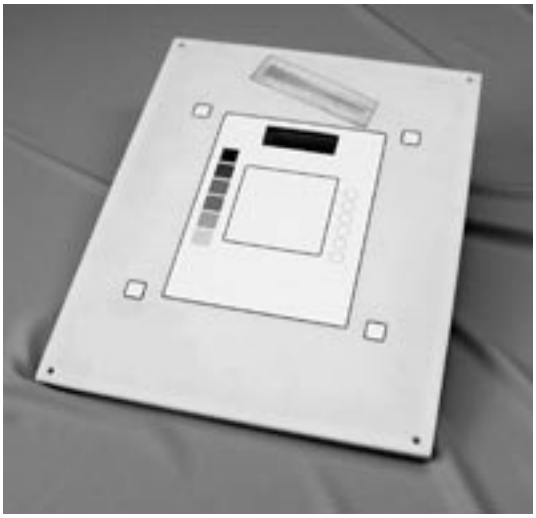
07-605-7777

CR/DR DIN Test Tool



The 07-605-7777 CR/DR DIN Test Tool is a timely and valuable solution to the image quality maintenance problem. Technologists, radiologists and physicists can easily perform quick and reliable assessments of their CR/DR systems.

Today's new image acquisition chains are considerably more complex than conventional screen/film systems. Computed Radiography (CR)/ Digital Radiography (DR) systems involve special processing for each body part. This is controlled by computers, rather than chemical processors and soft copy displays, which are calibrated using light meters rather than visual inspection. CR/DR systems also incorporate laser beams, photomultiplier tubes, network gateways and laser printers. The 07-605-7777 is designed specifically for evaluating the entire CR/DR image acquisition chain.

Ideal for use as a preventive maintenance quality control test tool, the 07-605-7777 can also be used to take regularly scheduled measured data points from the image, such as line pair resolution measurements, ROIs (regions of interest) and geometry symmetry. Measurements/angle can be used to evaluate monitor, as well as printed film image quality.

By performing daily quality-control checks, both before the first patient is examined and at the end of the day, equipment problems can be accurately and easily pinpointed and corrected. Equipment downtime is significantly reduced, resulting in increased patient throughput. Patients no longer need to endure repeat exams due to poor image quality.

You'll soon realize a dramatic savings in film costs when you use the 07-605-7777 as part of your QC program. In addition, radiological personnel will experience significantly less of the problems and frustrations associated with equipment maintenance and thank you for it.

Key features

- Quick and easily optimize images from your CR/DR system
- Effectively reduces equipment downtime
- Incorporates the "DIN" standard test pattern, DIN 6868/58
- Dramatically reduces repeat patient exams; thus preventing unnecessary patient exposure due to problems related to the image acquisition chain and poor image quality
- Lightweight, durable
- Easy-to-use, no moving parts
- Cost-effective
- Quickly verifies important parameters, including dynamic range, contrast resolution, homogeneity, and resolution

Specifications

Dimensions (WxDxH)	35.5 cm x 43.1 cm x 1.5 cm (14 in x 17 in x 0.5 in)
Weight	3.2 kg (7.05 lb)

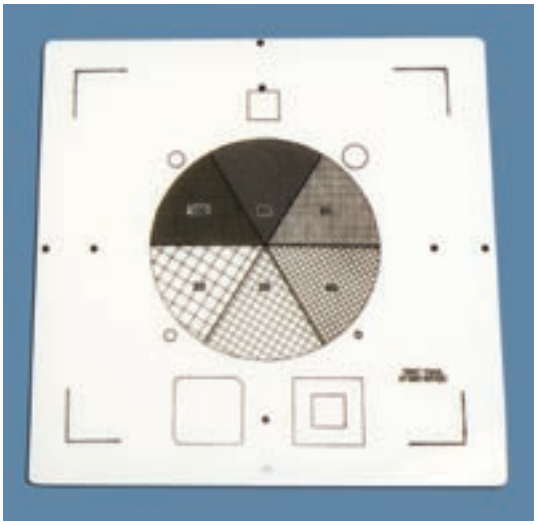
Ordering information

07-605-7777 CR/DR DIN Test Tool

07-647

R/F QC Phantom

FLUKE® Biomedical



The 07-647 R/F QC Phantom is designed to provide the diagnostic radiologic technologist with an accurate, easy-to-use tool for evaluating the image quality and performance of standard diagnostic radiographic and fluoroscopic imaging systems.

For fine-tuning of radiographic and fluoroscopic imaging systems, it is recommended that the phantom be imaged at least monthly on all radiographic and fluoroscopic equipment. To attain the most accurate, up-to-date quality control information, a daily or weekly frequency is preferable. When used daily, the R/F QC Phantom will allow the technologist to quickly determine whether the equipment is functioning correctly. This easy-to-use phantom allows the user to complete the suggested protocol in approximately five minutes or less, when used on a standard R/F system. Once the phantom is imaged, simply graph the results to determine any trends that may indicate a degradation of imaging system performance, such as a steady but slow change in the fluoro kVp or in the radiographic mAs.

Dimensions (WxDxH)	17.78 cm x 17.78 cm x 1.42 cm (7 in x 7 in x 0.56 in)
Weight	0.5 kg (1.1 lb)

Key features

- Designed specifically with the radiologic technologist in mind
- Provides an accurate overall evaluation of image quality consistency
- Ideal for use in determining subtle degradation in imaging performance
- Average test time is less than 5 minutes per unit
- Verifies fluoroscopic monitor contrast and brightness adjustment
- Includes pie-shaped wedges of varying mesh sizes: 20#, 30#, 40#, 60#, 80#, and 100# L/in, for evaluating high-contrast performance
- Surrounding the mesh are four low-contrast "masses" of different diameters: 2 mm, 4 mm, 6 mm, and 8 mm
- At one edge of the phantom is a small "density difference" patch, for a measure of contrast on the films
- At the opposite edge of the phantom are two monitor adjustment squares, each having a low-contrast square insert
- The phantom contains a 1 mm copper attenuator which allows it to simulate the attenuation of an average adult
- At the corners of the test tool are lines for aligning the light field
- QC charts are provided for plotting both the radiographic and fluoroscopic results
- Along the sides of the test tool are beads 1 cm inside and outside of the lines started in the corners

Ordering information

07-647 R/F QC Phantom

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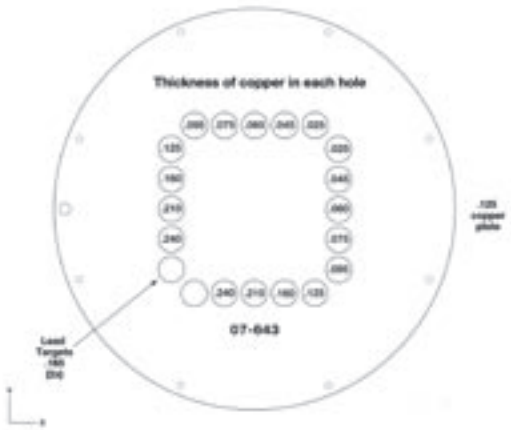
07-643

Contrast Imaging Phantom

FLUKE® Biomedical

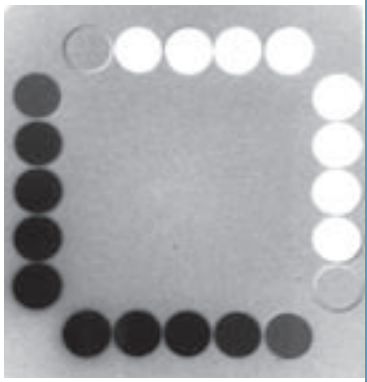
The 07-643 Contrast Imaging Phantom is an accurate, easy-to-use, indispensable tool for evaluating image quality and determining that the imaging system is operating at its full potential. It will immediately let you know if there's a problem.



Diagram

Key features

- Provides the ability to simultaneously check the dynamic range of the video system
- Allows users to evaluate during all fluoro modes—pulsed, non-pulsed, etc.
- Provides the ability to check film range and density



X-ray image

Specifications

Dimensions (WxDxH)	Outside diameter: 23 cm (9.05 in)
	Thickness: 1.28 cm (0.5 in)
Weight	1.26 kg (2.8 lb)

Ordering information

07-643 Contrast Imaging Phantom

07-653

Fluoroscopic Imaging Test Phantom

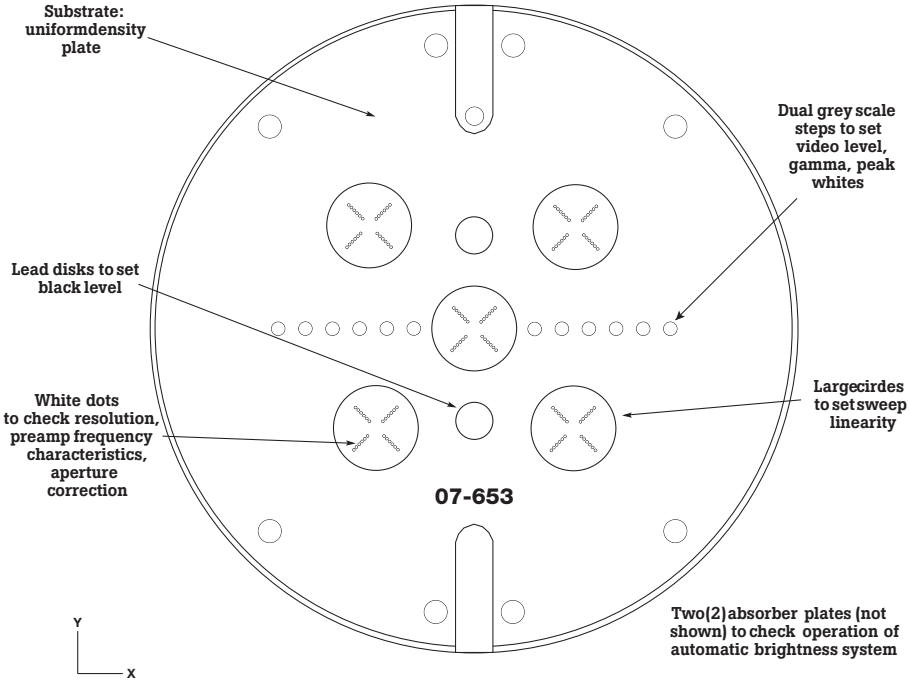
Ensure the optimum performance of your fluoroscopic system with the 07-653 Fluoroscopic Imaging Test Phantom.

This compact, versatile, and extremely easy-to-use phantom is inventively designed to enable you to evaluate, adjust and optimize fluoro video cameras, brightness systems and image processing systems. Its proven design makes it ideal for use by x-ray service engineers.

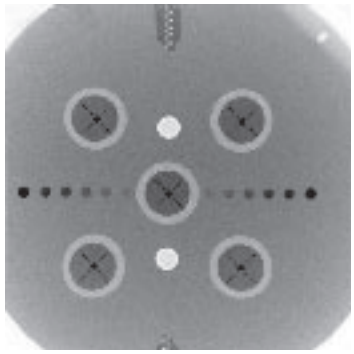
Key features

Provides a test pattern enabling the precise adjustment of many critical parameters of the fluoroscopic system:

- Video level, contrast, peak whites, black level
- Shading or vignetting correction
- Automatic brightness
- Sweep linearity
- Frequency response, aperture correction



Phantom diagram



X-ray image

Specifications

Outside diameter	22.78 cm (8.97 in)
Thickness	1.28 cm (0.5 in)
Weight	1.86 kg (4.1 lb)

Ordering information

07-653 Fluoroscopic Imaging Test Phantom

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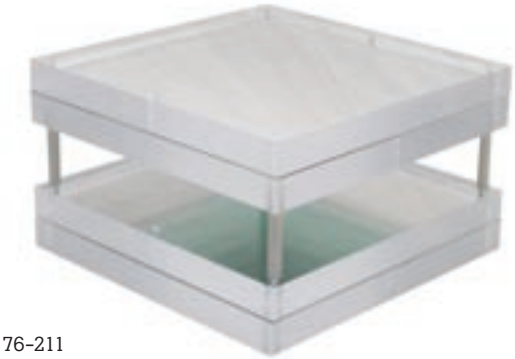
76-2 Series

Diagnostic X-Ray Phantoms



76-211

76-212

76-213

76-214

JCAHO requires that x-ray exposure measurements be determined for commonly used projections in all radiographic suites. In order to provide this information when using automatic exposure control (AEC) or automatic brightness control (ABC) systems, specially designed phantoms must be used. Attenuating material must be used between the source and AEC or ABC detectors. Since these detectors are energy dependent, measurement of skin entrance exposure requires the use of patient-equivalent phantoms for meaningful results.

AAPM Report No. 31 recommends the use of four unique phantoms for use in diagnostic x-rays. Fluke Biomedical's 76-2 Series phantoms meet this need. These acrylic and aluminum phantoms are patient-equivalent and are specifically designed to conform to the AAPM recommendations.

Key features

- Phantoms conform to AAPM recommendations contained in Report No. 31, "Standardized Methods for Measuring Diagnostic X-Ray Exposure"
- Patient-equivalent acrylic and aluminum phantoms provide the necessary attenuation between the source and AEC or ABC detectors
- Helps you comply with JCAHO requirements for radiographic exposure measurements
- These phantoms are recommended in AAPM Report No. 60, "Instrumentation Requirements of Diagnostic Radiological Physicists"

76-2 Series

Diagnostic X-Ray Phantoms

FLUKE® Biomedical

Specifications

76-211	
Dimensions (WxDxH)	(4) 25 cm x 25 cm x 2.54 cm clear acrylic sheets
	(1) sheet of 25 cm x 25 cm x 1 mm type-1100 high-purity aluminum
	(1) sheet of 25 cm x 25 cm x 2 mm type-1100 high-purity aluminum
Weight	8 kg (17.5 lb)
76-212	
Dimensions (WxDxH)	(5) sheets of 25 cm x 25 cm x 2.54 cm and (1) sheet of 25 cm x 25 cm x 5.08 cm clear acrylic to achieve a 17.78 cm thick phantom
Weight	17 kg (37 lb)
76-213	
The Skull Phantom has the same configuration as the 76-211, but without the air gap.	
Dimensions (WxDxH)	Center sheet: 25 cm x 25 cm x 5.08 cm clear acrylic
Weight	12 kg (26.5 lb)
76-214	
Dimensions (WxDxH)	(1) 25 cm x 25 cm x 1 mm piece of high-purity alloy aluminum sandwiched between (2) sheets of 25 cm x 25 cm x 2.54 cm clear acrylic
Weight	4.5 kg (10 lb)
76-215	
This kit contains all the components needed to make any one of the phantoms on this page	
Dimensions (WxDxH)	(5) 25 cm x 25 cm x 2.54 cm thick acrylic sheets
	(1) 25 cm x 25 cm x 5.08 cm thick acrylic sheet
	(1) 25 cm x 25 cm x 1 mm thick aluminum sheet
	(1) 25 cm x 25 cm x 2 mm thick aluminum sheet
	(1) 7 cm x 25 cm x 4.5 mm thick aluminum sheet
	Spacers for a 5.08 cm air gap
Weight	15.3 kg (34 lb)

Included accessories

76-211

Spacers to provide a 5.08 cm air gap

76-212

In order to provide additional attenuation in the spinal region, a 7 cm x 25 cm x 4.5 mm thick piece of high-purity alloy aluminum is included.

Ordering information

76-211 Chest X-Ray Phantom
76-212 Abdomen/Lumbar Spine Phantom
76-213 Skull X-Ray Phantom
76-214 Extremity X-Ray Phantom
76-215 Make-Your-Own-Phantom Modular Kit

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FLUKE®
Biomedical

76-025

CDRH Dental Image Quality Test Tool

The Nationwide Evaluation of X-Ray Trends (NEXT*) dental protocol has been issued to provide guidelines for quality control procedures for diagnostic dental radiography. In order to perform these procedures, a suitable phantom was developed: the 07-625 CDRH Dental Image Quality Test Tool.

The JCAHO requires certain standards to be met regarding radiographic quality control. The 07-625 CDRH Dental Image Quality Test Tool facilitates compliance with these standards, since the standards were compiled using a prototype of this phantom.

The 07-625 CDRH Dental Image Quality Test Tool is designed specifically for testing the functionality of dental x-ray units and provides a means of evaluating half-value layer, determining kVp, and assessing overall image quality. It is the only dental test tool designed with dental service personnel and inspectors in mind. The test tool will significantly improve the ability of service personnel to quickly and accurately survey the image quality of the x-ray unit. The 76-025 CDRH Dental Image Quality Test Tool can also be used as a constancy check for x-ray film processing, making it the most versatile and cost-effective dental test tool available today.

Clinical imaging involves diagnosis of tooth pathology. In order to permit an accurate simulated clinical image evaluation, the test tool contains a human tooth encased in its center. The 76-025 CDRH Dental Image Quality Test Tool consists of a wooden cradle (to hold the test tool body), built-in slots (for attenuation filters), a film slot, an exposure chamber holder, and a mounting screw (for use with a tripod). The test tool comes with an aluminum step wedge that is designed for evaluating darkroom fog and consistency testing. The step wedge has two slots, one for exposing a film pack and one for evaluating darkroom fog. The film slot also ensures easy, reproducible placement of the film for consistent imaging.

To use the 76-025 CDRH Dental Image Quality Test Tool, it is necessary to establish an acceptable baseline or standard for the x-ray unit performance. The test tool should be imaged using the same technical factors that were used to establish the baseline. These images, when compared to the baseline, will allow the user to determine if image quality degradation is occurring so appropriate corrective action can be taken.

Key features

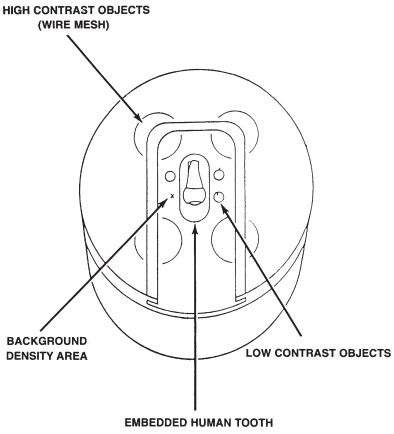
- Designed to meet the requirements for the NEXT dental survey protocol
- Conforms to Center for Devices and Radiological Health (CDRH) specifications
- Provides a means of reproducible setup, ensuring a consistent test protocol
- Reduces the need for repeat films
- Reduces setup time
- Increases patient safety
- Minimizes chance of misdiagnosis
- Ideal for dental service engineers and inspectors

*NEXT (Nationwide Evaluation of X-Ray Trends) is a committee of the Conference of Radiation Control Program Directors (CRCPD) that oversees quality control procedures for diagnostic radiology. They issue procedure protocols and guidelines for imaging modalities.

76-025

CDRH Dental Image Quality Test Tool

FLUKE® Biomedical



CDRH Dental Image Quality Test Tool (76-025) set up for half value layer measurements

Optional accessories

76-025-4000 Aluminum Step Wedge

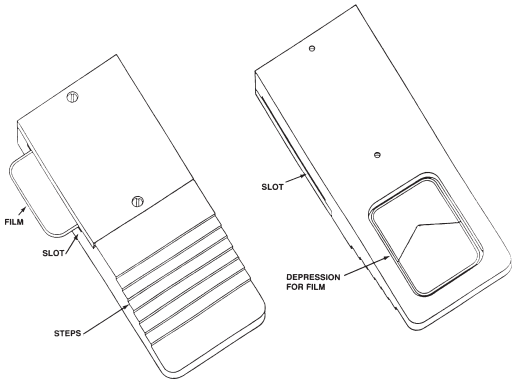
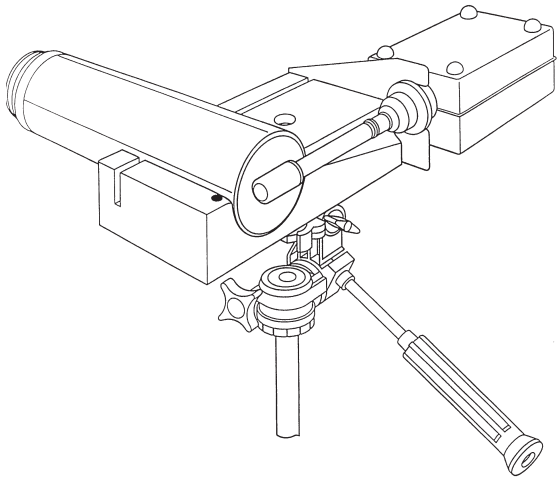


Diagram of Aluminum Step Wedge used for darkroom fog and consistency testing



CDRH Dental Image Quality Test Tool (76-025) set up for dental exposure measurement protocols

Specifications

Materials	Base: Wood
	Test tool: Acrylic
	Step wedge: Type-1100 aluminum
Dimensions (WxDxH)	Base: 10 cm x 20 cm x 4.9 cm (3.94 in x 7.87 in x 1.93 in)
	Test tool: 7.6 cm Ø x 5.5 cm long (3 cm x 2.17 cm)
	Step wedge: 5.1 cm x 12.7 cm x 1.3 cm
Weight	0.88 kg (2.06 lb)

Included accessories

Four different copper wire meshes that have the following lines-per-inch ratios: 100, 120, 150, and 200
Four air steps for contrast and density measurements
One human tooth encased in the phantom material
One aluminum step wedge

Ordering information

76-025 CDRH Dental Image Quality Test Tool

76-025-6661 Dental Image Quality Test Tool with Decayed Tooth

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FLUKE®
Biomedical

76-606DX

ATOM MAX
Diagnostic Head Phantom

ATOM MAX

The 76-606DX ATOM MAX Diagnostic Head Phantom is a standard of reference for diagnostic radiology of the head. The phantom is designed to assist technical and clinical staff in the selection, monitoring, training and verification of scanning parameters common to most radiological procedures requiring fine anatomical details.

The 76-606DX provides a consistent tool for researchers, clinicians and technologists. It is ideal for determining optimum system settings, commissioning new equipment, monitoring system performance and training in dental x-ray, panoramic x-ray, CT, and cone beam CT procedures.

The phantom includes an adjustable stand for positioning within a cone beam CT or panoramic x-ray system. The jaw of the phantom is slightly opened and front teeth are vertically aligned to replicate correct positioning with a bite guide. Please note that an actual bite guide can not be positioned in this product.

The phantom is constructed of proprietary tissue equivalent materials. ATOM MAX is made of tissue simulating resins that mimic the X-ray attenuation properties of human tissue for both CT and therapy energy ranges (50 keV to 25 MeV). The 76-606DX approximates the average male human head in both size and structure. The phantom includes detailed 3D anthropomorphic anatomy including brain, bone, larynx, trachea, sinus, nasal cavities and teeth. The bones contain both cortical and trabecular separation. The teeth include distinct dentine, enamel and root structure including the nerve. The sinus cavities are fully open.

Key features

- Our most realistic maxillofacial phantom for dental cone beam CT and panoramic x-ray
- Includes detailed anatomical features
- Frankfurt plane identified to ensure proper alignment
- Tissue equivalent from 50 keV to 25 MeV
- Positioning stand with six degrees-of-freedom
- Carrying case included
- Four-year warranty

Simple to set up and easy to use

The 76-606DX stand allows accurate phantom positioning. The included stand is adjustable in the x-y-z axes as well as allowing rotations about each of these axes. The head easily screws onto the stand and locks into place.

Capabilities and applications

- Commission x-ray, panoramic x-ray, CT, and cone beam CT systems
- Learn how to properly position head for optimal images
- Test reconstruction techniques and algorithms for implant planning and maxillofacial reconstruction
- Train and evaluate personnel during implementation of new equipment and techniques
- Validate consistency of image quality

Specifications

Overall size (phantom only)	22.9 cm x 22.9 cm x 29.2 cm (9 in x 9 in x 11.5 in)
Phantom weight	5 kg (11 lb)
Stand weight	3.2 kg (7 lb)
Shipping weight	13.2 kg (29 lb)

Included accessories

Positioning stand with soft sided carrying case and phantom carrying case

Ordering information

76-606DX ATOM MAX Diagnostic Head Phantom

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FLUKE®
Biomedical

07-645

Fluoro-Test™ Tool*

The 07-645 Fluoro-Test Tool is a fluoroscopic contrast resolution device that employs a target arrangement designed to reduce ambiguity and difficulty associated with employing a sequential array of targets with small differences in contrast between adjacent targets.

With the 07-645 Fluoro-Test target plates, the user focuses on a subset of three targets at a given time. In each subset or column, large differences (approx. 3 %) are present between adjacent targets and it is easy to decide if a target is visualized or not. The threshold contrast for a plate is the lowest of the values observed for the three columns of targets, and a contrast resolution precision of 0.5 % is obtained by the sequential use of the two plates. When imaged at 80 kVp with 2 mm of Cu beam attenuation, the targets of Plate A range in contrast from 1 % to 8 % in 1 % increments. Likewise, the targets of Plate B range from 0.5 % to 7.5 %. Tables of target contrast versus kVp permit the user to determine target contrast (and therefore threshold contrast resolution) at other fluoroscopic tube potentials.

Key features

- Designed to yield a quantitative assessment of fluoroscopic threshold contrast

Specifications

07-645	
Dimensions (WxDxH)	Two 6 in x 6 in x 0.25 in (6.1 mm) thick aluminum plates, with each plate containing an array of 1.1 cm targets of varying contrast
	Three 6 in x 6 in x 1 mm thick copper attenuator sheets
Weight	1.42 kg (3.15 lb)

* Manufactured under licensing agreement with UAB Research Foundation, University of Alabama at Birmingham, Alabama.

The development of the 07-645 is based on the work of A. J. Wagner, G. T. Barnes and X. Wu, "Assessing Fluoroscopic Contrast Resolution: A Practical and Quantitative Test Tool," Medical Physics, 18 (1991), 894-899.

Ordering information

07-645 Fluoro-Test Tool

07-444

"The Little Genius" Scanning Densitometer

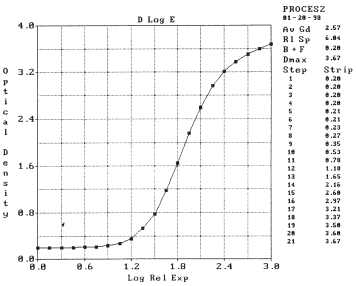
FLUKE® Biomedical

The 07-444 "Little Genius" Scanning Densitometer stands head and shoulders above all other densitometers when it comes to performance, reliability and economy. The only handheld scanning densitometer in the industry with built-in scanning and single-point (spot) measurement capability, it literally does the work of two densitometers.

The 07-444 measures and stores daily film data for up to 20 different x-ray film processors for 31 days in its own built-in memory. Use it to generate and print control charts and D-Log-E curves directly to a printer without using external software and a computer. Set base-line (target) and tolerance levels for each control chart parameter either manually or automatically by scanning and averaging up to 9 different film strips.

Key features

- Built-in scanning and single-point (spot) measurement capability, it literally does the work of two densitometers
- Quickly and easily generates control charts and D-Log-E curves, without the use of external software
- Saves time
- Increases accuracy of readings
- Provides vital information in seconds
- Includes built-in scanning and single-point measurement capabilities
- Available with AutoSTPP X-Ray Film Processor QC Software



D-Log-E curve generated by "The Little Genius" without external software

Specifications

Measuring range	0 to 4 OD units
Accuracy	0 to 3 OD ± 0.02 OD units; 3 to 4 OD ± 1 %
Repeatability	± 0.02 OD units
Power requirements	6 AA batteries, 1.5 V alkaline; 110 V ac with ac power converter
Spectral response	Centered at 540 nm
Aperture size	1 mm and 2 mm
Dimensions (WxDxH)	8.1 cm x 7 cm x 18 cm (3.2 in x 7.1 in x 2.75 in)
Weight	1.3 kg (2.8 lb)

Optional accessories

802013 RS-232 Interface Cable, 2 m (7 ft)
169072 9-Pin Adapter
169071 25-Pin Adapter
88-444 Non-Powered Serial Parallel Converter

Available ac adapters for (specify with order)
14-301 110 V ac, 9 V dc, 500 mA, USA and Japan
14-399 230 V ac, 9 V dc, 500 mA, Europe
14-415 230 V ac, 9 V dc, 500 mA, UK
14-415 and 14-416 adapter 230 V ac, 9 V dc, 500 mA, Australia

Included accessories

07-444
802013 RS-232 Interface Cable
169072 9-Pin Adapter
169071 25-Pin Adapter

07-446
07-444-1CD AutoSTPP X-Ray Film Processor QC Software
802013 RS-232 Interface Cable
169072 9-Pin Adapter
169071 25-Pin Adapter

Ordering information

07-444 "The Little Genius" Scanning Densitometer
07-446 "The Little Genius" Scanning Densitometer

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FLUKE®
Biomedical

07-443

Handheld Deluxe Digital Clamshell Densitometer

Get all the benefits of state-of-the-art features in a compact, handheld unit. The 07-443 Handheld Deluxe Digital Clamshell Densitometer has today's most-wanted features for "go-anywhere" quality control testing...from darkroom to darkroom, and from lab to field.

It's easy to use. Just lift the "shell" and insert the test film; close the "shell" and press the READ button. The measured optical density appears on the three-digit liquid crystal display. The self-contained light source makes it convenient to use, anywhere.

Key features

- Features a self-contained light source
- Fast and accurate results
- Lightweight and portable
- Reads grayscale up to 4 OD
- Two aperture choices: 1 mm and 2 mm
- Easy-touch pads
- Battery operated
- Easy read display

Specifications

Range	0 to 4.0 OD
Accuracy	± 0.02 OD
Reproducibility	± 0.01 OD
Temperature range	10 °C to 40 °C (50 °F to 104 °F)
Apertures	1 mm and 2 mm
Measuring length	Throat: 135 mm (5.3 in)
Zero range	Auto zeros to density 0.0
Sensor	High-efficiency silicon photodiode
Controls	Zero pushbutton: zeros unit
	Power on/off switch
	READ pushbutton: initiates READ sequence
	Calibration control: screwdriver adjustable 20-turn potentiometer used to calibrate against a known step tablet
Display	Three-digit, 0.5 in LCD with a low-battery indicator
Light source	When turned on during measurement, provides extremely long life with minimum spectral and intensity degradation. Reduces heating to a minimum
Power requirements	Four 1.5 V AA batteries (approx. 3,000 exposures)
Dimensions (WxDxH)	8.1 cm x 18 cm x 6.1 cm (3.2 in x 7.1 in x 2.4 in)
Weight	0.82 kg (1.81 lb)

Optional accessories

87-443-1000 Battery Charger
87-443-2140 Battery and Charger Kit, includes four AA NiCad batteries and one battery charger
89-443 Carrying Case

Included accessories

010128 Five-Step Density Tablet
89-443 Carrying Case

Ordering information

07-443 Handheld Deluxe Digital Clamshell Densitometer

FLUKE®
Biomedical

07-417

Handheld Dual-Color Sensitometer

This compact, precision instrument is ideal for maintaining consistent, high-quality film processing. By evaluating control films on a daily basis, the technologist can identify processor variations before they affect clinical radiographs. Also, processing conditions in multiprocessor departments may be standardized. In the past, this was difficult in departments using varied film-screen combinations in different areas. With this sensitometer, proper exposure of either blue- or green-sensitive x-ray film is easily accomplished, with no need for internal adjustments.

The Handheld Dual-Color Sensitometer features a 21-step density wedge with 0.15 OD increments. The 21 density-gradient steps are numbered for convenience. An innovative, dual-color, electroluminescent light source provides precisely-controlled repeatable exposures. The desired color is selected with a front-panel switch.

To make an exposure, the platen is raised and a sheet of film is inserted beneath it until the film stops are reached. The platen is lowered and the exposure switch is depressed. An audible buzzer is activated during the exposure. To prevent double-exposures, a two-second delay is engaged before the next exposure can be made. When battery replacement becomes necessary, the unit will not expose film. Battery life is approximately 10,000 exposures.

Processor variations are monitored by comparing the control film to previously processed films. Speed, contrast, and base-plus-fog values can be graphically plotted for easier comparison.

Key features

- Helps maintain optimum film processing conditions
- Easy selection of blue or green light emission
- Lightweight, portable, battery-operated
- Repeatability: ± 0.04 OD log exposure from unit-to-unit
- Stability: ± 0.02 OD log exposure per year at 10 °C to 45 °C
- Numbered, 21-step density wedge

Specifications

Light source	Dual-color electroluminescent
	Blue 455 nm ±10 nm; green 520 nm ± 10 nm
Repeatability	± 0.04 OD log exposure from unit to unit
Stability	± 0.02 OD log exposure per year at 10 °C to 45 °C
Exposure area	21 steps, each 5 mm x 10 mm
Tablet densities	0.05 OD to 3.05 OD in 0.15 OD increments
Exposure time	Adjustable, 50 ms to 500 ms typical
Exposure adjustment	Separate external screwdriver adjustments ± 0.5 OD on each color
Controls	Push-to-expose button: buzzer monitor and two-second delay to prevent double exposures
	Blue/Green rocker switch
	Power switch: none required. Unit draws no power on standby
Power requirements	Two 9 V alkaline transistor batteries. Optional ac power converter. Approximate battery life 10,000 exposures
Dimensions (WxDxH)	13.34 cm x 19.37 cm x 9.21 cm (5.25 in x 7.625 in x 3.625 in)
Weight	1.14 kg (2.5 lb)

Optional accessories

89-417 Carrying Case

Available ac adapters for (specify with order)

14-301 110 V ac, 9 V dc, 500 mA, USA and Japan

14-399 230 V ac, 9 V dc, 500 mA, Europe

14-415 230 V ac, 9 V dc, 500 mA, UK

14-415 and 14-416 Adapter 230 V ac, 9 V dc, 500 mA, Australia

Ordering information

07-417 Handheld Dual-Color Sensitometer

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FLUKE®
Biomedical

07-402

Portable Digital Thermometer

This 07-402 Portable Digital Thermometer is a battery-powered unit with a detachable immersion probe. Temperature readings appear in Centigrade or Fahrenheit with ± 0.5 % accuracy. The LED display eliminates problems that can result from the misreading of stem-type thermometers.

Detachable immersion probes are time-savers for x-ray departments that have several film processors. The use of multiple probes, each remaining in a specific tank, also eliminates the possible cross-contamination of chemicals.

CE

The 07-402 includes many convenient features and capabilities. You can quickly and easily display the lowest and highest temperatures measured by the probe since the unit was turned-on. Our digital thermometer also enables you to "freeze" the current temperature reading on the display. The thermometer display can be easily illuminated, making it perfect for use in the darkroom. You can also program the 07-402 for auto or manual shut-off.

The 07-402 Portable Digital Thermometer is a shock resistant, solid-state unit that needs no adjustments to maintain accuracy. Calibration is traceable to the National Institute of Standards and Technology (NIST)*. The unit includes a high-impact plastic case with a recess for storing one probe, and is equipped with a power jack that will accept the optional ac power supply. The jack should be used when the unit will be in use for extended periods of time (in order to prevent battery failure).

Key features

- Displays minimum/maximum readings
- Hold/freeze function
- Auto shut-off
- Battery eliminator jack for a 9 V dc converter
- Checks film processor solution temperatures quickly and accurately
- Large, easy-to-read, backlit digital display of temperature in Centigrade or Fahrenheit
- Accuracy: ± 0.5 %
- State-of-the-art detachable immersion probe saves time and allows use of multiple probes with one display unit

Specifications

Temperature range	-40 °C to 150 °C (-40 °F to 300 °F)
Resolution	0.1 °F
Accuracy	± 0.5 % over entire range
Display	Four-digit LED, plus decimal point
Battery	Standard 9 V alkaline or equivalent
Dimensions	Thermometer (WxDxT): 7.6 cm x 20.3 cm x 2.9 cm (3 in x 8 in x 1.125 in)
	Display area: 5.1 cm x 2.4 cm (2 in x 0.94 in)
	Probe: 15.3 cm long (6 in long)
Weight	3.38 kg (7.44 lb)

*Factory re-calibration available.

Optional accessories

07-403 Immersion Probe
07-401 Waterproof Probe, will not be damaged in chemistry or water

Included accessories

High-impact plastic case

Ordering information

07-402 Portable Digital Thermometer with one probe

FLUKE®
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07-424

Digital Densitometer

The 07-424 Digital Densitometer is an easy-to-use precision instrument that quickly measures the optical density of film. And with its optional RS-232 interface, you have the capability to automatically transfer the data to a computer for storage and retrieval.

Constructed of rugged steel and compact enough to fit on any crowded worktable, it offers exceptional accuracy (± 0.02 optical density). The optical density value is displayed in bright LED numerals on the detector arm. The sample table is 6.125 in x 10.5 in with a 4.75 in x 5.5 in illuminated section. It will accommodate film up to 14 in x 17 in and provides ample room for positioning any selected area under the detector.

The detector is a hermetically-sealed silicon photodiode. The detector lamp is at full brilliancy only during the actual measurement, thus preventing heating problems and ensuring very long lamp life with minimum wavelength shift or other degradation. When necessary, the lamps are easily replaced. The densitometer includes a five-step optical density tablet.

Key features

- Large illuminated surface
- Density range is 0 D to 4.5 D
- Three apertures: 1 mm, 2 mm, and 3 mm
- RS-232 interface available
- Includes a five-step optical density tablet

Specifications

Density range	0 D to 4.5 D
Accuracy	± 0.02 density. Reference tablet supplied
Response time	Two seconds at 3 density
Zero drift	Negligible
Apertures supplied	1 mm, 2 mm, and 3 mm D. Anodized aluminum
Throat	21 cm length (8.2 in). Easily measures to center of 35.6 cm x 43 cm (14 in x 17 in) film
Illuminated table	12 cm x 14 cm (4.75 in x 5.50 in)
Diameter of aperture holder	(area obscured) 0.73 in
Spectral response	5000 A to 5500 A peak of bell-shaped curve
Detector illumination	Incandescent lamp with spectral compensation filter. Lamp is at full brilliancy only during measurement.
Table illumination	Four #37, low voltage, wedge-base lamps
Digital readout	Three 0.4 inch high light-emitting diode (LED) numerals on detector arm.
Detector	Hermetically-sealed, silicon photodiode.
Zero control	Allows wide range adjustment for different apertures and density subtraction.
Power	110/220 V, 50/60 Hz
Dimensions (WxDxH)	16 cm x 34 cm x 12.5 cm (6.3 in x 13.4 in x 4.9 in)
Weight	3.2 kg (7 lb)

Optional accessories

89-424 Carrying Case
07-413 Apertures, set of three
010037 Step Tablet
802013 RS-232 Interface Cable, 2 m (7 ft)
169072 9-Pin Adapter
169071 25-Pin Adapter

Included accessories

010128 Step Tablet

Ordering information

07-424 Digital Densitometer,
07-424-220 Digital Densitometer, 220 V
07-440 Digital Densitometer with RS-232 interface
07-440-2200 Digital Densitometer with RS-232 interface, 220 V

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FLUKE®
Biomedical

18-220

Mammographic Accreditation Phantom

The 18-220 Mammographic Accreditation Phantom will assist you in complying with MQSA and the American College of Radiology (ACR) Quality Control Programs. This phantom is intended for use as an integral part of the Mammographic Quality Control Program, and when used to perform routine mammographic QC, it will help you quickly, easily, and accurately evaluate the overall imaging performance of your mammographic system. This phantom will detect imaging changes so you can make the necessary corrections in order to maintain your system at peak performance.

The 18-220 Mammographic Accreditation Phantom was designed to test the performance of a mammographic system by a quantitative evaluation of the system's ability to image small structures similar to those found clinically. Objects within the phantom simulate calcifications, fibrous calcifications in ducts, and tumor masses.

The phantom is also designed to determine if a mammographic system can detect small structures that are important in the early detection of breast cancer. Test objects within the phantom range in size from those that should be visible on any system, to objects that will be difficult to see even on the best mammographic system.

Key features

- Helps ensure optimum image quality and peak performance of the mammographic system
- Essential for MQSA compliance
- Complies with ACR phantom specifications and QC requirements
- Contains test objects to simulate indications of breast cancer; punctuate calcifications, tissue fibrillar extensions in adipose tissue, and tumor like masses
- Ideal for monitoring the overall performance of your mammographic imaging system, x-ray generator, film processor, and screen-film combination
- Equivalent in x-ray attenuation to a 4.5 cm compressed "average" breast

Optional are two 2 cm acrylic plates. The addition of these two plates, when combined with the overall 4.4 cm thickness of the phantom, will allow the system image quality to be checked in varying thicknesses of 2 cm to 8.5 cm. Both of these items are recommended by ACR in their Mammography Quality Control Procedure.

Specifications

Phantom body		
Material	Acrylic	
Dimensions	Overall (WxDxH): 10.15 cm x 10.8 cm x 4.4 cm (4 in x 4.25 in x 1.75 in)	
	Acrylic base: 3.4 cm in thick (1.375 in)	
	Cover: 3 mm thick (0.128 in)	
	Acrylic contrast test disk: 1 cm Ø x 4 mm	
Weight	0.55 kg (1.2 lb)	
Wax insert		
Nylon fibers	**Al2O3 Specks**	**Masses (thickness)**
1) 1.56 mm	7) 0.54 mm	12) 2 mm
2) 1.12 mm	8) 0.4 mm	13) 1 mm
3) 0.89 mm	9) 0.32 mm	14) 0.75 mm
4) 0.75 mm	10) 0.24 mm	15) 0.5 mm
5) 0.54 mm	11) 0.16 mm	
6) 0.4 mm		

Optional accessories

18-237 Acrylic Plates, 10 cm x 10 cm x 2 cm thick, set of 2
18-205 Acrylic Contrast Test Disc, 1 cm Ø x 4 mm
89-220 Carrying Case

Included accessories

Acrylic contrast test disk, faxitron x-ray image, and magnifying glass

Ordering information

18-220 Mammographic Accreditation Phantom

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FLUKE®
Biomedical

18-250

Digital Stereotactic Breast Biopsy Accreditation Phantom*

Phantom with image evaluation insert

In the past, there was not an easy way to compare the image quality of conventional and digital biopsy mammography units because the field of view on the digital system is typically much smaller than the 24 cm x 30 cm field of view on conventional mammography units. In order to image the Mammographic Accreditation Phantom specified by the American College of Radiology (ACR) on the biopsy units, the user has to move the phantom to various positions in order to obtain four separate images, to be sure all objects were imaged. This is a very inconvenient, time consuming task.

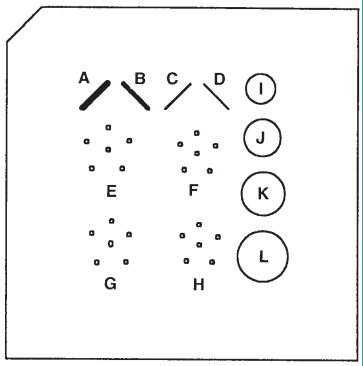
The small size of the 18–250 Digital Stereotactic Breast Biopsy Accreditation Phantom phantom permits fast, easy comparison of conventional and digital image quality, because you can attain an image of the entire unit in a single exposure. The objects are some of the same ones found in the Mammographic Accreditation Phantom specified by the ACR, so it makes comparison of the two imaging systems easy.

Key features

- The fast, easy way to test image quality on digital biopsy mammography units and qualify for ACR accreditation
- Accepted by the ACR for use in its Stereotactic Breast Biopsy Accreditation Program
- One exposure is all you need
- The phantom contains test objects that are similar to those found in the Mammographic Accreditation Phantom specified by the ACR
- The extended top edge of the phantom allows ease of positioning on recumbent biopsy units
- The phantom's small size allows it to be imaged in its entirety in a single exposure when used with a digital biopsy unit
- Enables you to determine if the images are similar to or better than screen-film

Specifications

Phantom body		
Material	Cast acrylic base block	
Dimensions (WxDxH)	6.05 cm x 6.2 cm x 3.71 cm (2.38 in x 2.44 in x 1.46 in)	
Weight	1.2 kg (8.7 oz)	
Wax insert		
Fibers	**Al2O3 Specks**	**Masses**
A) 0.93 mm nylon fiber	E) 0.54 mm speck	I) 0.25 mm (thickness) mass
B) 0.74 mm nylon fiber	F) 0.32 mm speck	J) 0.5 mm (thickness) mass
C) 0.54 mm nylon fiber	G) 0.24 mm speck	K) 0.75 mm (thickness) mass
D) 0.32 mm nylon fiber	H) 0.2 mm speck	L) 1 mm (thickness) mass



Digital image demonstrating image evaluation insert

Ordering information

18-250 Digital Stereotactic Breast Biopsy Accreditation Phantom

*Designed by Carol Mount, R.T. (R) (M), and Joel E. Gray, Ph.D., Department of Diagnostic Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

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18-251-2000

Contrast and Resolution Mammography Phantom*

The 18-251-2000 Contrast and Resolution Mammography Phantom is designed with an extended top edge to aid the user in positioning it on recumbent biopsy tables.

On digital mammography units, this phantom can test the high contrast spatial resolution of the system with the results being viewed on the monitor. The focal spot high contrast resolution can also be determined by placing a conventional mammography cassette behind the phantom and making an appropriate exposure.

It is suggested that a resolution test pattern from 5-20 LP/mm be used to evaluate the condition of the focal spot. Instead of making focal spot measurements that can be ambiguous, an accurate determination of the x-ray tube's resolution ability can be measured by using the optional Resolution Test Pattern (07-555).

On conventional mammography units, the phantom can be used to meet the ACR guidelines for testing focal spot resolution. The ACR suggests placing a resolution target 4.5 cm above the image receptor and imaging twice: once parallel to the anode-cathode axis and once rotated 90 degrees. With two resolution targets, this can be achieved in a single exposure. The grey scale step wedge can also be used to check the dynamic range of the entire system, indicate processing problems, and variation in film emulsion.

Key features

With a single exposure you can:

- Measure the contrast and dynamic range of the imaging system
- Easily measure the system resolution of the focal spot length and width on mammography units (with optional Resolution Test Pattern, 07-555)

Phantom with two 5-20 LP/mm test patterns (optional) in parallel and perpendicular orientation. Also includes an air step wedge with aluminum attenuator.

Specifications

Phantom body	
Materials	Cast acrylic block with aluminum plate
Dimensions (WxDxT)	6.66 cm x 6.4 cm x 4.3 cm (2.6 in x 2.5 in x 1.7 in)
Weight without test patterns	8 oz (0.5 lb)
07-555 Optional Resolution Test Pattern	
Material	Gold nickel construction (equivalent to 25 microns of lead or 2.6 mm of aluminum)
Dimensions (LxW)	25 mm x 12.5 mm
Thickness	0.0175 mm (0.0152 mm gold, 0.0025 mm nickel)

Optional accessories

07-555 Resolution Test Pattern

Ordering information

18-251 Contrast and Resolution Mammography Phantom

18-251-1000 Contrast and Resolution Mammography Phantom with one resolution test pattern (07-555)

18-251-2000 Contrast and Resolution Mammography Phantom with two resolution test patterns (07-555)

*Designed by Carol Mount, R.T. (R) (M), and Joel E. Gray, Ph.D., Department of Diagnostic Radiology, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

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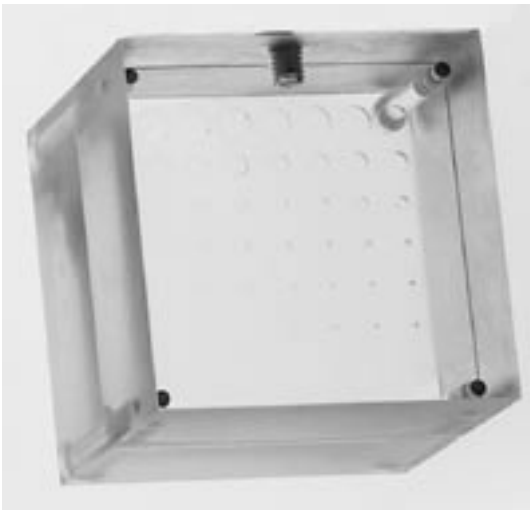
FLUKE®
Biomedical

18-252

Contrast Detail Phantom for Mammography



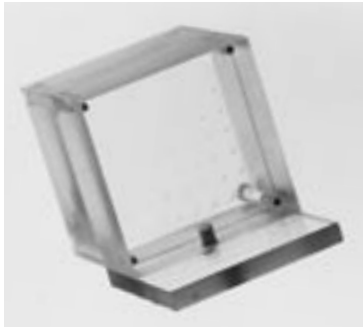
The 18-252 Contrast Detail Phantom for Mammography is designed to provide a means of quantitatively testing and monitoring the total performance of an entire mammographic imaging chain. Its small size, as well as the number and distribution of holes simulating embedded objects, make this phantom particularly useful in evaluating digital spot mammography systems. With 49 holes generating subtle contrast variations, the phantom makes it possible to detect small changes in overall system performance.

The Contrast Detail Phantom for Mammography contains a 7 x 7 matrix of objects. The diameter of each row of objects decreases from 0.169 inch to 0.007 inch. In each row, the subject contrast decreases from approximately 6.6 % to 0.41 % at mammographic energies.

The Contrast Detail Phantom for Mammography is easy to use. Simply place the phantom on the image receptor surface in the same position as a breast. Position the x-ray tube and compression device as in a craniocaudal examination. When using the phantom on prone-position breast biopsy systems, use the rotating top plate of the phantom and the compression device to secure the phantom against the image receptor. Choose the appropriate kV and mAs factors (26 kV and 60 mAs works well on most systems), or select automatic exposure control.

Key features

- Optimized for digital imaging
- Easy-to-use, compact and lightweight
- Closely simulates scattering conditions of the breast
- Rotatable support plate accommodates prone-position x-ray units. The plate can be returned to a position that does not interfere with placement of the phantom on flat surfaces
- Geometrically-increasing hole depths result in linearly-increasing x-ray transmission
- Geometrically-increasing hole diameters enable quantitative measurement of the contrast threshold of the mammographic system



Rotatable support plate accommodates prone-position x-ray units

Specifications

Phantom material	Plexiglas®	
Dimensions (WxDxH)	6.27 cm x 6.27 cm x 6.27 cm (2.47 in x 2.47 in x 2.47 in)	
Weight	0.58 kg (1.2 lb)	
Object diameter and contrast		
Column number	**Object depth**	**Typical contrast at mammographic energies**
1	0.853 mm (0.033 in)	6.6 %
2	0.533 mm (0.021 in)	4.2 %
3	0.332 mm (0.013 in)	2.6 %
4	0.208 mm (0.008 in)	1.7 %
5	0.129 mm (0.005 in)	1 %
6	0.08 mm (0.003 in)	0.65 %
7	0.05 mm (0.002 in)	0.41 %

Object diameter			
Row number	**Object diameter**	**Row number**	**Object diameter**
1	4.292 mm (0.169 in)	**5**	0.513 mm (0.02 in)
2	2.524 mm (0.099 in)	**6**	0.302 mm (0.011 in)
3	1.485 mm (0.058 in)	**7**	0.177 mm (0.007 in)
4	0.873 mm (0.034 in)		

Row number	**Minimum number of objects detected**
1	6
2	6
3	5
4	4
5	2
6	1
7	0
Minimum detectability score: 24/49	

Ordering information

18-252 Contrast Detail Phantom for Mammography

FLUKE®
Biomedical

18-227

CDMAM Phantom*

Key features

- Helps identify objects with very low contrast and very small diameter
- Compatible with full-field analog and digital units
- Compares of image quality with various screen-film combinations
- Evaluates conventional, digital, and stereotactic modalities
- Determines the optimum exposure technique, e.g., by variation of tube potential
- Compares image quality at various object thicknesses, by variation of the amount of Plexiglas® at a fixed density

The 18-227 CDMAM (Contrast Detail Mammography) Phantom was developed to evaluate conventional mammographic x-ray equipment, film, and cassettes. However, with the increase of digital imaging in mammography, especially when performing stereotactic breast needle biopsies and preoperative needle localizations, the phantom can aid in achieving improved image quality, processing, display quality, and speed in these new modalities.

What makes the CDMAM Phantom so special?
The CDMAM Phantom consists of an aluminum base with gold discs (99.99 % pure gold) of varying thicknesses and diameters, which is attached to a Plexiglas® cover. The 5 mm thick Plexiglas cover (PMMA plate) has a 2 mm deep cavity that accommodates the aluminum base with gold discs. The assembly (PMMA and aluminum) has a Plexiglas-equivalent thickness of 10 mm, under standard mammography-exposure conditions.

The aluminum base is 0.05 mm thick Al 1050 (99.5 % pure aluminum). The base has been polished and anodized black. Precisely measured gold discs of varying thickness (range = 0.05 µm to 1.6 µm) and diameter (range = 0.1 µm to 3.2 µm) have been attached to the base by means of evaporization. Finally, the base has been airbrushed to protect the gold discs.

The "Gold Standard" of Mammographic Phantoms
The discs are arranged in 16 rows and 16 columns. Within a row, the disc diameter is constant, with logarithmically increasing diameter. The precision of the disc diameter and thickness makes the CDMAM Phantom an ideal tool for conducting contrast-detail and other image quality experiments.

*Developed by M.A.O. Thijssen, Ph.D., K.R. Bijkerk, MSc. and J.M. Lindeyer, BSc., Project: Quality Assurance in Mammography (QAMAM), Department of Diagnostic Radiology, University Hospital, St. Radboud, Nijmegen, The Netherlands.

18-227

CDMAM Phantom

A line pattern has been engraved onto the Plexiglas cover and treated with paint containing aluminum. The x-ray image will show a number of squares ordered in 16 columns and 16 rows, with the disc diameter shown for each row, and the disc thickness for each column.

The 18-227 CDMAM Phantom includes a set of four Plexiglas plates, which are used for the simulation of different breast thicknesses. The plates are 10 mm thick and the same dimensions as the phantom. The plates are marked in one corner, for identification of the configuration of Plexiglas and phantom in an x-ray image. The phantom and Plexiglas plates match the standard mammography film size (18 cm x 24 cm).

Under standard mammography-exposure conditions (Mo-anode, 30 µm Mo-filtration, 28 kVp), the phantom has a Plexiglas-equivalent thickness of 10 mm.

The actual attenuation of the CDMAM Phantom depends on the configuration of the phantom and Plexiglas plates. The effective energy of the phantom plane will be higher when more Plexiglas is added to the top and bottom of the phantom.

Application

To make an x-ray image, the CDMAM Phantom should be positioned on the bucky with the smallest disc diameters at the thorax side, in combination with one or more Plexiglas plates. The markings on the Plexiglas plates should be aligned at the thorax side of the bucky. On digital stereotactic systems with smaller fields of view, specific portions of the phantom can easily be imaged as well.

The density of the image has to be checked after the film has been processed. In a series of CD images, all images should approximately have the same densities in a reference-position on the film.

Specifications

Dimensions (WxDxT)	Plexiglas plates: 162.5 mm x 240 mm x 10 mm (6.38 in x 9.45 in x 0.4 in)
	Aluminum base: 162.5 mm x 240 mm x 0.5 mm
Weight	2.06 kg (4.54 lb)

Included accessories

Four Plexiglas plates

Ordering information

18-227 CDMAM Phantom

FLUKE®
Biomedical

18-222

Tissue-Equivalent Mammography Phantom

Proven simulation technology enables the use of tissue-equivalent, realistically-shaped phantoms for mammographic quality control.

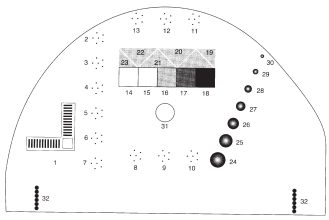
The 18-222 Tissue-Equivalent Mammography Phantom contains targets that are engineered to test the threshold of the new generation of mammography machines.

The phantom is 4.5 cm thick, simulates a 50 % glandular tissue composition and is designed to test the performance of a mammographic system by a quantitative evaluation of the system's ability to image small structures similar to those found clinically. The phantom is designed to determine if your system can detect small structures that are important in early detection of breast cancer. Test objects within the phantom range in size from those that should be visible on any system to objects that will be difficult to see in the best mammographic systems.

The 18-222 includes a 30x hand-held microscope and mammography QA documents for recording image evaluations and scores.

Key features

- Breast phantom to test new generation of mammography machines
- A refined quality control for today's advanced imaging systems
- Objects within the phantom simulate calcifications, fibrous calcifications in ducts, and tumor masses



Specifications

Line-pair target	1: 20 lp/mm		
Calcium carbonate specks	2: 0.13	3: 0.165	4: 0.196
	5: 0.23	6: 0.275	7: 0.4
	8: 0.23	9: 0.196	10: 0.165
	11: 0.23	12: 0.196	13: 0.165
Step wedge (1 cm thick)	14: 100 % gland	15: 70 % gland	16: 50 % gland
	17: 30 % gland	18: 100 % gland	
Nylon fibers	19: 1.25 mm Ø	20: 0.83 mm Ø	21: 0.71 mm Ø
	22: 0.53 mm Ø	23: 0.3 mm Ø	
Hemispheric masses (75 % glandular/ 25 % adipose)	24: 4.76 mm thick	25: 3.16 mm thick	26: 2.38 mm thick
	27: 1.98 mm thick	28: 1.59 mm thick	29: 1.19 mm thick
	30: 0.9 mm thick		
Optical density	31: reference zone		
Edge beam	32: localization target		
General			
Material	Epoxy		
Dimensions (WxDxH)	18.5 cm x 12.5 cm x 4.5 cm (7.28 in x 4.92 in x 1.77 in)		
Weight	1 kg (2.2 lb)		

Included accessories

18-222
Handheld microscope and mammography QA recording documents

18-223
Tissue-equivalent phantoms 4 cm, 5 cm, and 6 cm thick, and phototimer compensation plates from 0.5 cm to 7 cm

Ordering information

18-222 Tissue-Equivalent Mammography Phantom

18-223 Mammography Phantom Research Set

References
Skubic S.E., Fatouros P.P., "Absorbed Breast Dose: Dependence on Radiographic Modality and Technique, and Breast Thickness," Radiology, 61 (1986), 263-270.
Fatouros P.P., Skubic S.E., Goodman H., "The Development and Use of Realistically Shaped, Tissue-Equivalent Phantoms for Assessing the Mammographic Process," Radiology, 32 (1985), 157.

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18-216

Single-Exposure High Contrast Resolution Phantom

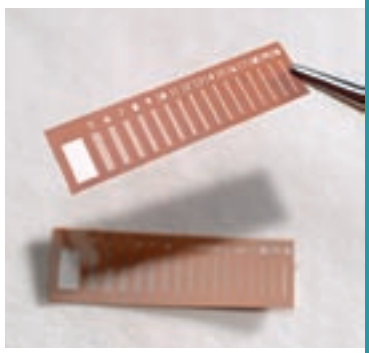
The 18-216 Single-Exposure High-Contrast Resolution Phantom incorporates a 17.5 micrometer-thick gold-nickel alloy bar pattern. This allows the assessment of resolution perpendicular and parallel to the anode-cathode axis in just one exposure. This pattern has segments from 5 lp to 20 lp/mm and is equivalent to 25 micrometers of lead, or 2.6 mm of aluminum at 20 keV. The bar pattern is permanently embedded in a thin acrylic wafer, to protect it from wear and damage.

The phantom body is available in BR-12 or BR50/50. It enables consistent, reproducible positioning of the bar pattern at 4.5 cm above the breast support plate at 1 cm from the chest wall, centered laterally as recommended by the American College of Radiology.

The bar pattern can also be positioned at a variety of heights for more thorough evaluations.

Key features

- Perform quality control inspections of mammography system resolution with just one exposure
- Meets ACR guidelines
- Meets MQSA requirements
- Rugged, easy-to-use, and cost-effective
- The phantom includes a 30x handheld microscope.



Specifications

Material	BR12 or BR50/50
Dimensions (WxDxH)	100 mm x 125 mm x 20 mm
Weight	0.57 kg (1.3 lb)

Optional accessories

18-216-2555 Acrylic Wafer Test Pattern

Included accessories

30x handheld microscope

Ordering information

18-216 Single-Exposure High Contrast Resolution Phantom, BR-12

18-216-1000 Single-Exposure High Contrast Resolution Phantom, BR50/50

18-228 and 18-229-1313

Stereotactic Biopsy Phantoms

18-228 Stereotactic Needle Biopsy Tissue-Equivalent Training Phantom

With the increasing use of stereotactic breast biopsy procedures, it is essential that radiology healthcare providers maintain and increase their needle biopsy skills. The 18-228 tissue-equivalent phantom is a MUST for every mammography facility.

The automated stereotactic breast biopsy procedure depends on several variables for accurate needle placement. Thus, for patient safety, this system must be properly maintained and evaluated.

This versatile 18-228 was designed to assist in training technologists and physicians in the use of a stereotactic system, and for verifying the proper operation of mammographic stereotactic biopsy systems.

Because the phantom closely mimics properties of the human breast, it is also an ideal teaching tool and practice medium for mammographic needle biopsy procedures. It should also be used whenever a new system is installed or repaired, to ensure accurate needle placement.

This training phantom is also an excellent research and development/demonstration tool for manufacturers of mammography equipment.

The phantom should be stored in a cool place. The phantom should be discarded after all the tumors have been aspirated.

Key features

18-228

- Compressible
- Contains cysts, dense masses and calcifications
- Proprietary gel simulates physical density and mass attenuation of BR-12
- Gel will not dry out after initial needle punctures, thus extending storage life
- Physical consistency similar to human tissue, combined with an elastic, skin-like membrane, enables palpation of embedded structures and accurately simulates needle resistance
- Anthropomorphic shape allows for accurate simulation of breast compression

18-229-1313

- The most cost-effective and economical phantom for teaching, training, and QC

Specifications

18-228

Targets	Color	Dimensions	Quantity	Position
Cystic masses	green	5 mm to 12 mm	6	Random
Dense masses	black	5 mm to 12 mm	6	Random
Microcalcifications	orange	0.3 mm to 0.35 mm	two clusters	Mid-plane on right and left sides
General				
Dimensions (LxH)	10 cm x 5 cm; 1500 cc			
Weight	0.91 kg (2 lb)			

18-229-1313 Mammo-Cube Stereotactic Core Biopsy Phantom

Embedded lesions	Six dense masses, 5 to 12 mm Ø
Proprietary gel	Simulates the physical density and mass attenuation of BR-12. The gel will not dry out after initial needle punctures, thus extending storage life
Physical consistency	Similar to human tissue and combined with an elastic, skin-like membrane which enables palpation of embedded structures and accurately simulates needle resistance
Care	The phantom should be stored in a cool place, and discarded after all lesions have been biopsied
Dimensions (WxDxH)	6.5 cm x 7 cm x 4.5 cm
Weight	5 oz (Individual cube dimensions and weights may vary by 10 %)

18-228 Mammo-Cube Stereotactic Core Biopsy Phantom

Ordering information

18-228 Stereotactic Needle Biopsy Tissue-Equivalent Training Phantom

18-229-1313 Mammo-Cube Stereotactic Core Biopsy Phantom

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18-229

Triple-Modality Biopsy Training Phantom

Suspect lesions discovered in x-ray mammography must often be evaluated under ultrasound to aid diagnosis and in some cases, use of MRI may be indicated. The 18-229 Triple-Modality Biopsy Training Phantom is an ideal training device because it can be imaged under three modalities and was designed specifically for needle biopsy.

The 18-229 Triple-Modality Biopsy Training Phantom is a disposable phantom that was designed to closely mimic the properties of the human breast, making it an extremely useful accessory for training technologists and physicians, as well as for verifying the proper operation of a mammographic biopsy system.

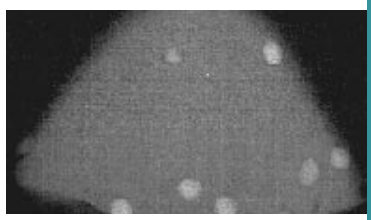
Training
With the increasing use of breast biopsy procedures, it is essential that radiology healthcare providers maintain and increase their needle biopsy skills. This training phantom is a must for every mammography facility.

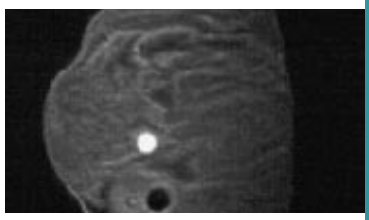
Quality control
The breast biopsy procedure depends on several variables for accurate needle placement. Thus, for patient safety, the system must be properly maintained and evaluated. A comprehensive mammography quality control program must provide assurances that all aspects of the mammography equipment are operating at optimum levels. The Triple-Modality Biopsy Training Phantom is the ideal tool for such a program. Additionally, the phantom can and should be used whenever a new system is installed or repaired, to ensure accurate needle placement.

Research and development
This cost-effective phantom is also an excellent research and development/demonstration tool for manufacturers of mammography equipment.

Key features

- Tissue-equivalent under x-ray, ultrasound, and MRI
- Compressible
- Ideal for physician and technologist training, and quality control
- Physical density and attenuation characteristics accurately simulate that of an average 50 % glandular breast (BR-12 equivalent)
- Flesh-like consistency allows for the palpation of embedded lesions while accurately simulating needle resistance found in human tissue
- Anthropomorphic shape is suitable for compression mammography, ultrasound or MRI examinations
- The American College of Radiology recommends this type of product in their quality assurance program


X-ray mammography


MRI


Ultrasound

Specifications

Material	Zerdine®[1]
Targets	Dense masses: 2 mm and 8 mm Ø for core biopsy
	Cystic masses: 3 mm to 10 mm Ø for needle aspiration
Volume	500 cc
Dimensions (WxDxH)	10 cm x 12 cm x 9 cm (3.94 in x 4.72 in x 3.54 in)
Weight	0.44 kg (1 lb)

[1]US Patent #5196343

Ordering information

18-229 Triple-Modality Biopsy Training Phantom

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18-203 and 18-224

Mammography Phototimer Consistency Test Tool and Mammography Phantom Material

18-203

18-203 Mammography Phototimer Consistency Test Tool

The mammographic unit's automatic exposure control should be capable of maintaining optical density within ± 0.15 OD as the voltage is varied from 25 kVp to 35 kVp, and as breast thickness is varied from 2 cm to 8 cm for each technique. Test images taken of uniform phantoms of varying thicknesses should not differ by more than 0.3 OD from each other. These tests should be carried out over the kVp range customarily used by the mammography center.

The 18-203 Phototimer Consistency Test Tool is available in two materials: acrylic; and, for more accurate results, breast-tissue-equivalent BR-12 material. Both are supplied in uniform 2 cm slabs to produce thicknesses of 2 mm, 4 mm, 6 mm, and 8 cm.

18-224

18-224 Mammography Phantom Material

The American College of Radiology's Committee on Quality Assurance in Mammography (Medical Physicist's Manual) recommends, as part of the required test equipment, the 18-224 Mammography Phantom Material. This material is best suited for testing automatic exposure control (AEC), collimator assessment, and artifact evaluation.

Key features

18-203

- Available in either acrylic or tissue-equivalent BR-12 material*
- Should be used to test thickness tracking
- The American College of Radiology recommends this type of product in their quality assurance program
- Meets MQSA requirements

18-224

- Available in either acrylic or tissue-equivalent BR-12 material*

*BR-12 is a designation (D.R. White, et al.) of certain epoxy resin formulations which react to x-ray in the mammographic energy range (15 keV to 30 keV) in the same manner as human tissue. The tissue-simulation properties for these slabs are maximized at 20 keV (28 kVp ±). The glandular equivalency of this material is 45 % in the mammographic range.

Specifications

18-203	Material: Acrylic
	Dimensions (WxDxH): 10 cm x 12.5 cm x 2 cm thick
	Weight: 1.34 kg (3 lb)
18-204	Material: BR-12
	Dimensions (WxDxH): 10 cm x 12.5 cm x 2 cm thick
	Weight: 1 kg (2.2 lb)
18-238	Material: BR-12
	Dimensions (WxDxH): (3) 10 cm x 12.5 cm x 2 cm; (2) 10 cm x 12.5 cm x 1 cm thick; (1) 10 cm x 12.5 cm x 0.5 cm thick
	Weight: 1.2 kg (2.6 lb)
18-238-3070	Material: Tissue-equivalent, 30 % gland/70 % adipose
18-238-5050	Material: tissue-equivalent, 50 % gland/50 % adipose
18-238-7030	Material: tissue-equivalent, 70 % gland/30 % adipose
18-224	Material: Acrylic
	Dimensions (WxDxH): 10 cm x 12.5 cm x 2 cm thick
	Weight: 0.92 kg (2 lb)
18-225	Material: BR-12
	Dimensions (WxDxH): (2) 18 cm x 24 cm x 2 cm thick
	Weight: 1.7 kg (3.8 lb)

Ordering information

18-203 Mammography Phototimer Consistency Test Tool set of four acrylic slabs

18-204 Mammography Phototimer Consistency Test Tool set of four BR-12 slabs

18-238 Mammography Phototimer Consistency Test Tool Research, set of six BR-12 slabs

18-238-3070 Mammography Phototimer Consistency Test Tool, set of six slabs

18-238-5050 Mammography Phototimer Consistency Test Tool, set of six slabs,

18-238-7030 Mammography Phototimer Consistency Test Tool, set of six slabs

18-224 Mammographic Phantom Material

18-225 Mammographic Phantom Material

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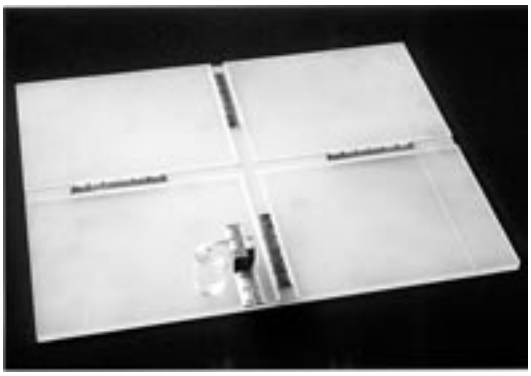
18-303

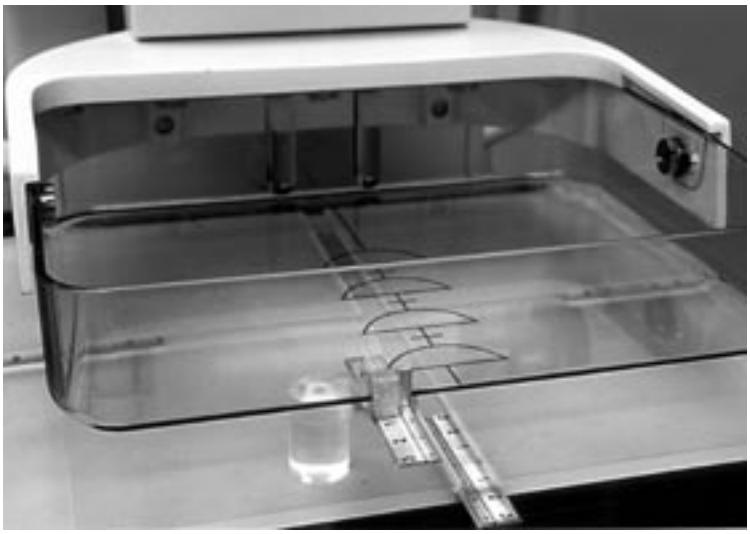
Mammography Collimation Assessment Test Tool*



The 18-303 Mammography Collimation Assessment Test Tool is a self-contained precise QA tool that gives you instant measurements by simply viewing the image. The 18-303 Mammography Collimation Assessment Test Tool is simple to use. Just follow the exact instructions contained in the ACR Mammography QC Manual for the Collimation Assessment. However, instead of using all those hard-to-find coins, you use the 18-303. The "0" point of the metal ruler is placed at the edge of the light field. The compression paddle rests on top of the appropriate size plastic peg (1.7 mm and 2.2 cm pegs are included to accommodate different cassette thicknesses) and the alignment ruler (generously sized at 3 cm in both directions) fits snugly against the edge of the paddle. It couldn't be much simpler or much quicker.

Key features

- Reduces setup time by half
- Simple to use
- Complies with MQSA testing requirements as contained in the ACR Mammography QC Manual
- Measurement can be quickly and easily repeated
- Compression paddle rests on peg exactly 4.2 cm above the bucky—no measurement of compression paddle height needed
- Stays firmly in place
- Adaptable for 18 cm x 24 cm, 24 cm x 30 cm and magnification stand testing



Mammography Collimation Assessment Test Tool shown in position

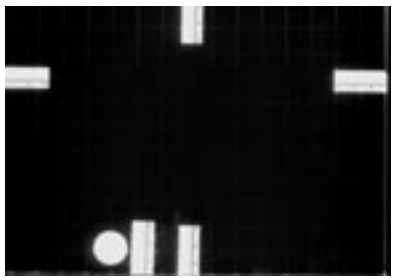


Image of test tool on top of bucky

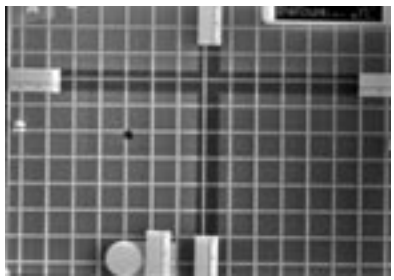


Image of test tool in bucky

Specifications

Dimensions (WxH)	24 cm x 30 cm (9.45 in x 11.81 in)
Weight	0.57 kg (1.25 lb)

Ordering information

18-303 Mammography Collimation Assessment Test Tool, includes one 1.7 cm peg and one 2.2 cm peg

*Designed by Carol Mount, R.T. (R) (M), Supervisor of Mammography, Mayo Clinic®, Rochester, MN 55905. Manufactured under licensing agreement with Mayo Foundation for Medical Education and Research.

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18-210-8000

View Markers for Mammography

As stated in the American College of Radiology Mammography Quality Control Manual, it is required that all mammography films are labeled to prevent misinterpretation. The 18-210-8000 View Markers provide the optimal solution to comply with ACR requirements.

The markers are radiopaque, and each is equipped with an attached "super hold" suction cup. Firm, gentle pressure will hold the suction cup in place on the side of the mammography unit.

Key features

- Meets all requirements for standardized terminology set forth by the MQSA and American College of Radiology
- Standardized labeling of mammography films is essential to ensure that films are not misinterpreted

Choose from the following kits:

- Standard Kit (normal requirement) Consists of eight markers for the most frequently used positions. Weight is 0.24 kg (0.5 lb)
- Specialty Kit Consists of 14 specialty markers. Weight is 0.5 kg (1 lb).
- Full-Service Kit Consists of 22 markers (Standard Kit plus 14 specialty markers) for use with all possible positions. Weight is 0.78 kg (1.75 lb).

Specifications

Labeling codes for positioning*

	Labeling code	Purpose
Laterally		
Right	R**	
Left	L**	
Projection position		
Mediolateral oblique	MLO	Standard view
Craniocaudal	CC	Standard view
90° Lateral		
Mediolateral	ML	Localize, define
Lateromedial	LM	Localize, define
Spot compression	SPOT	Define
Magnification	M**	Define
Exaggerated craniocaudal	XCCL	Localize
Cleavage	CV	Localize
Axillary tail	AT	Localize, define
Tangential	TAN	Localize, define
Rolled lateral	RL (rolled lateral)†	Localize, define
Rolled medial	RM (rolled medial)†	Localize, define
Caudocranial	FB (from below)	Define
Lateromedial oblique	LMO	Define
Superolateral to infermedial oblique	SIO	Define
Implant displaced	ID	Augmented breast

†Used as a suffix after the projection. For example, LCCRL equals Left Craniocaudal Upper Breast Tissue Rolled Laterally.
*Taken from ACR Mammography Quality Control Radiologic Technologist Manual.
**Used as a prefix before the projection. For example, RMMLO equals Right Magnification Mediolateral Oblique.

Included accessories

Suction cup
Each set includes a holder (the small set gets a small holder, the larger sets get a larger holder).

Ordering information

18-210-8000 Standard Kit of 8 View Markers
18-210-1400 Specialty Kit of 14 View Markers
18-210-2200 Full-Service Kit of 22 View Markers

76-410-4130

AAPM CT Performance Phantom

The increasing use of computed tomography (CT) as a diagnostic tool creates the need for an efficient means of evaluating the performance of the CT scanners now in use. Recognizing this requirement, the American Association of Physicists in Medicine established the AAPM Task Force on CT Scanner Phantoms. Its goals are to define CT scanner performance and present practical methods of performance testing through the utilization of special phantoms. This phantom design is based on the guidelines presented in Report #1 of the Task Force and approved by the AAPM.

The modular 76-410-4130 AAPM CT Performance Phantom offers the CT user a single system with which to measure nine performance parameters. This phantom permits the routine standardization of alignment, beam width, spatial uniformity, linearity/contrast, spatial resolution, linespread, noise, size independence, and absorbed dose. All components of the phantom are housed in a compact, transparent tank that holds the system together in the correct orientation.

The phantom consists of an 8.5-inch diameter acrylic tank containing a beam-width insert, a spatial resolution and linespread block, a high-contrast insert, and a means for inserting alignment pins and/or TLD holders. Additionally, a 0.25-inch thick Teflon® band, positioned at the base of the tank and concentric to the 8-inch internal diameter, simulates human bone. Attached to the base of the tank is a low-contrast section with resealable cavities (from 1 in to 0.125 in diameter) which can be filled with a diluted dextrose or other appropriate solution to provide a low-contrast media. The optional external resolution and noise ring slides snugly over the outside diameter of the tank, allowing whole-body scanner systems to be evaluated.

Key features

- Meets guidelines in AAPM Report No. 1 for Performance Evaluation and QC of CT Scanners
- Single system measures nine performance parameters

This ONE phantom evaluates:

- Noise
- Spatial resolution
- Sensitivity (low contrast resolution)
- Absorbed dose
- Size dependence
- Contrast scale
- Slice thickness
- Alignment
- Linearity
- Beamwidth

Specifications

Watertank	
Material	Made of acrylic
Dimensions (ODxIDxL)	(8.5 in x 8 in x 12.75 in)
Resealable with fill and drain ports. Low-contrast detectability block is attached to base	
Linearity and contrast insert	
Dimensions (ODxL)	(7.5 in x 2.5 in)
Contains 1 inch diameter contrast pins of polyethylene, acrylic, polycarbonate, polystyrene and nylon. Density values: polyethylene, 0.95 gm/cc; polystyrene, 1.05 gm/cc; nylon, 1.1 gm/cc; acrylic, 1.19 gm/cc; polycarbonate, 1.2 gm/cc	
Note: The contrast pins in each AAPM CT Performance Phantom are identical in density to the contrast pins of similar material in every other Fluke Biomedical CT Phantom. For example, the nylon pin in every CT Phantom we manufacture has the same density.	
This uniform density among all Fluke Biomedical phantoms provides the user with a standard for comparing the performance of different scanners	

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76-410-4130

AAPM CT Performance Phantom

Specifications

Resolution insert	
Dimensions (ODxL)	(7.5 in x 2.5 in) with 6 inch diameter solid acrylic block
76-410-4130	Block has eight sets of five holes: 1.75 mm, 1.5 mm, 1.25 mm, 1.00 mm, 0.75 mm, 0.61 mm, 0.5 mm, and 0.4 mm round
76-410-4132	Block has nine sets of five holes: 1.75 mm, 1.5 mm, 1.25 mm, 1.00 mm, 0.75 mm, 0.61 mm, 0.5 mm, 0.4 mm, and 0.2 mm round
In both phantom inserts, the holes are spaced longitudinally on 5 mm centers and vertically on centers equal to twice the hole width. All cavities are filled with air. The 6 inch block is sectored 1.25 inch out on radius. The insert contains 0.014 inch stainless steel wire positioned longitudinally to the insert plates. The wire allows simple computation of linespread functions. A sectored 1.25 inch portion of the main 6 inch block permits an edge gradient to be measured.	
Beam width insert	
Dimensions (ODxL)	(7.5 in x 3.5 in)
Contains three 0.020 in x 1.00 in aluminum strips angled at 45°, positioned on the center line and displayed vertically. A simple, direct calculation permits the accurate measurement of beam width. Adjacency is determined merely by a double exposure of two adjacent frames.	
Low-contrast extension	
Dimensions (ODxL)	(8.5 in x 2.75 in) solid acrylic block
Has two each of the following 2.25 inch deep cavities: 1 in, 0.75 in, 0.5 in, 0.375 in, 0.25 in, and 0.125 in diameter, spaced twice the appropriate diameter apart, one row of cavities on each side of the center line. Cavities with screw-locking sealing ports are easily filled with dextrose or sodium chloride solutions of various densities. The user may adjust densities to any value suitable for the scanner. Typically, 2 % or 3 % differentials in density between cavities are used	
Alignment pin	
Dimensions (ODxL)	(0.25 in x 3 in) aluminum with tapped hole, allowing pin to be secured to cover plate
TLD insert	
Dimensions (ODxL)	(0.5 in x 3.5 in) polystyrene rod drilled 3 inch deep to accept TLD inserts
Resealable cavity. Tapped on other end to allow mounting to cover plate.	
External (whole-body) resolution and noise ring (76-411)	
Annulus 12 in OD x 8.5 in ID x 2.5 in long contains the same hole pattern as the Resolution Insert, at two locations 90° apart. Permits whole-body resolution and noise measurements when positioned on the main tank. Inner and outer resolution values are easily determined.	
CT-SSP insert (76-412)	
The CT-SSP (Slice Sensitivity Profile) Point Response Phantom can be used as a stand-alone phantom or as an insert with the AAPM CT Performance Phantom. The AAPM CT Performance Phantom meets the guidelines in AAPM Report #1 for Performance Evaluation and QC of CT Scanners. The AAPM CT Performance Phantom is described in the report by the AAPM Task Force on CT Scanner Phantoms. The acrylic and closed-cell foam ball bearing size is 0.01 in, diameter is 7.5 in, width is 3.5 in, and weight is 0.825 lb.	
Low-Contrast CT Resolution Insert (76-421)	
The insert consists of an almost-water-equivalent plastic disc, 201 mm Ø x 25 mm thick, protected on both sides by clear plastic. The resolution targets are a series of water-filled holes from 2.5 mm to 7.5 mm in Ø, in 0.5 mm steps. For each target size, the center-to-center distance between holes is twice the hole diameter to ensure meaningful resolution testing. The insert's 25 mm thickness eliminates alignment problems. Dimensions are 201.6 cm x 32.5 cm thick. Weight is 1 lb.	
Dimensions (ØxD)	21.59 cm x 39.37 cm (8.5 in x 15.5 in)
Weight	7.84 kg (17.25 lb)

Optional accessories

76-411 External (Whole-Body) Resolution and Noise Ring

76-412 CT-SSP Point Response Phantom

76-421 Low-Contrast CT Resolution Insert

Ordering information

76-410-4130 AAPM CT Performance Phantom with Resolution Insert (to 0.4 mm)

76-410-4132 AAPM CT Performance Phantom with Resolution Insert (to 0.2 mm)

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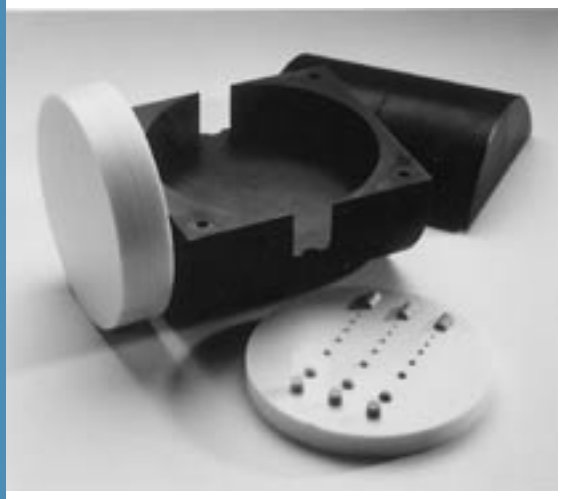
76-409

Spiral/Helical CT Lesion Detectability Phantom



The 76-409 CT Lesion Detectability Phantom is particularly useful to physicians, CT technologists, and medical physicists who design scanning protocols for abdominal, pelvic, and brain CT. It allows users to test various scanning protocols to verify that small low contrast lesions will be detected. This is the only way to be sure that a CT scanner is "seeing" tumors that are known to be present. The use of this phantom removes any doubt as to the limit of low contrast spherical lesion detectability for various scan protocols.

The phantom is designed to permit complete testing of low contrast lesion detection when various scan or image reconstruction parameters are varied. These include: collimation, pitch, reconstructed field of view, reconstruction algorithm, z-axis (patient's long axis) interpolators, kVp, mA, and rotation time. This lesion detectability testing can be applied to protocols designed for imaging of the liver, spleen, pancreas, kidneys, and adrenal glands. It can also be used for mass detection in the brain.

Key features

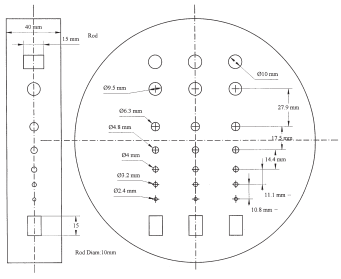
- Incorporates clinically relevant lesion shape (spherical) and size
- Provides clinically relevant absolute HU values for soft tissue
- Provides a clinically relevant HU differential (i.e. tumors have a slightly lower HU than background)
- Designed for use on all conventional and spiral (helical) CT scanners
- Compact, rugged
- Features three cylindrical reference plugs made of the same material as the spherical lesions
- Valid for x-ray energies from 80 kVp to 140 kVp
- Background Hounsfield Units (HU) approximate liver tissue
- Contains clinically relevant sphere sizes of 2.4 mm, 3.2 mm, 4 mm, 4.8 mm, 6.3 mm, and 9.5 mm in diameter
- Spheres are 5 HU, 10 HU, and 20 HU below background HU
- Carrying case is designed for use as a phantom support during scanning procedure

Specifications

Low-contrast sphere diameters	2.4 mm, 3.2 mm, 4 mm, 4.8 mm, 6.3 mm and 9.5 mm
Disk dimensions	18 cm Ø x 4 cm thick
Phantom dimensions	20 cm long x 18 cm Ø
Weight	5.4 kg (11.9 lb)

Note: The CT Lesion Detectability Phantom is a tissue-equivalent test object that consists of an 18 cm diameter right circular cylinder with a CT value of 50 HU at 120 kVp. Within the phantom is an 18 cm diameter, 4 cm deep right circular void in which a soft-tissue-equivalent disk (containing low contrast spheres) can be placed. The cylindrical void is in a plane containing the z-axis of the scanner. The soft-tissue-equivalent disk also has a background CT value of 50 HU.

Embedded within the disk are three sets of simulated spherical lesions. One set is 5 HU below background, a second set is 10 HU below background, and the last set is 20 HU below background. Each set contains one sphere each of the following diameters: 2.4 mm, 3.2 mm, 4 mm, 4.8 mm, 6.3 mm, and 9.5 mm. These diameters were chosen to encompass the full range of clinically significant lesions. The disk can also be placed at the end of the phantom when axial scanning detectability testing is desired.



Disk with embedded targets

Ordering information

76-409 Spiral/Helical CT Lesion Detectability Phantom

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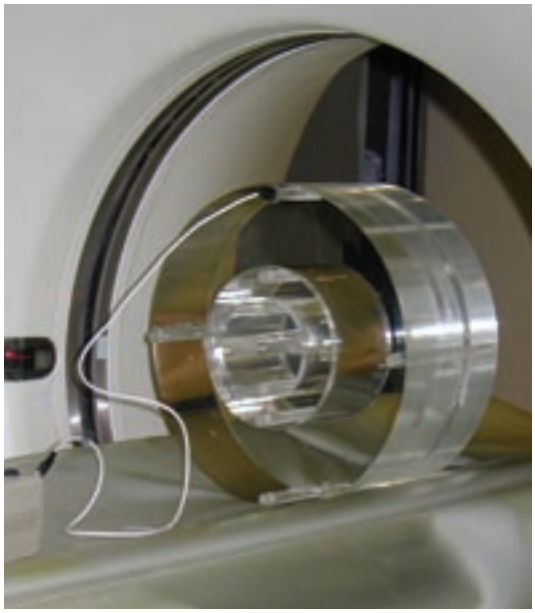
76-424-4156

Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body



The innovative nested CT Dose Phantom can be used with any computed tomography (CT) system designed to image pediatric and adult head and body. Each phantom segment can provide separate dose information. When performing dose profile measurements, the dose phantoms allow the user to collect information for the maximum, minimum, and mid-range value of the nominal tomographic section thickness.

This essential phantom kit consists of three parts: an adult body phantom, an adult head phantom that doubles as a pediatric body phantom, and the new pediatric head phantom, nested together for easy storage and convenient transport. All are made of solid acrylic with diameters of 32 cm, 16 cm and 10 cm, respectively. Each part contains four probe holes around the perimeter, 90° apart and 1 cm from the edge and the pediatric head (center insert) has one probe hole in its center. The inside diameter of the holes is 1.31 cm. Each part includes five acrylic rods for plugging all the holes in the phantom. A sturdy storage and carrying case with wheels and pull handle that holds all three phantoms is included. An optional smaller case without wheels is available.

The CT Dose Phantoms were designed in accordance with the Food and Drug Administration's performance standard for diagnostic x-ray systems, which includes regulations specifically applicable to CT systems (21 CFR 1020.33).

Key features

- Uniquely designed for pediatric and adult computed tomography dose index (CTDI) in a lightweight 20 kg (44 lb) total package
- Can be used with new multi-detector (MDCT) units
- Meets requirements of FDA performance standards
- All new carrying case with wheels and pull handle
- Case includes space for CT Ion Chambers (purchased separately)

76-424-4156 Kit: Adult body phantom, adult head phantom, pediatric head phantom, and acrylic rods

Optional accessories

89-419 Carrying Case with wheels and pull handle for 76-419-4150

89-414 Carrying Case for 76-414-4150

Specifications

76-424-4156	
Adult body phantom	Dimensions: (LxØ): 15.5 cm x 32 cm
	Weight: 11.3 kg (25 lb)
Adult head/pediatric body phantom	Dimensions: (LxØ) 15.5 cm x 16 cm
	Weight: 2.3 kg (5 lb)
Pediatric head phantom	Dimensions: (LxØ) 15 cm x 10 cm
	Weight: 1.3 kg (3 lb)
3 nested phantoms	Weight: 15 kg (33 lb)

76-419-4150	
Weight	Body phantom: 14.5 kg (32 lb)
	Head phantom: 3.6 kg (8 lb)

76-414-4150	
Weight	Body phantom: 14.5 kg (32 lb)
	Head phantom: 3.6 kg (8 lb)
	Pediatric head phantom: 1.3 kg (2.85 lb)

Ordering information

76-424-4156 Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle

76-424-4150 Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case without wheels and pull handle

76-414-4150 CT Dose Phantom Kit for Adult Head and Body including carrying case

76-419-4150 CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle

76-419 CT Pediatric Head Dose Phantom with five plugs

76-414 CT Head Dose Phantom with five plugs

76-415 CT Body Dose Phantom with five plugs

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CT Ion Chambers

CT Ion Chambers

Specifications

10 cc high sensitivity	
Detector type	Vented air ion chamber
Volume	10.1 cc
Sensitive length	10 cm
Chamber material	Acrylic (PMMA)
Chamber outside diameter	12.7 mm ± 0.4 mm (0.5 in ± 0.015 in)
Chamber inside diameter	11.44 mm (0.45 in)
Chamber wall thickness	77 mg/cm^2
Electrode material	Aluminum, 1100
Sensitivity	3.2 R•cm/nC (nominal) or 0.3/nC
Standard calibration	100 kVCP, 5.5 mm Al HVL (NIST Tech. M100)
Response uniformity along axis	± 3 % over central 90 % of active length
Beam orientation	Normal to chamber axis
Leakage current	(300 V collection potential) Less than 10^{-14} A at 10 min polarization time
Intensity limits	Continuous beam: 31.6 R/sec, (1 % recombination loss)
Pulsed beam	15.8 mR/pulse (1 % recombination loss)
Collection time	0.478 mSec
Cable length	0.9 m (3 ft)
Operating voltage	-300 V

3.2 cc	
Detector type	Vented air ion chamber
Volume	3.2 cc
Sensitive length	10 cm
Chamber material	Polystyrene
Chamber inside diameter	6.4 mm
Chamber wall thickness	54 mg/cm^2
Electrode material	Aluminum
Sensitivity	10 R•cm/nC (nominal)
Standard calibration	100 kVCP, 5.5 mm Al HVL (NIST Tech. M100)
Response uniformity along axis	± 3 % over central 90 % of active length
Beam orientation	Normal to chamber axis
Phantom adapter OD	1.27 ± 0.04 cm (0.5 ± 0.015 in)
Leakage current (300 V collection potential)	Less than 1013 A at 10 min polarization time, less than 1014 A at 2 hour polarization time
Intensity limits	Continuous beam: 4.86 kR/min (1 % recombination loss)
Pulsed beam	51.5 mR/pulse (1 % recombination loss)
Maximum pulse repetition rate	3.3 kHz
Cable length	0.9 m (3 ft)
Operating voltage	-300 V

10 cc high sensitivity ion chamber

3.2 cc ion chamber

Ordering information

660-6 CT Ion Chamber, 3.2 cm^3, with UHF termination: used with the 660 Electrometer

500-100 CT Ion Chamber, 3.2 cm^3, with triax BNC: used with the 35040 (ATD), TRIAD™ and TRIAD™ TnT

500-200 CT Ion Chamber High Sensitivity, 10 cm^3 for multislice CT, with triax BNC: used with the 35040 ATD and other electrometer/dosimeters, including TRIAD and TRIAD TnT

6000-100 CT Ion Chamber, 3.2 cm^3, with coax BNC for signal and banana plug for bias: used with the 4000, 8000 and RAD-CHECK® Plus Dosimeter

6000-200 CT Ion Chamber High Sensitivity, 10 cm^3, for multislice CT, with coax BNC for signal and banana plug for bias: used with the 4000, 8000 and RAD-CHECK Plus Dosimeter

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FLUKE®
Biomedical

84-357

Interventional Triple-Modality 3D Abdominal Phantom

Needle not included

The 84-357 Interventional Triple-Modality 3D Abdominal Phantom is made from proprietary materials which accurately mimic human tissues under magnetic resonance imaging (MRI), ultrasound, and computed tomography (CT). It is designed for image-guided interventional procedures.

The 84-357 contains simulated lungs, liver, hepatic vessels, ribs, vertebra, kidneys, abdominal aorta, inferior vena cava, muscle fat and interstitial tissues. Embedded within the lung and liver are simulated lesions available in a range of sizes and relative contrasts.

Each phantom is protected by a fat-equivalent urethane membrane and ABS end-caps. These features make the phantom durable enough for extended scanning sessions and enable insertion of various surgical instruments, as needed.

Key features

- Mimics human tissue for MRI, ultrasound and CT
- Designed for training, quality control and demonstrating scan techniques
- Improve performance of free-hand abdominal biopsies
- Test new equipment
- Validate automated biopsy systems
- Demonstrate CT, ultrasound and MRI scan techniques
- Optimize imaging protocols

Specifications

Material	Zerdine®[1], urethane, epoxy, and ABS
Dimensions (WxDxH)	28 cm x 12.5 cm x 20 cm
Weight	5.5 kg (12 lb)

[1]US Patent #5196343

Ordering information

84-357 Interventional Triple-Modality 3D Abdominal Phantom

76-907 and 76-908

Uniformity/Linearity Phantom (AAPM) and MR 3D Slice Thickness Resolution Phantom

76-907

76-907 MR Uniformity/ Linearity Phantom (AAPM)
The 76-907 Uniformity/ Linearity Phantom was designed to conform to AAPM MRI specifications. This large, flat-flood phantom can be filled with an MR signal-producing solution. The orthogonal array holes contain orientation reference markers, and the flood section has an image artifact cylinder.

76-908

76-908 MR 3D Slice Thickness/High Contrast Resolution Phantom (AAPM)
Various sections are arranged within a cubical shape to make the 76-908 truly three-dimensional. The 76-908 3D Slice Thickness Resolution Phantom contains slice thickness measuring sections, and a void between the inserts to allow for a signal-producing solution. Slice thickness and resolution information can be obtained in all three directions (transaxial, coronal, and sagittal) without moving the phantom.

Key features

76-907
Accurately evaluates:
- Spatial linearity
- Image artifact
- Signal-to-noise
- Resonance frequency
- Quadrature error

76-908
Accurately evaluates:
- High-contrast resolution
- Slice thickness
- Gradient strength
- Slice position/separation
- Resonance frequency
- Designed to conform to AAPM MRI specifications*

*These phantoms conform to the AAPM Specifications contained in the report: "Quality Assurance Methods and Phantoms for Magnetic Resonance Imaging," issued by the AAPM NMR Task Group No. 1 (article appeared in Medical Physics, 17:2 (Mar/Apr 1990). This report has also been co-sponsored by the American College of Radiology MR Committee on Imaging Technology and Equipment.

Specifications

76-907	
Dimensions (WxDxH)	33.02 cm x 33.02 cm x 10.16 cm (13 in x 13 in x 4 in)
Weight	5.3 kg (11.68 lb)

76-908	
Dimensions (WxDxH)	15.24 cm x 15.24 cm x 12.7 cm (6 in x 6 in x 5 in)
Weight	1.56 kg (3.46 lb)
Phantom configuration	
Resolution section	Six sections
	Square holes: 0.5 mm, 0.75 mm, 1 mm and 2 mm
	Hole depth: 0.5 in
Slice thickness	1 mm or 2 mm gap
	Slice position/separation
	Gradient strength
Slice thickness ramp section	Four sections
	2 with 1 mm gap
	2 with 2 mm gap

Optional accessories
76-903-7000 Copper Sulfate, 1 gm/l

Ordering information
76-907 Uniformity/Linearity Phantom (AAPM)
76-908 3D Slice Thickness/High Contrast Resolution Phantom (AAPM)

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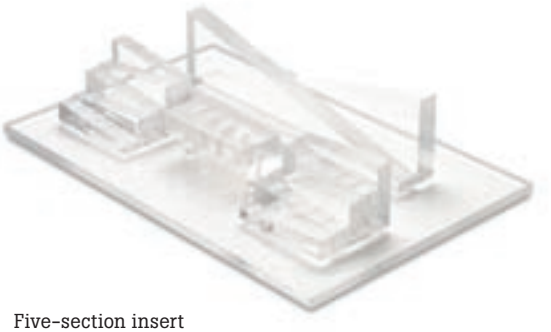
FLUKE®
Biomedical

76-904

MRI Surface Coil Phantom*



Five-section insert

The use of surface coils in Magnetic Resonance Imaging (MRI) has become an important part of the clinical operations in most MR facilities. Surface coils are preferred in some MR studies, in part, because their use can minimize motion artifacts, obtain high signal-to-noise ratio in the areas closer to the surface, and obtain high resolution images of smaller areas of interest.

The 76-904 MRI Surface Coil Phantom was specifically designed for acceptance testing and routine QC of surface coils. It provides the proper geometry not found in conventional head or body phantoms.

The 76-904 is constructed of non-magnetic Plexiglas®. It is rectangular in shape, contains three inserts, and is designed to be filled with an MRI signal-producing solution. The void between the inserts provides a fully flooded area.

Key features

- Provides proper geometry not found in conventional head or body phantoms

Accurately evaluates:

- High spatial resolution
- RF signal brightness profile
- Slice thickness
- Slice to slice gap
- MTF evaluation
- Magnetic field uniformity
- Gradient linearity
- Image artifacts
- And more!

Specifications

Outer dimensions (WxDxH)	33.02 cm x 15.24 cm x 17.46 cm (13 in x 6 in x 6.875 in)
Inner dimensions (WxDxH)	30.49 cm x 12.7 cm x 15.24 cm (12 in x 5 in x 6 in)
Weight	3.61 kg (7.96 lb)

*Developed by Seong Ki Mun, Ph.D., Department of Radiology, Georgetown University Hospital, Washington, DC.

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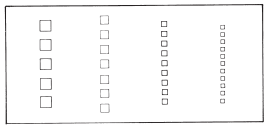
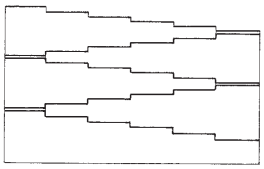
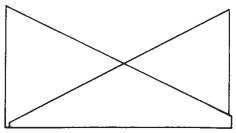
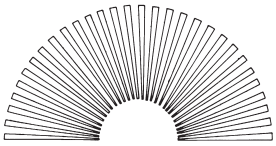
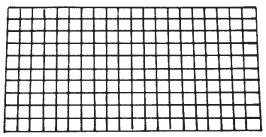
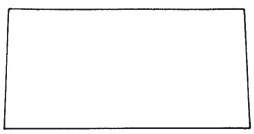
76-904

MRI Surface Coil Phantom

Specifications

A wide range of tests are provided by individual phantom sections

High-resolution hole pattern		
	Five holes: 2 mm x 2 mm Seven holes: 1 mm x 1 mm Nine holes: 0.75 mm x 0.75 mm Eleven holes: 0.5 mm x 0.5 mm Hole depth: 9 mm	
Folded step ramps		
	• Slice thickness, profile • Interslice gap • Slice orientation evaluation	Step interval: 1 mm Range: 30 mm Step size: 10 x 10 mm
Matching pair of ramps		
	• Precision slice definition evaluation	160 mm run, 40 mm rise (4:1 ratio). 0.5 in thick
Star pattern		
	• Qualitative MTF evaluation • Resolution • Asymmetric resolution • Image artifacts	Thirty 3° wedges (60 mm x 30 mm) covering a 180° fan shape. 0.785 mm gap at narrow end, 3 mm gap on wide end
Square grid		
	• RF intensity profile • Magnetic field uniformity • Gradient linearity • Aspect ratio	Dimensions 0.5 x 0.5 gird of 12 in x 6 in x 0.375 in thick
Flood section		
	• RF signal uniformity • Single T_1 and T_2 values	Dimensions 12 in x 5 in x 6 in

Optional accessories

76-903-7000 Copper Sulfate, 1 gm/l

Ordering information

76-904 MRI Surface Coil Phantom

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FLUKE®
Biomedical

76-903

MRI Multipurpose Phantom*

Five-section insert

The 76-903 MRI Multipurpose Phantom monitors the overall performance of an MRI system. The parameters that can be measured include: slice thickness, slice orientation, interslice gap, magnetic field homogeneity, radio frequency signal uniformity, spatial resolution in positive and negative contrast, and modulation transfer function (MTF). The phantom can also be used to evaluate quadrature setting, baseline correction, aspect ratio, and single T_1 and T_2 values.

The 76-903 is constructed of non-magnetic materials. It is 9 inches in diameter, with two inserts, and is designed to be filled with an MRI signal-producing solution. One insert is a series of concentric conic sections. The other insert is made up of five sections: one for positive contrast, two for slice evaluation, one for MTF evaluation, one for T_1 and T_2 evaluations.

A void between the sections provides a fully flooded area for signal uniformity.

Key features

Provides a comprehensive range of tests in one compact unit

- Slice thickness
- MTF evaluation
- Spatial resolution
- RF signal uniformity
- Magnetic field homogeneity

Specifications

Sections	Segments provided
Folded step ramps	two 60°
Star pattern	one 120°
T1, T2 solution insert	one 60°
High-resolution hole pattern	one 60°
Flood section	one 360°
Concentric conic section	one 360°
General	
Phantom dimensions (WxH)	OD is (9 in x 4.5 in)
Weight	3.09 kg (6.82 lb)

*Developed by Seong Ki Mun, Ph.D., Department of Radiology, Georgetown University Hospital, Washington, DC.

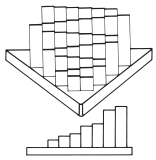
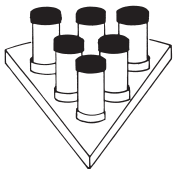
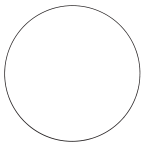
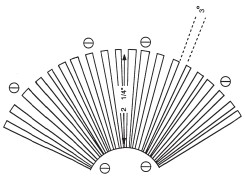
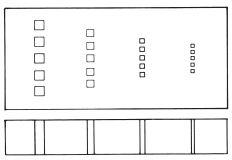
76-903

MRI Multipurpose Phantom

FLUKE® Biomedical

Specifications

Individual phantom inserts and sections permit a wide range of tests

Folded step ramps		
	• Slice thickness • Slice orientation • Interslice gap	Step Interval: 1 mm Range: 36 mm
T_1 and T_2 solution insert		
	Six 5 cc refillable glass vials with caps 15 mm Ø x 47 mm (h)	
Flood section		
	Diameter 9 in Depth 1.25 in	
Star pattern		
	• MTF evaluation • Horizontal and vertical spatial resolution • Quadrature setting • Baseline correction	Wedge angle: 3° Number of wedges: 20 Fan angle: 60° Wedge length: 60 mm Height: 30 mm
High-resolution hole pattern		
	Four holes: 2 mm x 2 mm, 1 mm x 1 mm, 0.75 mm x 0.75 mm, 0.5 mm x 0.5 mm Hole depth: 9 mm	
Concentric conic section		
	Outside diameter: 8 in Number of segments: 4	

Optional accessories

76-903-7000 Copper Sulfate, 1 gm/l

Ordering information

76-903 MRI Multipurpose Phantom

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FLUKE®
Biomedical

84-349

Ultrasound Elasticity QA Phantom

The 84-349 Ultrasound Elasticity QA Phantom contains 10 mm and 20 mm diameter spheres of varying hardness relative to the background material. The spheres are located at depths of 15 mm and 35 mm respectively and will appear isoechoic to the background using standard B-mode imaging. All materials are tested and a certification is provided listing the acoustic and elastic properties of each tissue.

Housed in a durable ABS housing with flexible scanning surface, 84-349 is manufactured from Zerdine®[1]—a solid-elastic polymer whose elastic properties can be controlled independently of its acoustic properties. The phantom is a reliable and consistent elasticity reference tool useful for researchers, sales demonstrations and quality assurance testing.

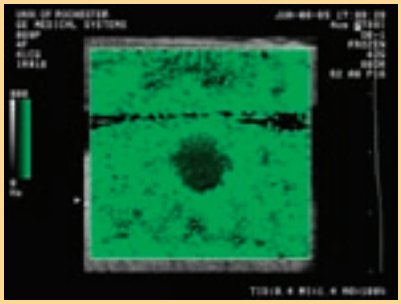
Key features

- Provide users with targets of known hardness
- 10 mm and 20 mm diameter spheres
- 15 mm and 30 mm depth placements
- 4 separate hardnesses
- Spheres appear isoechoic on standard B-mode imaging

[1]US Patent #5196343.

Specifications

Background	Material: Zerdine, solid elastic water-based polymer.
	Freezing point: 0 °C (32 °F), Melting point: above 100 °C (212 °F)
	Speed of sound: 1540 m/s ± 6 m/s
	Attenuation coefficient: 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz
	Contrast: 90 db with respect to reference
Lesions	Material: Zerdine, solid elastic water-based polymer.
	Freezing point: 0 °C (32 °F), Melting point: above 100 °C (212 °F)
	Speed of sound: 1545 m/s ± 6 m/s
	Attenuation coefficient: 0.5 dB/cm/MHz ± 0.05 dB/cm/MHz
	Contrast: 90 db with respect to reference
Elasticity	Lesion Type I 16 kPa ± 8 %
	Lesion Type II 25 kPa ± 8 %
	Lesion Type III 44 kPa ± 8 %
	Lesion Type IV 56 kPa ± 8 %
Diameter	Qty. 4, 10 mm at 15 mm depth one of each hardness
	Qty. 4, 20 mm at 30 mm depth one of each hardness



Elastograph image courtesy of C. Wu at the University of Rochester

Ordering information

84-349 Ultrasound Elasticity QA Phantom

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FLUKE®
Biomedical

84-317

Multipurpose Tissue-Cyst Ultrasound Phantom

The 84-317 Multipurpose Tissue/Cyst Ultrasound Phantom helps provide both quantitative and qualitative information on the performance of all diagnostic ultrasound imaging systems. When used on a regular basis, it promotes uniform system performance, better patient data, and more productive work schedules. Imaging equipment can be evaluated for axial and lateral resolution, vertical and horizontal distance calibration and linearity, and ring down.

This updated and improved phantom is filled with Zerdine®, a solid-elastic, water-based polymer that exhibits echogenic patterns similar to those encountered in human liver parenchyma. Unlike other phantom materials, Zerdine is elastic and is not damaged by heavier scanning pressures. It is also highly-resistant to damage by extreme temperatures.

Key features

- Complies with the AIUM standard for quality assurance
- The best-performing phantom in the industry, for evaluating system and transducer performance
- Includes cyst-like and solid structures in various sizes
- Simulates liver tissue scattering and attenuation
- Now available with 0.5 or 0.7 dB/cm/MHz attenuation coefficients
- Provides resolution targets at several depths
- Compatible with all types of imaging equipment, including small parts scanners
- Withstands extreme temperatures, making it ideal for service and quality control use
- Three large scanning surfaces

Specifications

Phantom body	
Phantom material	Zerdine[1]; solid-elastic water-based polymer
Freezing point	0 °C
Melting point above	100 °C
Storage temperature	0 °C to 66 °C (32 °F to 150 °F)
Speed of sound	1540 m/s ± 6 m/s
Attenuation coefficient	0.5 dB/cm/MHz or 0.7 dB/cm/MHz
Scatter	Mimics healthy liver parenchyma
Positional tolerance of wires (monofilaments)	Stated distance ± 0.1 mm
Diameter of cylindrical targets	Stated Diameter ± 5 %
Base material	Cork
Phantom dimensions (WxHxT)	20 cm x 2 cm x 8 cm (7.87 in x 8.26 in x 3.15 in)
Weight	3.36 kg (7.4 lb)
Optional scanning trough	
For scanning with a liquid coupling agent (water or coupling oil)	
Optional carrying case	
This insulated case is large enough to hold the phantom and trough and also protects the phantom from extreme heat or cold	
Optional acoustic standoffs	
A fast, easy, accurate way to bring the focal zone closer to the surface, for enhanced diagnostic detail during ultrasound examinations	
Material	Sonolucent gel
Dimensions	10 cm x 15 cm
Weight	0.42 kg (1 lb)

[1]US Patent #5196343.

Optional accessories

84-318 Scanning Trough: for Oil and Water

89-317 Carrying Case: insulated for phantom and trough

84-325-1000 Acoustic Standoff, 1.0 cm

84-325-2000 Acoustic Standoff, 2.0 cm

84-325-3000 Acoustic Standoff, 3.0 cm

84-325 Acoustic Standoff, 4.0 cm

84-325-1234 Acoustic Standoff Set, includes all four: 1 cm, 2 cm, 3 cm and 4 cm

Ordering information

84-317 Multipurpose Tissue/Cyst Ultrasound Phantom, 0.5 dB/cm/MHz

84-314 Multipurpose Tissue/Cyst Ultrasound Phantom Kit, consists of phantom (either 0.5 dB/cm/MHz or 0.7 dB/cm/MHz), scanning trough, carrying case, and the "AIUM Quality Assurance Manual"

FLUKE®
Biomedical

84-340

General Purpose Mulit-Tissue Ultrasound Phantom

The 84-340 General Purpose Multi-tissue Ultrasound Phantom is constructed from a patented solid elastic material called Zerdine®. Unlike other phantom materials, it is not affected by changes in temperature. It can be subjected to boiling or freezing conditions without sustaining significant damage. It is also more elastic than other materials and allows more pressure to be applied to the scanning surface without subsequent damage to the material.

At normal room temperature, Zerdine will accurately simulate the ultrasound characteristics found in human liver tissue. It contains dense and cystic masses in a range of sizes, one high-density target, and an assortment of nylon monofilament target groups. It was designed to allow for assessment of linearity, axial and lateral resolution, depth calibration, dead zone measurement, and registration within two different backgrounds of 0.5 dB/cm/MHz and 0.7 dB/cm/MHz. The phantom is protected by an acrylic case and plastic membrane to facilitate scanning and minimize desiccation.

Key features

- Complies with the AIUM Standard for Quality Assurance
- Simulates characteristics found in human liver tissue
- Ensures patient's safety and doctor's confidence
- Perfect for QC/service use since phantom is not affected by changes in temperature
- Promotes uniform system performance for all types of imaging equipment, including small parts scanners
- Supplied with insulated, rugged storage/carrying case
- Quick scanning can be performed without removing phantom from the airtight case

Specifications

Material	Zerdine[1] Type: Solid elastic water-based polymer Freezing point: 0 °C Melting point: Above 100 °C
Attenuation coefficient	0.5 dB/cm/MHz; 0.7 dB/cm/MHz
Speed of sound	1540 m/s
Scanning well	1 cm deep
Scanning membrane	Saran
Targets	Material: Monofilament nylon wire Diameter: 0.1 mm
Vertical and horizontal plane target	Number of groups: 1 Number of targets: 7 Depth range: 9 cm Spacing: 2 cm
Resolution targets	Number of arrays: 3 Depths: 3 cm and 10 cm Axial intervals: 0.5 mm, 1 mm, 2 mm, 3 mm, 4 mm, and 5 mm Horizontal intervals: 1 mm, 2 mm, 3 mm, 4 mm, and 5 mm
Low contrast targets	Number of targets: 4 Diameter of targets: 2 mm, 4 mm, 6 mm, and 8 mm Depth of targets: 2 cm, 4 cm, 6 cm, and 8 cm Contrast of targets: –15 dB relative to background
High contrast targets	Number of targets: 4 Diameter of targets: 2 mm, 4 mm, 6 mm, and 8 mm Depth of targets: 2 cm, 4 cm, 6 cm, and 8 cm Contrast of targets: 15 dB relative to background
Phantom dimensions (WxDxH)	19 cm x 20 cm x 14 cm (7.5 in x 8 in x 5.5 in)
Weight	9.1 kg (20 lb) with case
Carrying case (WxDxH)	46 cm x 38 cm x 43 cm (18 in x 15 in x 17 in)

Tolerances
Distance between any two wires equals stated ± 0.38 mm
Cylinder diameters equal state ± 5 %
Accuracy of measured parameters
Speed of sound equals stated ± 3 m/s
Attenuation coefficient equals stated ± 0.02 dB/cm/MHz
Temperature at time of measurement
Recorded on certification document

Ordering information

84-340 General Purpose Multi-tissue Ultrasound Phantom

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FLUKE®
Biomedical

84-342

General Purpose Urethane Ultrasound Phantom

The 84-342 General Purpose Urethane Ultrasound Phantom offers a reliable medium which contains specific, known test objects, making it more accurate than random scannable materials. The phantom enables repeatable, qualitative assessment of ultrasound scanner performance over time. The phantom is constructed from a proprietary urethane matrix, housed within a rigid PVC container with three separate scanning windows. It allows for depth of penetration, uniformity, distance calibration, resolution and lesion detectability assessment. The three scanning surfaces also provide the user with the ultimate in versatility, simplicity and ease of use. The scanning wells permit either water or gel to be used as an acoustic coupling agent.

Key features

- Features three scan-surfaces
- Complies with the AIUM standard for quality assurance
- Rugged, durable
- Ideal for service use
- Performs a wide variety of tests needed to meet AIUM and ACR ultrasound QC guidelines
- Includes an in-house certification traceable to NIST standards

Specifications

Phantom material	Proprietary urethane matrix
Attenuation coefficient	0.5 dB/cm/MHz ± 0.05 dB/cm/MHz at 5 MHz
Speed of sound	1430 m/s ± 10 m/s at 20 °C
Scanning surfaces	Number: 3 Depth of scanning wells: 2 cm
Housing material	White PVC
Vertical plane targets	Number of groups: 1 Number of targets per group: 10 Depth of visualization: 1 cm and 19 cm Visualized spacing: 20 ± 0.38 mm Material: Nylon monofilament, 0.10 mm Ø
Horizontal plane targets (**Note:** This target group is also the Vertical Plane Target Group)	Number of groups: 1 Number of targets per group: 10 Depth of visualization: 3 cm and 10 cm Visualized spacing: 20 ± 0.35 mm Material: Nylon monofilament, 0.1 mm Ø
Axial resolution targets	Number of groups: 2 Number of targets per group: 12 Depths of visualization: 2 cm, 5 cm, 8 cm, and 11 cm Axial resolution test range: 0.5 mm, 1 mm to 5 mm, in 1 mm increments Material: Nylon monofilament, 0.1 mm Ø
Lateral resolution targets	Number of groups: 2 Number of targets per group: 6 Depths of visualization: 2 cm, 5 cm, 8 cm, and 11 cm Lateral resolution test range: 1 mm to 5 mm, in 1 mm increments Material: Nylon monofilament, 0.1 Ø
Anechoic targets	Number of targets: 2 Diameter: 8 mm to 2 mm, in 2 mm increments Depths of visualization 2 cm, 5 cm, 8 cm, 11 cm, 13 cm, and 16 cm
Phantom dimensions (WxDxT)	17 cm x 25.5 cm x 7 cm (6 in x 10 in x 2.75 in)
Weight	5.45 kg (12 lb)

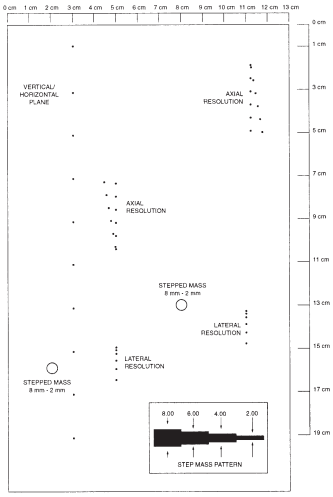

Diagram showing internal targets

Ordering information

84-342 General Purpose Urethane Ultrasound Phantom, includes carrying case

Service and Calibration

World-class facility. World-class service.

Fluke Biomedical's Global Calibration Lab is NVLAP Lab Code 200566-0 accredited, adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA, and CNSC, and is traceable to national and international standards.

Fluke Biomedical offers one-stop, bulk contracts for managing larger instrument pools, including various asset-management alternatives for pools larger than 150 units. Fluke Biomedical's asset-management program takes over your grueling task of instrument tracking and allows you to use your time more productively.

If you have a large number of instruments that require service, you can greatly benefit from this quality service. Proper protocols are strictly followed, eliminating the problems with inspectors and audits that can result when other less-qualified labs perform the calibrations. Instrumentation includes Fluke Biomedical as well as other industry models.

Fluke Biomedical's Global Calibration Laboratory is equipped to calibrate and repair the following types of instruments:

- Area Monitors
- Barometers
- Blood Pressure Simulators
- Defibrillators/External Pace Maker Analyzers
- Densitometers
- Diode Detectors
- Dosimeters
- Electrical Safety Analyzers
- Incubator Analyzers
- Ion Chambers
- IV Pump Analyzers
- kVp Meters
- mAs Meters
- Electrical Multimeters
- Oscilloscopes
- Patient Simulators
- Pressure Meters/Parameter Testers
- Radiation Multimeters
- Sensitometers
- SpO2 Simulators/Analyzers
- Thermometers
- Test Lungs
- Ultra Sound Analyzers
- Velometers
- Ventilators/Gas flow Analyzers

Calibration Beam Specifications

Tungsten Anode

NIST-Traceable Techniques

Equivalent Beam Code	Potential (kV)	Filtration				HVL mm Al
		mm Al	mm Cu	mm Sn	mm Pb	
L20	20					0.07
L100	100	1.98				2.75
M30	30	0.50				0.33
M50	50	1.00				0.98
M60	60	1.50				1.68
M80	80	2.6				2.98
M100	100	5.0				5.1
M150	150	5.0	0.25			10.2
M200	200	4.1	1.12			14.9
M250	250	5.0	3.2			18.5
H50	50	4.0			0.12	4.4
H60	60	4.0	0.6			6
H100	100	4.0	5			13.5
H150	150	4.0	4	1.5		16.8
H200	200	4	0.6	4	0.7	19.5
H250	250	4	0.6	1	2.7	21.5

PTB-Traceable Techinques

Equivalent Beam Code	Potential (kV)	Filtration				HVL mm Al
		mm Al	mm Cu	mm Sn	mm Pb	
DV30	30	2.5				0.98
DV40	40	2.5				1.44
DV50	50	2.5				1.81
DV60	60	2.5				2.13
DV70	70	2.5				2.45
DV80	80	2.5				2.78
DV90	90	2.5				3.1
DV100	100	2.5				3.48
DV120	120	2.5				4.15
DV150	150	2.5				5.36
DH40	40	4				2.2
DH50	50	10				3.75
DH60	60	16				5.35
DH70	70	21				6.77
DH80	80	26.0				8.12
DH90	90	30.0				9.26
DH100	100	34.0				10.15
DH120	120	40.0				11.67
DH150	150	45.0				13.36

Service and Calibration

World-class facility. World-class service.

FLUKE® Biomedical

Calibration Beam Specifications

Molybdenum/Rhodium Anode

NIST-Traceable Techniques

Equivalent Beam Code	Potential (kV)	Filtration			HVL mm Al
		mm Mo	mm Rh	mm Al	
Mo/Mo 28	28	0.032			0.33
Mo/Mo 35	35	0.032			0.39
Mo/Rh 28	28	0.029			0.41
Rh/Rh 25	25		0.029		0.35
Rh/Rh 40	40		0.029		0.56
Mo/Mo28x	28	0.030		2	0.63
Rh/Rh/35x	35		0.029	2	0.898

PTB-Traceable Techinques

Equivalent Beam Code	Potential (kV)	Filtration			HVL mm Al
		mm Mo	mm Rh	mm Al	
MV20	20	0.030			0.223
MV25	25	0.030			0.282
MV30	30	0.030			0.337
MV35	35	0.030			0.374
MV40	40	0.030			0.402
MV50	50	0.030			0.440
MV20	20	0.030		2	0.450
MV25	25	0.030		2	0.580
MV30	30	0.030		2	0.670
MV35	35	0.030		2	0.749
MV40	40	0.030		2	0.825
MV50	50	0.030		2	0.968

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www.flukebiomedical.com/service

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Publications

The following Fluke Biomedical catalogs are also available

Fluke Biomedical Radiation Oncology QA

The Radiation Oncology QA catalog provides a full range of QA solutions for the Radiation Oncology Physicist, Therapist, and Dosimetrist. The catalog contains information about the linear accelerator QA instrumentS, radiation oncology chambers, phantoms, and accessories needed to manage radiation oncology QA and maintain a safe, regulatory-compliant facility.

For more information, contact sales@flukebiomedical.com

Fluke Biomedical Radiation Safety

The Radiation Safety catalog highlights devices used to measure radiation levels, manage regulatory QA requirements, and aide in radiation emergencies. These devices are intended for Radiation Safety Officers (RSOs), Health Physicists, Emergency Responders and other radiation-minded professionals. The catalog contains information about a variety of survey meters and probes, area monitors, and other radiation-monitoring accessories.

For more information, contact sales@flukebiomedical.com

Fluke Biomedical Test

The Biomedical Test catalog emphasizes the complete line of biomedical test and simulation products for Biomedical/Clinical Engineers and Technicians. The catalog contains information about Fluke Biomedical's test and simulation products, including standalone electrical safety testers, patient simulators, and performance analyzers, as well as fully integrated and automated performance-testing and documentation systems.

For more information, contact sales@flukebiomedical.com

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FLUKE®

Biomedical

Radiation Oncology

Product Catalog

2011

7600 Double Check® Pro
Daily Check Device

35040 Advanced
Therapy Dosimeter

05-433 PRIMALERT® 10
Teletherapy Radiation Monitor

37-705 VeriDose®
PDMQC System

Fluke Biomedical.
Better products. More choices. One company.

Radiation Oncology Product Catalog

FLUKE® Biomedical

Providing solutions, not just products

Today, biomeds, physicists, RSO's, other medical personnel must meet increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

Service

Fluke Biomedical is dedicated to providing the best service within the healthcare industry. Equipped with the best-credentialed facilities, onsite experts, and full asset-management capabilities, Fluke Biomedical's service team is always on call to take care of its customers. Fluke Biomedical's world-class staff leads the industry in post- and pre-sale support, including helping customers choose the best products and accessories for their needs, technical support, product calibration, and repairs.

Regulatory compliance

Fluke Biomedical's benchmark quality operates to the most rigorous standards in the industry, including compliance with ISO 9001:2000, ISO 13485:2003, FDA/QSR as applicable, and NRC/Part 50, Appendix B/Part 21 and adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA and CNSC. Many of the Fluke Biomedical products are CE-marked and CSA-certified. In addition, the Global Calibration Laboratory holds its NVLAP Lab Code 200566-0 certification and is traceable to both the NIST & PTB.

Legacy

You may be familiar with some of our legacy brand names, including:

- Victoreen®
- Nuclear Associates
- Keithley
- Metron
- DNI Nevada
- Bio-Tek Instruments

Fluke Biomedical has taken the best elements and products of these former brands and have incorporated them into the Fluke Biomedical culture and product line available today.

Our newest catalog

Thank you for requesting our Radiation Oncology catalog. Within these pages, you will find solutions to manage your quality assurance and maintain a safe, regulatory-compliant facility in the radiation oncology physics field.

If you are interested in receiving catalogs or information about any of Fluke Biomedical's other product-lines, please visit www.flukebiomedical.com/catalog.

Catalogs are available for the following product lines:

- Biomedical Test
- Diagnostic Imaging QA
- Radiation Safety
- Service

About Fluke Biomedical

Fluke Biomedical leads the world in the manufacture of biomedical test and simulation products, including standalone electrical safety testers to fully integrated and automated performance testing and documentation systems. Fluke Biomedical also provides some of the most trusted and accurate radiation safety, medical imaging, and oncology quality-assurance solutions for regulatory compliance.

About Fluke Corporation

Fluke Biomedical is a division of Fluke Corporation. Fluke Corporation is the world leader in the manufacture, distribution, and service of electronic test tools and software and is a wholly owned subsidiary of Danaher Corporation (NYSE:DHR).

FLUKE®
Biomedical

35040

Advanced Therapy Dosimeter

CE

The 35040 Advanced Therapy Dosimeter (ATD) is a reference grade instrument used to measure the charge and current from ion chambers in radiation therapy, and provides bias voltage for all commonly-used chambers. Front panel controls select ion-chamber calibration factors, facilitate entry of temperature and pressure values for air density correction, allow bias voltage selection, threshold level, timer control, and choice of display screens. The user-customized display screens can simultaneously show dose, exposure time, dose rate, effective exposure time, average current/rate, accumulated charge/dose, bias voltage, leakage, and other important information that ensures the validity of the instrument. The customization software allows design of 16 screens that display conditions, parameters, values and text. Up to 32 chamber factors, 11 bias voltages can be programmed. It is PC compatible and connects via a RS-232 cable. The user can customize the display for basic use or for specialized applications such as brachy therapy. The Advanced Therapy Dosimeter exceeds the recommendations of calibration laboratories for leakage, linearity, and stability by a wide margin. This instrument raises the standard of radiation therapy measurements.

Key features

- Wide measurement range, up to 1.000 µA and 19.999 mC for HDR Brachy therapy applications
- Automatic reset and hold of measured values between exposures
- Front panel adjustment of exposure threshold and user disable of threshold to permit manual operation
- Thirty-two ion chamber calibration factors
- Automatic power-down after user specified time period, when operating from battery supply
- Annunciators warn of low battery, low bias, and operational errors
- Large capacity battery provides eight hours of continuous operation; fast recharge in less than three hours, even during operation
- AC line operation over the range 100 V ac to 240 V ac and 47 Hz to 63 Hz without operator intervention
- Charge and current calibration factors entered by calibration laboratories at user's option

Included accessories

Remote probe, test leads, alligator clips, K-type thermocouple (1587 only), hard case and user documentation.

Ordering information

Fluke-1577 Insulation Multimeter
Fluke-1587 Insulation Multimeter
Fluke-1587/ET Advanced Electrical Troubleshooting Kit
Fluke-1587/MDT Advanced Motor and Drive Troubleshooting Kit

35040

Advanced Therapy Dosimeter

FLUKE® Biomedical

Specifications

Charge full scale	Charge sensitivity	Current* full scale	Current* sensitivity
200.00 pC	0.01 pC	200.0 pA	0.1 pA
2.0000 nC	0.0001 nC	2.000 nA	0.001 nA
20.000 nC	0.001 nC	20.00 nA	0.01 nA
200.00 nC	0.01 nC	200.0 nA	0.1 nA
2.0000 µC	0.0001 µC	1.000 µA	0.001 µA
20.000 µC	0.001 µC		
200.00 µC	0.01 µC		
2.0000 mC	0.0001 mC		
20.000 mC	0.001 mC		

*Average current is displayed with ten times greater resolution.

Effective exposure time ranges	
Full scale range	**Display resolution**
59.99 s	0.01 s
5 hr 33 min 19.9 s	0.1 s

Stability	Designed for ultra long-term stability error of approximately 0.1 % per five years
Leakage	Virtually removes effects of total system leakage during measurement. Uncorrected leakage < 10 fA over temperature range
Linearity	Maximum non-linearity variation from straight line of 0.1 % of all charge and current ranges
Resolution	0.005 % of range (4.5 digits) for charge, dose, average rate and average current; 0.05 % of range (3.5 digits) for current and rate
Warm-up	Fully meets specifications within five minutes of applying power
Measurement accuracy	18 °C to 28 °C (64 °F to 82 °F); charge ± (0.20 % reading plus two counts); current ± (0.20 % reading plus two counts)
Bias	Eleven user-programmable steps from -500 to +500 V in 0.1 volt increments; accuracy ± 0.3 V for loads < 0.2 mA; front panel selectable
Ion chamber calibration factors	Thirty-two user-programmable calibration factors; front panel selectable
Display units	All practical radiation and electrical units
RS-232 computer configuration	For customizing and data transfer
Power requirements	Internal lead acid battery; integral charger operates 100 V ac to 240 V ac (47 Hz to 63 Hz)
Connectors	Triax BNC front/rear 35040; Triax TNC front/rear 35040TNC
Dimensions (WxDxH)	21.6 cm x 26 cm x 8.9 cm (9.4 in x 10 in x 4 in)
Weight	4.6 kg (10 lb)

Optional accessories

86120 Extension Cable, 20 ft, Triax BNC to BNC

30-356 BNC to TNC Converter

External chamber accessories

30-344 Semiflex™ Ionization Chamber, 0.125 cm^3, Waterproof

30-316 Semiflex™ Ionization Chamber, 0.3 cm^3, Waterproof

30-353 PinPoint™ Ionization Chamber, 0.015 cm^3, Waterproof

30-332 Roos™ Electron Ionization Chamber, 0.35 cm^3, Waterproof

30-353 Advanced Markus™ Electron Ionization Chamber, 0.02 cm^3, Waterproof

Ordering information

35040 Advanced Therapy Dosimeter

35040TNC Advanced Therapy Dosimeter, TNC option

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FLUKE®
Biomedical

37-705

VeriDose® PDMQC System

Our innovation and leading-edge technology combines the powerful performance capabilities of patient dose monitoring and linear-accelerator quality-control into one compact, easy-to-use product. We give you this powerful combination of technology and versatility for a lower price than you would expect to pay for one unit alone.

CE

Use VeriDose PDMQC as a patient dose monitor and when needed, simply plug in the VeriDose QC Module and VeriDose PDMQC is transformed into a precision linear-accelerator quality-control device.

Key features

- Measures beam constancy, flatness, and symmetry
- Two systems in one
- Accurate to within 1 % or better
- Measurements and updates are provided in real time.
- Automatically adjusts the proper offset voltage for each detector, resulting in up to ten times less drift than other products
- VeriDose PDMQC stores up to 25 separate calibration sets. (A calibration set can be created for up to five diodes at a time.)
- In vivo measurements with the VeriDose PDMQC as a patient dose monitor are reimbursable under CPT-4 Section 77331 Special Dosimetry
- Ability to print patient treatment dose reports, date and time of the procedure, diode detector group and serial number

Specifications

Electrometer	
Input circuitry	Five electrometer channels with digital zeroing and gain control; bi-polar
Rate range	1 to 1000 cGy/min
Dose range	0.1 to 1000 cGy
Sensitivity adjustment	0.1 to 10 nC/cGy
Display	240 x 64 dot LCD. 8 lines x 40 characters, with CCF backlight
Clock	Real-time clock, battery operated, US or European format
Alarm	User-selectable level for each channel
User controls	On-Off switch, 5-column select soft-keys for control functions, scroll-up, scroll-down, and enter key for data entry
User setup parameters	Stored in nonvolatile, battery-backup RAM
Computer interface	RS-232, 19.2 BAUD, 8, N, 1 Data format: standard decimal points or Euro-commas
Printer interface	Parallel, selectable drivers for LaserJet in ASCII format only
Environmental	Storage temperature: 0 °C to 70 °C (32 °F to 158 °F)
	Operating temperature: 10 °C to 30 °C (50 °F to 86 °F)
	Relative humidity: 5 % to 95 %, non-condensing
Power requirements	120 V ac, 60 Hz or 230 V ac, 50 Hz to 12 V dc @ 1A AC adapter, UL, CSA, CE
Dimensions (WxDxH)	22.9 cm x 21.6 cm x 6.4 cm (9 in x 8.5 in x 2.5 in) (EMI shielded)
Weight	1.2 kg (2.5 lb)
Phantom	
Detector	Five diode detectors
Energy range	Photon: 4 MV to 25 MV
	Electron: 5 MeV to 25 MeV
Sensitive volume	0.25 mm^3
Sensitivity	1.5 nC/cGy
Diode polarity	Negative
Rad damage at 10 kGy	< 15 %
Detector configuration	Flatness/Symmetry One central axis. Four orthogonally-positioned at 8 cm off central axis in the transverse and radial dimensions. Off-axis detectors are positioned at 80 % of field size for flatness and symmetry measurements
	Energy constancy Detector depth positions: 4.5, 12.5 and 20.5 cm
Interface cable	15 m (50 ft)
Buildup	1.9 cm acrylic (2.3 g/cm^2)
Dimensions (WxDxH)	25 cm x 25 cm x 3.8 cm (9.85 in x 9.85 in x 1.5 in)
Weight	11.6 kg (5.25 lb)

30-471

VeriDose® Solid-State Diode Detectors

FLUKE® Biomedical

Using the VeriDose Patient Dose Monitor Quality Control (PDMQC) System or the VeriDose V Patient Dose Monitor in conjunction with VeriDose Solid-State Diode Detectors, you can verify the given dose quickly and accurately during treatment, thus avoiding potential misadministration of radiation.

VeriDose Solid-State Diode Detectors are silicon-based radiation detectors that utilize a p-n junction. These rugged diodes are encased within a biocompatible polystyrene material. A low-noise coaxial cable with BNC connectors connects the diode to an electrometer. When attached to an electrometer, these diodes provide enhanced sensitivity and instantaneous response time.

- Optimized for use with all Fluke Biomedical Patient Dose Monitors and high-quality medical-grade ionization chamber electrometers
- All diodes are supplied with a noncrimp repairable cable with a coax BNC connector

Key features

- Designed to provide superior response, reliability, and performance
- Long-lifetime diodes. Tested to 2 x 10^6 cGy in a high-energy electron beam, the most damaging radiation
- Very low dose rate and temperature dependence
- Hemispherical shape improves isotropic response and reduces angular and field-size dependencies
- Waterproof design with appropriate buildup for all clinical photon and electron energies
- Flat bottom permits secure, easy placement on the patient
- Dose rate independent
- Responds to photons and electrons
- Responds to dose rates of 1.0 to 1000 cGy/min
- Can be used on continuous (^{60}Co) x-ray beams, pulsed (linear-accelerator) x-ray beams, and electron beams

Specifications

Photon and electron diode detectors	
Nominal sensitivity	1.5 nC/cGy
Sensitivity volume	0.25 mm^3
Output polarity	Positive/Negative
Linearity	< 0.1 % for dose ranges from 0.01 to 10 Gy; < 0.1 % for dose rates 3 to 5 Gy/min
Reproducibility	0.2 %
Angular dependence	< 2 % ± 60° for lower energy diodes (30-471 and 30-472); < 2 % ± 10°; < 5 % ± 60° (for higher energy photon diodes and electron diodes)
Sensitivity loss at 10 kGy	< 15 %
Cable length	3 m (10 ft)
Dimensions	8 mm Ø
Weight	42 gm

Model	Range	Polarity/Color	Buildup	Buildup (g/cm^2)	Electrometer
30-471	1 mV to 4 mV	Positive/Blue	Cu	0.732	37-720
30-471-8000	1 mV to 4 mV	Negative/Blue			37-705
30-472	5 mV to 11 mV	Positive/Yellow	Cu	1.359	37-720
30-472-8000	5 mV to 11 mV	Negative/Yellow			37-705
30-473	12 mV to 17 mV	Positive/Red	W	2.606	37-720
30-473-8000	12 mV to 17 mV	Negative/Red			37-705
30-474	18 mV to 25 mV	Positive/Green	W	3.574	37-720
30-474-8000	18 mV to 25 mV	Negative/Green			37-705
30-475	5 mV to 25 MeV	Positive/Grey		0.284	37-720
30-475-8000	5 mV to 25 MeV	Negative/Grey			37-705

Optional accessories

88-490 Diode Extension Cable, 9 m (30 ft)
88-490-1000 Diode Extension Cable, 3 m (10 ft)

Ordering information

30-471 VeriDose Diode, 1-4 mV Photons, Positive Polarity, Blue
30-471-8000 VeriDose Diode, 1-4 mV Photons, Negative Polarity, Blue
30-472 VeriDose Diode, 5-11 mV Photons, Positive Polarity, Yellow
30-472-8000 VeriDose Diode, 5-11 mV Photons, Negative Polarity, Yellow
30-473 VeriDose Diode, 12-17 mV Photons, Positive Polarity, Red
30-473-8000 VeriDose Diode, 12-17 mV Photons, Negative Polarity, Red
30-474 VeriDose Diode, 18-25 mV Photons, Positive Polarity, Green
30-474-8000 VeriDose Diode, 18-25 mV Photons, Negative Polarity, Green
30-475 VeriDose Diode, 5-25 MeV Electrons, Positive Polarity, Grey
30-475 VeriDose Diode, 5-25 MeV Electrons, Negative Polarity, Grey

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FLUKE®
Biomedical

37-720

Dual-Diode Dosimeter Patient Dose Monitor

Key features

- Provides instant patient data on radiation exposure to sensitive organs and rapid checks of equipment output
- Prevents the potential for misadministration
- Battery operated
- Provides instantaneous readings on the radiation dose being delivered to the patient
- Designed for use with positive polarity diodes only

CE

Excessive radiation exposure (misadministration) to the patient is always a matter of concern in radiation therapy. The Dual-Diode Dosimeter eliminates this concern by providing a dosimetry system specifically designed to verify the amount of radiation received by the patient during treatment.

Measurements are presented on a large digital display with a range of 0 to 2000 Rad or Rad/minute. The electrometer accepts either one or two diode detectors, which are selected using a front-panel switch. Calibration and zero adjustments, as well as dose or dose rate selection, are all readily accessible on the front panel. While the Dual-Diode Dosimeter is not intended as a primary calibration device, it can also be used to accurately determine therapy machine output.

Specifications

Accuracy	± 5 %
Reproducibility	± 5 %
Range	0 to 2000 Rad or Rad/minute
Readout	0.5 inch high digits on display
Front controls	On/Off, Dose/Rate, Detector A/Detector B, reset, Trimpots for Zero, and Calibration for Detectors A and B
Rear connections	Detector A and B input
Power requirements	9 V battery or equivalent
Dimensions (WxDxH)	15.24 cm x 16.51 cm x 7 cm (6 in x 6.5 in x 2.75 in)
Weight	0.9 kg (2 lb)

Optional accessories

30-492 Diode Detector Holder; 7 in x 7 in x 0.5 in thick clear acrylic plate routed to hold six diodes in a level, reproducible position during field measurements

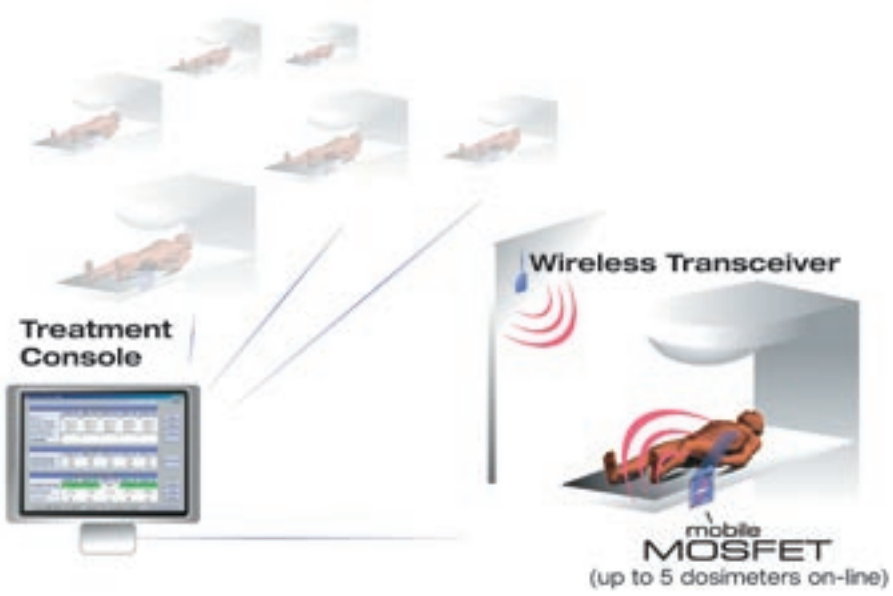
Ordering information

37-720 Dual-Diode Dosimeter Patient Dose Monitor

FLUKE®
Biomedical

37-105

mobileMOSFET Wireless Dose Verification System



Key features

- Small, isotropic, direct read dose verification system
- One to five dosimeters or one linear array
- Accurate, non-shielding
- Brachytherapy, IMRT
- Radiosurgery, TBI (total body irradiation), diagnostic x-ray
- Reader houses wireless transceiver
- Bluetooth® technology
- IMRT QA and phantom work
- Brachytherapy
- IGRT/tomotherapy
- Intracavitary measurement

37-105 mobileMOSFET Dose Verification System takes MOSFET Dosimetry to the next level. The mobileMOSFET is a portable, easy-to-use, seamlessly-integrated system that simplifies dosimetry and minimizes QA time, making it ideal for a busy radiotherapy center. For example, one Reader Module can be easily shared between multiple treatment rooms (with LAN connections and additional transceivers).

This new wireless system is entirely software driven, allowing for remote control of one or more systems from a PC. The system consists of Remote Monitoring Dose Verification Software, wall-mounted Bluetooth Wireless Transceiver, and a small Reader Module that acts as a channel between the MOSFET and software and provides a final dose report for patient records. Up to five MOSFETs or one Linear 5ive Array can be plugged into one module. This provides easy mobility within the treatment room. The PC is online with the Reader Module and dose is obtained in real-time.

Specifications

MOSFET Sensitivity	
Under full build-up	1 mV/cGy on standard bias
	2.7 mV/cGy on high sensitivity bias (Higher sensitivities available)
Under x-ray energies	9 mV/R on high sensitivity bias

Dose	Bias supply	
	Standard	High
200 cGy	< 2 %	< 0.8 %
100 cGy	< 3 %	< 1.2 %
20 cGy	< 8 %	< 3 %

System dose-to-dose reproducibility at 1σ

37-105

mobileMOSFET Wireless Dose Verification System

FLUKE® Biomedical

Specifications

Software
Interactive, 2-way on-line communication between a PC and the reader module
Dose obtained in real time
Able to perform all dose data measurements with a few mouse clicks
Calibration feature enables quick and easy calibration of the MOSFETs
Capability to assign Calibration Factors, Correction Factors and Target Dose to each MOSFET
Final dose and percent deviation from target are automatically calculated
Export to MS Excel and MS Word
Set interval read times to sample multiple doses during treatment (automatic or manual control)
With multiple systems and transceivers, one PC can read MOSFETs in multiple treatment rooms simultaneously
Patient records can be saved, imported, and printed
Final dose report provided

Hardware
Wireless transceiver: Bluetooth transceiver (wall mounted)
Reader module: Small size (17.8 cm x 15.9 cm x 4.2 cm)
Wireless (up to 10 m), portable and mobile
Contains reader, Bluetooth transceiver, dual bias supply settings (high and standard), ports for 5 MOSFETs and 1 linear array
One reader module can be used for 1 to 5 MOSFETs or one linear array
Battery operated (rechargeable; > 20 hours of typical use)
Built-in smart charger (< 3 hours)
Up to 40 MOSFETs can be read on-line with additional systems and transceivers
Portability between multiple treatment rooms

The MOSFET dosimeter
One dosimeter/ calibration factor for all photon and electron modalities
Isotropic (± 2 % for 360°)
Active region of 0.2 mm x 0.2 mm
Permits pinpoint measurement without patient shielding
Dose-rate and temperature independent
Unobtrusive in procedures
Lightweight and flexible
Multiple dosimeter capability with one reader
Standard MOSFET is 2 mm wide
microMOSFET is 1 mm wide
Linear 5ive Array: 5 dose points on one flex

Included accessories

37-105-1000 Wireless Transceiver Bluetooth wall mount
37-105-2000 Cable, RS-232, 15 m (50 ft)
37-105-3000 Software License for mobileMOSFET Remote Monitoring Dose Verification
37-100-1005 MOSFET Dosimeters with Radiopaque Marker, package of five

Ordering information

37-105 mobileMOSFET Wireless Dose Verification System
37-105-LA5 mobileMOSFET Wireless Dose Verification System with Linear 5ive MOSFET Array

Optional accessories

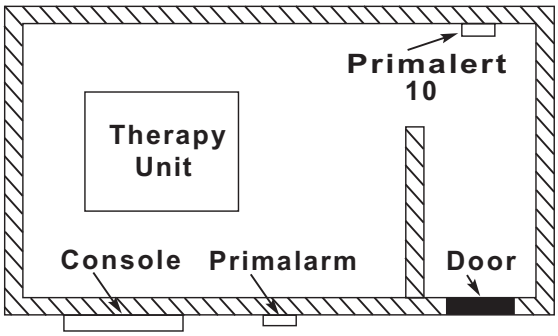
37-100-1003 MOSFET Dosimeters with Reinforcement, package of five
37-100-1004 MOSFET Dosimeters with Reinforcement, package of two
37-100-1005 MOSFET Dosimeters with Radiopaque Marker, package of five
37-100-1006 MOSFET Dosimeters with Radiopaque Marker, package of two
37-102-1003 High Sensitivity MOSFET Dosimeters with Reinforcement, package of five
37-102-1004 High Sensitivity MOSFET Dosimeters with Reinforcement, package of two
37-102-1005 High Sensitivity MOSFET Dosimeters with Radiopaque Marker, package of five
37-102-1006 High Sensitivity MOSFET Dosimeters with Radiopaque Marker, package of two
37-103-1003 microMOSFET Dosimeters with Reinforcement, package of five
37-103-1004 microMOSFET Dosimeters with Reinforcement, package of two
37-103-1005 microMOSFET Dosimeters with Radiopaque Marker, package of five
37-103-1006 microMOSFET Dosimeters with Radiopaque Marker, package of two
37-103-1007 MOSFET Dosimeters (5 pack) – customized with 10 ft cables
37-104-1003 High Sensitivity microMOSFET Dosimeters with Reinforcement, package of five
37-104-1004 High Sensitivity microMOSFET Dosimeters with Reinforcement, package of two
37-104-1005 High Sensitivity microMOSFET Dosimeters with Radiopaque Marker, package of five
37-104-1006 High Sensitivity microMOSFET Dosimeters with Radiopaque Marker, package of two
37-105-1000 Wireless Transceiver Blue Tooth wall mount
37-105-1001 (LAN) Local Area Network adapter for the 37-105-100
37-105-1002 LAN and Blue Tooth Wireless Transceiver Package
37-100-3012 Build-up Cap, 1 cm, package of one
37-100-3002 Build-up Cap, 1 cm, package of five
37-100-3009 Build-up Cap, 1.5 cm, package of one
37-100-3004 Build-up Cap, 1.5 cm, package of five
37-100-3011 Build-up Cap, 2 cm, package of one
37-100-3006 Build-up Cap, 2 cm, package of five
37-100-3007 Build-up Caps, 3 pack: 1, 1.5 and 2 cm
37-100-4000 XWU-IMRT Phantom, for a minimum of 9 dose points and film (only to be used with the MOSFET System)
37-105-4000 Linear 5ive MOSFET Array (5 MOSFETS on one flex array)

05-433

PRIMALERT® 10
Teletherapy Radiation Monitor

FLUKE® Biomedical

The 05-433 PRIMALERT® 10 Teletherapy Radiation Monitor is a compact monitor that responds to scatter radiation and can be mounted anywhere in the treatment room. A pair of bright red lamps on the instrument face flash a warning when the source is exposed, and continues until safe conditions are re-established. The flashing green Operation Indicator light indicates continuous monitoring of background radiation and provides visible indication that the instrument is functioning. PRIMALERT® 10 comes with a self-stick wall-mounting bracket and an ac adaptor/power converter.



Key features

- Flashing lights indicate source is exposed
- Line-operated
- Optimized for use with Primapak II Backup Battery Pack

Specifications

05-433 PRIMALERT® 10 Teletherapy Radiation Monitor	
Detector	Energy-compensated GM tube
Accuracy	± 20 % from 60 keV to 2 MeV
Alarm trip level	Switch-selectable at 2.5 or 20 mR/hr
Alarm	Two flashing red lamps with a 180° field of view. Alarm ceases when radiation falls below trip level
Power requirements	Line-operated with UL-listed converter (105 to 125 V ac, 60 Hz to 12 V dc). Also can be powered by Primapak II
Dimensions (HxWxT)	15.24 cm x 8.89 cm x 3.81 cm (6 in x 3.5 in x 1.5 in)
Weight	0.91 kg (2 lb)
05-434 PRIMALARM™ Remote Alarm	
Alarm trip level	Controlled by PRIMALERT 10
Alarms	Two flashing red lamps with a 180° field of view. The aural alarm is switch-selectable.
Power requirements	Line-operated with UL-listed converter. Also can be powered by PRIMAPAK II (05-441). 220 V with optional converter
Dimensions (HxWxT)	15.24 cm x 8.89 cm x 3.81 cm (6 in x 3.5 in x 1.5 in)
Weight	0.45 kg (1 lb)
05-441 PRIMAPAK II Backup Battery Pack	
Dimensions (HxWxT)	15.24 cm x 11.43 cm x 7 cm (6 in x 4.5 in x 2.75 in)
Weight	1.8 kg (4.5 lb)

Optional accessories

62-103 Check Source, 137Cs, 10 µCi. Flat Disc, 1 inch diameter
05-441 Primapak II Backup Battery Pack, 110 V
05-434 Primalarm Remote Alarm

Available ac adapters for 05-441 (specify with order)
14-102 110 V ac, 12 V dc 500 mA, USA, Japan
14-103 230 V ac, 12 V dc 500 mA, Europe
14-104 230 V ac, 12 V dc 580 mA, UK
14-105 230 V ac, 12 V dc 580 mA, Australia

Available ac adapters for 05-434 (specify with order)
14-314 110 V ac 12 V dc, 500 mA, USA, Japan
14-400 230 V ac 12 V dc, 500 mA, Europe
14-417 230 V ac 12 V dc, 580 mA, UK
14-436 230 V ac 12 V dc, 580 mA Australia

Ordering information

05-433 PRIMALERT 10 Teletherapy Radiation Monitor

Available ac adapters for 05-433 (specify with order)
14-314 110 V ac, 12 V dc 500 mA, USA, Japan
14-400 230 V ac, 12 V dc 500 mA, Europe
14-417 230 V ac, 12 V dc 580 mA, UK
14-436 230 V ac, 12 V dc 580 mA, Australia

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FLUKE®
Biomedical

37-731

Precision Iscentric QC Beam-Checker II

This precision quality-control tool is ideal for daily, weekly and monthly assessments of all mechanical and geometrical parameters of linear accelerators or teletherapy units.

The Precision Isocentric Beam Checker II consists of a large opaque acrylic screen backed by a secondary plate, both supported by two uprights. The screen is inscribed with lines precisely defining the corners, edges and center of the screen's 10 cm x 10 cm and 20 cm x 20 cm fields. Intersecting center lines are inscribed with short lines spaced 1 cm apart. The screen can rotate about its axis in increments of 45°. Tungsten markers of 2 mm in diameter are embedded in the center and corners of the fields.

A 10 in x 12 in ready-pack film can be sandwiched between the two plates. When exposed, the tungsten markers project a sharp image on the film, thus eliminating the inaccuracy and need to prick holes into the film.

The device's acrylic base-plate has an attached bubble level and non-slip leveling legs that allow it to be quickly and conveniently set up for use.

Key features

For checks of:

- Radiation and light-field congruence
- Collimator isocentricity
- Collimator field-size accuracy
- Gantry isocentricity
- Table isocentricity
- ODI accuracy
- Isocenter rotational stability
- Laser alignments

Specifications

Material	White and clear acrylics
Markers	Tungsten spheres; 2 mm Ø
Screen dimensions	30.5 cm x 30.5 cm (12 in x 12 in)
Overall dimensions (WxDxH)	15.2 cm x 45.7 cm x 33 cm (6 in x 18 in x 13 in)
Weight	2.7 kg (6.1 lb)

Ordering information

37-731 Precision Isocentric QC Beam-Checker II

FLUKE®
Biomedical

37-001

TEL-ALIGN™ Teletherapy Alignment Gauge*

Accuracy begins with beam alignment. It is impossible to deliver the carefully-calculated plan if the beam position is not verified. TEL-ALIGN verifies the coincidence of the light and radiation fields and checks the isocenter variation and the optical back pointer when the gantry is rotated ± 90°.

TEL-ALIGN consists of a rectangular plastic base with a removable vertical scale. The top surface of the base contains lead markers that form a square (10 cm x 10 cm) for visualization on film. A crosshair in the center of the square lines up with two additional sets of crosshairs, one on each outer edge of the base.

The vertical scale is placed on the base to check the optical distance indicator, or a film can be placed under the base to check the light field versus the radiation field. By rotating the gantry angle at ± 90°, the isocenter variation and optical back pointer are also checked. If adjustment of machine geometry is needed, it can be done quickly and easily, with the TEL-ALIGN Teletherapy Alignment Gauge in place.

Key features

Permits checks of:

- Optical distance indicator (over a 15 cm range)
- Collimator and central crosshair
- Head rotation and pitch
- Isocenter variation
- Side lights and optical back pointer
- Light field vs. radiation field

Specifications

Dimensions (WxDxH)	Base: 14 cm x 18 cm x 2 cm (5.51 in x 7.09 in x 0.79 in)
	Vertical scale: 18 cm (7.09 in)
Weight	0.91 kg (2 lb)

Ordering information

37-001 TEL-ALIGN Teletherapy Alignment Gauge

* Designed and developed by the Medical Physics Department, Memorial Sloan Kettering Hospital, New York, NY 10021.

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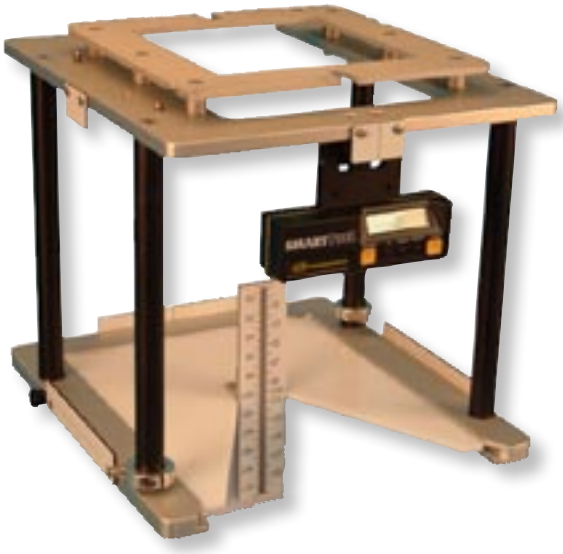
FLUKE®
Biomedical

37-013

GARD™ (Geometric Accuracy Radiotherapy Device)



The GARD* (geometric accuracy radiotherapy device) is designed to fit into the shadow tray of the therapy machine, providing a fixed reference point for all measurements. This helps to eliminate errors associated with using independent devices for each geometric parameter.

The GARD very precisely measures gantry and collimator angle indicators; light and radiation field coincidence; optical distance indicator and laser alignment.

Key features

- Geometric accuracy reproducibility device
- Designed to verify geometric accuracy of linear accelerators and simulators
- Provides quick visual verifications
- Helps eliminate errors
- Custom manufactured to fit any machine

Specifications

Goniometer accuracy/ resolution	0.1°
Optical distance indicator resolution	1.0 mm
Field size indicators	5 cm x 5 cm, 10 cm x 10 cm, 15 cm x 15 cm, 20 cm x 20 cm
Dimensions (WxDxH)	13.5 cm x 13.5 cm x 14.5 cm
Weight	4.3 kg (9.5 lb)

Alignment Tool	
Optical distances	5 cm steps to 40 cm
Material	White plastic w/mat finish and black dots
Ball pointer	12 inch L with 1/16 inch Ø ball
Rod clamp base	13 cm x 10 cm x 0.50 inch zinc plated steel with rubber feet
Height	43 cm (17 in)
Weight	1.8 kg (4 lb)

* Designed by A. Kalend, Ph.D., and L. Reinstein, Ph.D., State University of New York at Stony Brook.

Optional accessories

37-013-2000 Film Cassette, 8 in x 10 in
37-013-1300 Optical Distance Verification and Alignment Tool

Included accessories

One 8 x 10 inch film cassette

Ordering information

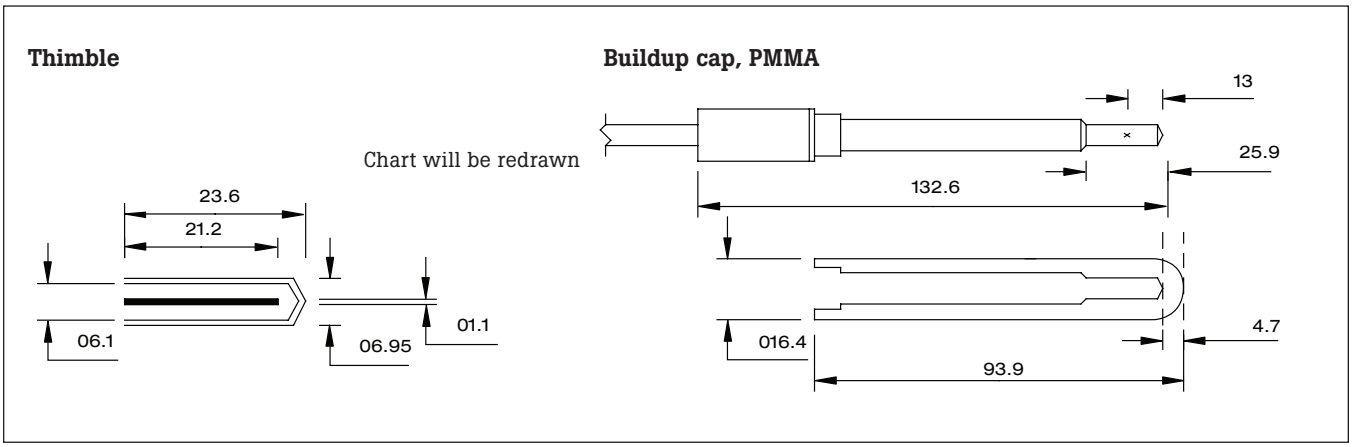
37-013 GARD. Custom-manufactured to fit the shadow tray of any therapy machine. Specify manufacturer's model number when ordering.

FLUKE®
Biomedical

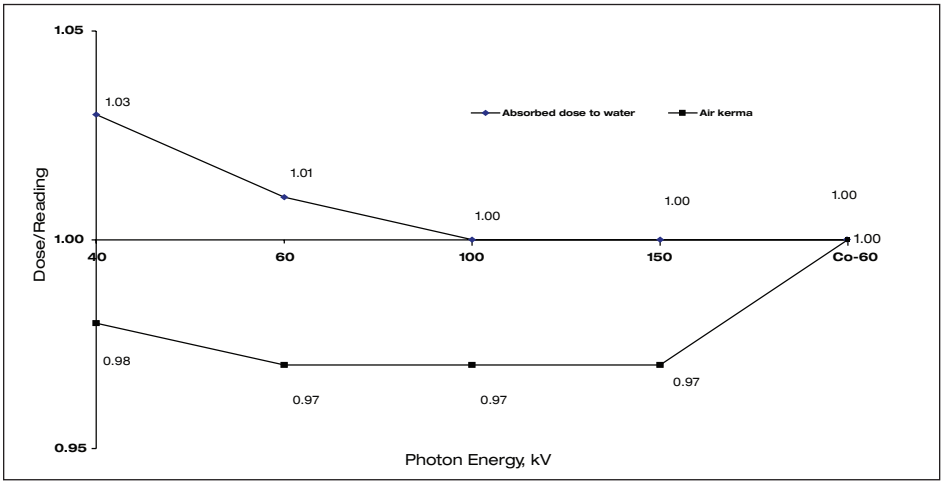
30-351

Farmer-Type Ionization Chamber, 0.6 cc³, Waterproof

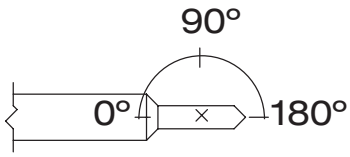
Diagram (Approximate dimensions in mm, drawing not to scale)



Energy dependence



Directional dependence



in Air												
Reading/ Dose, %	6°	12°	18°	24°	30°	60°	90°	120°	150°	162°	174°	180°
70 kV	20	48	69	81	88	99	100	100	98	96	91	88
140 kV	36	66	82	90	94	100	100	100	100	98	96	94
280 kV	57	80	90	94	96	100	100	100	100	99	98	97
Co-60	67	85	91	95	97	100	100	100	100	99	99	98

in PMMA												
Reading/ Dose, %	6°	12°	18°	24°	30°	60°	90°	120°	150°	162°	174°	180°
70 kV	78	88	96	100	101	100	100	100	100	101	102	102
140 kV	90	97	101	102	103	101	100	100	99	100	102	102
280 kV	100	102	103	103	103	101	100	100	100	101	102	102
Co-60	102	101	101	101	101	100	100	100	101	102	102	102

Included accessories

BNC Triax connector and PMMA buildup cap

Ordering information

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

Other types of triaxial cable connectors available

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FLUKE ®
Biomedical

30-344

Semiflex™ Ionization Chamber, 0.125 cc³, Wateproof

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

Key features

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

Specifications

Volume	0.125 cm^3
Response	$4 \cdot 10^{-9}$ C/Gy
Leakage	$\pm 4 \cdot 10^{-15}$ A
Polarizing voltage	Maximum 500 V
Cable length	1.3 m (4.3 ft)
Cable leakage	10^{-12} C/(Gy • cm)
Wall material	PMMA ($C_5H_8O_2$), Graphite (C)
Wall density	1.19 gm/cm^3 (PMMA), 0.82 gm/cm^3 (C)
Wall thickness	0.55 mm PMMA, 0.15 mm C
Area density	78 mg/cm^2
Electrode	Aluminum, 1.0 mm Ø, 5.0 mm long
Nominal useful range	30 keV to 50 MeV
Range of temperature	10 °C to 40 °C
Range of relative humidity	10 % to 80 %
Ion collection time	300 V 0.14 ms
	400 V 0.10 ms
	500 V 0.08 ms

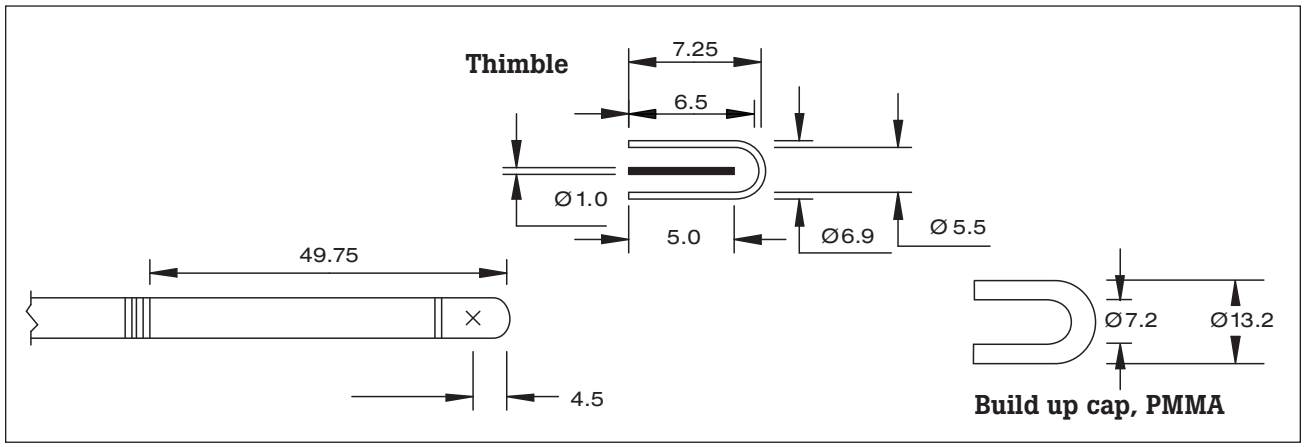
Saturation behavior	Polarizing voltage	99.0 % saturation	99.5 % saturation
Maximum dose rate at continuous irradiation	300 V	5.6 Gy/s	2.8 Gy/s
	400 V	10.0 Gy/s	5.0 Gy/s
	500 V	15.0 Gy/s	7.5 Gy/s
Maximum dose rate per irradiation pulse	300 V	0.7 mGy	0.4 mGy
	400 V	1.0 mGy	0.5 mGy
	500 V	1.2 mGy	0.6 mGy

30-344

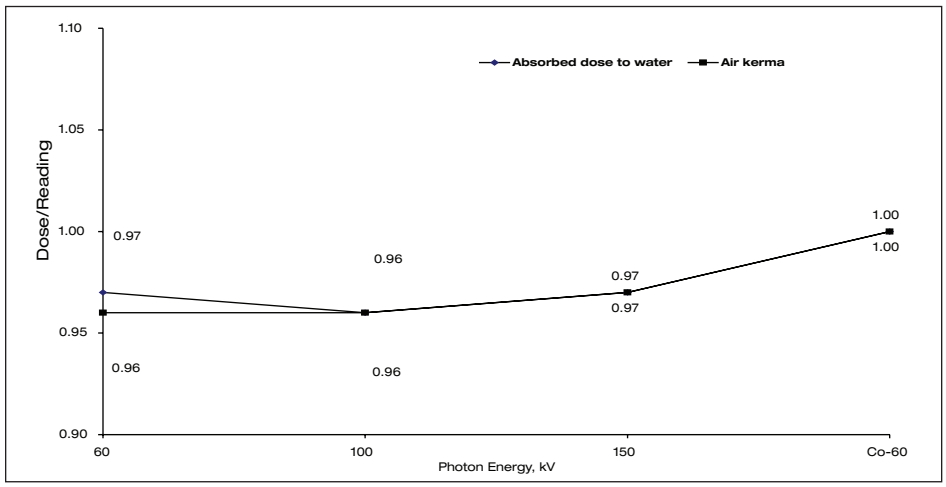
Semiflex™ Ionization Chamber, 0.125 cc³, Wateproof

FLUKE® Biomedical

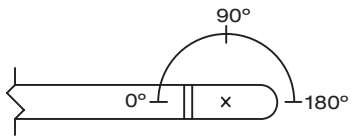
Diagram (Approximate dimensions in mm, drawing not to scale)



Energy dependence



Directional dependence



in Air												
Reading/ Dose, %	6°	12°	18°	24°	30°	60°	90°	120°	150°	162°	174°	180°
100 kV	3	20	44	67	80	97	100	99	96	95	94	93
140 kV	10	32	55	76	87	99	100	99	97	97	96	96
280 kV	33	62	78	87	93	99	100	101	101	101	100	100
Co-60	79	89	93	95	97	100	100	100	100	100	100	100

in PMMA												
Reading/ Dose, %	6°	12°	18°	24°	30°	60°	90°	120°	150°	162°	174°	180°
100 kV	56	63	71	81	88	98	100	100	100	100	100	100
140 kV	58	68	77	87	93	99	100	100	100	100	100	100
280 kV	67	83	91	95	97	99	100	101	101	101	101	100
Co-60	85	95	99	100	100	100	100	100	100	100	100	100

100 kV, 0.17 mm Cu HVL; 140 kV, 0.49 mm Cu HVL; 280 kV, 3,4 mm Cu HVL

Included accessories

BNC Triax connector, PMMA buildup cap, and 36 mm rigid stem for mounting

Ordering information

30-344 Semiflex Ionization Chamber, 0.125 cm³, Waterproof

Other types of triaxial cable connectors available

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FLUKE®
Biomedical

30-329

Markus™ Electron Ionization Chamber, 0.055 cc³, Waterproof

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

Key features

- Suitable for use in solid-state phantoms and water phantoms
- Vented measuring volume
- Fully guarded up to measuring volume
- All touchable parts fully insulated from high voltage
- Extension cables up to 100 meters in length available

Specifications

Volume	0.055 cm^3
Response	$2 \cdot 10^{-9}$ C/Gy
Leakage	$\pm 2 \cdot 10^{-16}$ A
Polarizing voltage	300 V recommended, 400 V maximum
Cable length	1.05 m (3.4 ft)
Cable leakage	$3.5 \cdot 10^{-12}$ C/(Gy • cm)
Wall material	Polyethylene CH_2
Membrane thickness	0.03 mm
Area thickness	2.5 mg/cm^2
Electrode	Acrylic, graphite coated, 5.3 mm Ø
Nominal useful range	2 to 45 MeV
Range of temperature	10 °C to 40 °C
Range of relative humidity	10 % to 80 %
Ion collection time	150 V: 0.20 ms
	300 V: 0.09 ms
	400 V: 0.07 ms

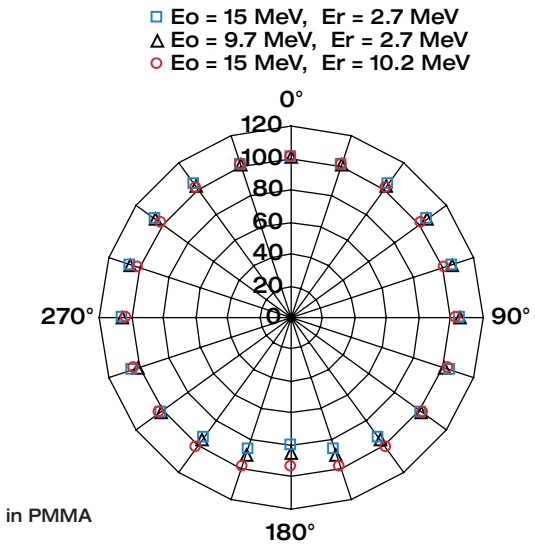
Saturation behavior	Polarizing voltage	99 % saturation	99.5 % saturation
Maximum dose rate at continuous irradiation	100 V	5.9 Gy/s	2.9 Gy/s
	200 V	24 Gy/s	12 Gy/s
	400 V	42 Gy/s	21 Gy/s
Maximum dose rate per irradiation pulse	100 V	0.7 mGy	0.4 mGy
	200 V	1.4 mGy	0.7 mGy
	400 V	1.9 mGy	0.9 mGy

30-329

Markus™ Electron Ionization Chamber, 0.055 cc³, Waterproof

FLUKE® Biomedical

Diagram dependence (The values given in the diagrams are typical for the construction)



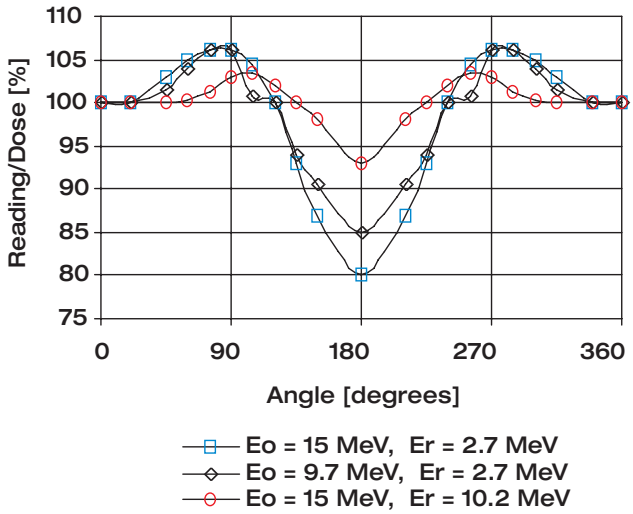
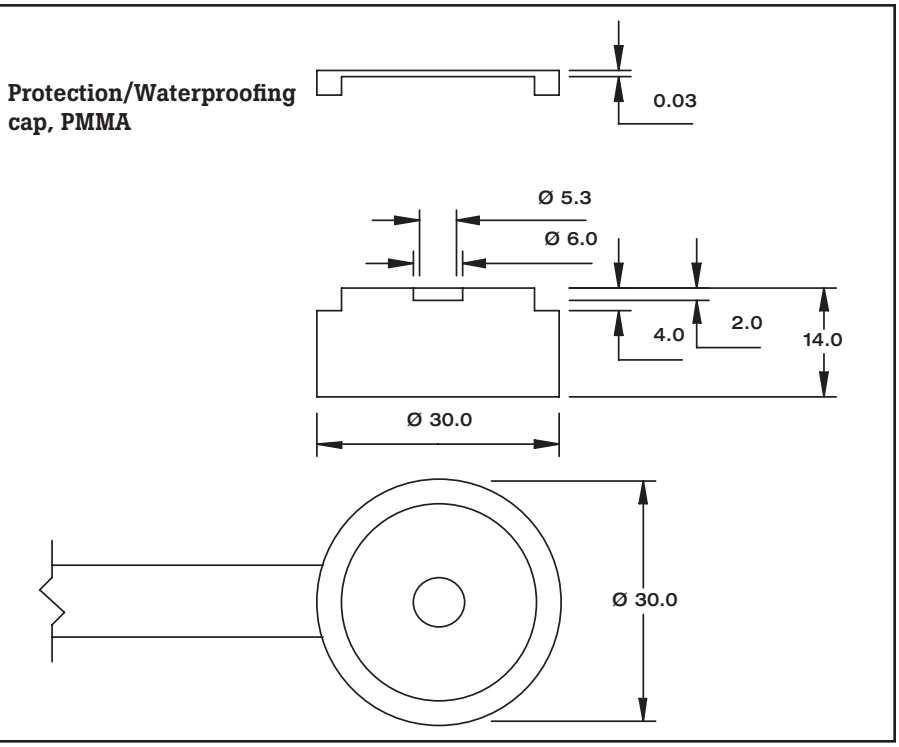


Diagram (Approximate dimensions in mm, drawing not to scale)



Included accessories
BNC Triax connector and PMMA buildup cap

Ordering information
30-329 Markus Electron Ionization Chamber, 0.055 cm³, Waterproof
Other types of triaxial cable connectors available

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FLUKE®
Biomedical

30-355

Extension Cable Reel for Ionization Chambers

The 30-355 cable reel offers a great convenience in winding and storage of extension cables. This cable reel significantly extends the life of a cable by eliminating kinks and providing protection during storage. Only as much cable as needed need be reeled out at any time. A cable reel accommodates a white extension cable up to 12 meters in length; optional grey cable also available. Either gender may be specified at the hub, depending on whether the cable reel will be kept at the electrometer (male connector at the hub) or inside the treatment room (female connector at the hub).

Key features

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

Specifications

Dimensions (Ø x h)	21.5 cm x 7.5 cm (8.5 in x 3.0 in)
Weight	1 lb to 3 lb (depending on the cable length)

Ordering information

30-355 Extension Cable Reel for Ionization Chambers

74-007, 74-008 and 74-034

IMRT Phantoms

FLUKE® Biomedical

Advanced Pelvic 3D
74-034

Homogeneous
74-008

Thorax
74-007

The IMRT (Intensity-Modulated Radiotherapy) Phantom for Film and Ion Chamber Dosimetry is designed to address the complex issues surrounding commissioning and comparison of treatment planning systems while providing a simple yet reliable method for verification of individual patient plans and delivery. The phantoms are elliptical in shape. They are a reasonable representation of human anatomy in size and proportion. The phantoms are manufactured from a unique proprietary material that faithfully mimics water within 1 % from 50 keV to 25 MeV. The phantoms also support radiographic or GAFCHROMIC® film at mid-plane in the phantom for analysis of dose distributions. Optional inserts are available to support a variety of other detectors including TLD's, MOSFET, and diodes. The surfaces of the phantoms are etched for ease of laser alignment, and CT markers ensure accurate film to plan registration.

Key features

- Check 2D or 3D dose distributions
- Point dose measurements in multiple planes
- Calibrate film with ion chamber
- Quickly verify individual patient treatment plans
- Correlate CT units to electron density

Electron density reference inserts

	Density	Electron density per cc x 10^{23}	Electron density relative to H_2O
H_2O	1.00	3.34	1.000
Lung	0.21	0.69	0.207
Bone	1.60	5.03	1.506
Muscle	1.06	3.48	1.042
Adipose	0.96	3.17	0.949
Plastic Water® —diagnostic/ therapy range	1.04	3.35	1.003

Ordering information

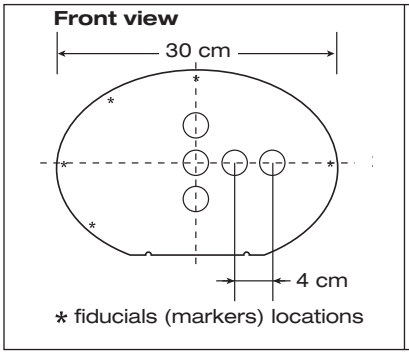
74-008 IMRT Phantom, Homogeneous
74-007 IMRT Phantom, Thorax
74-034 IMRT Phantom, Advanced Pelvic 3D

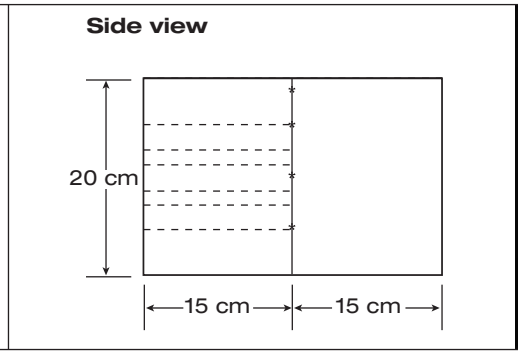
74-007, 74-008 and 74-034

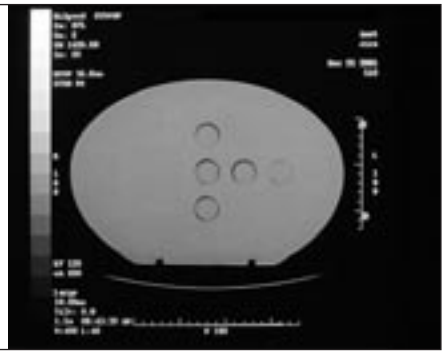
IMRT Phantoms

FLUKE® Biomedical

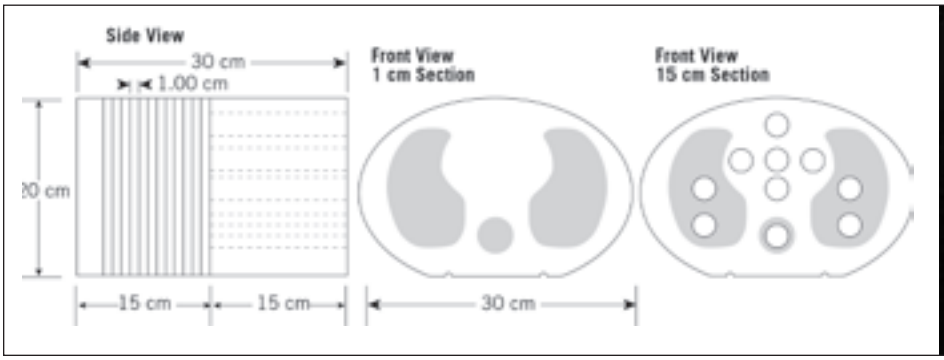
Specifications Homogeneous (74-008)

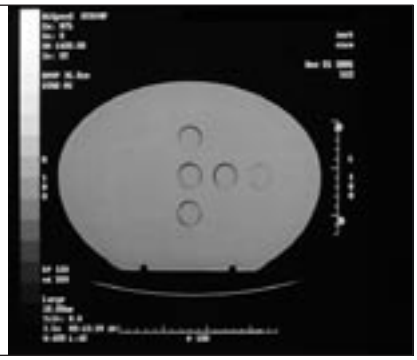




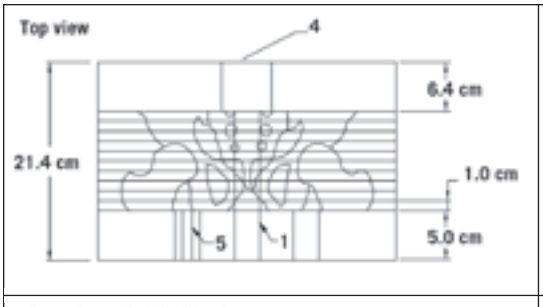


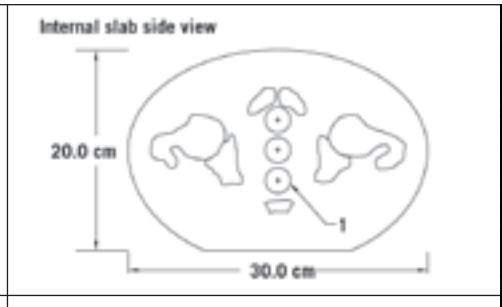
Specifications Thorax (74-007)

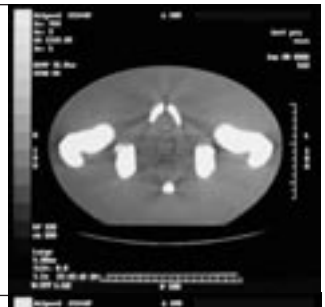


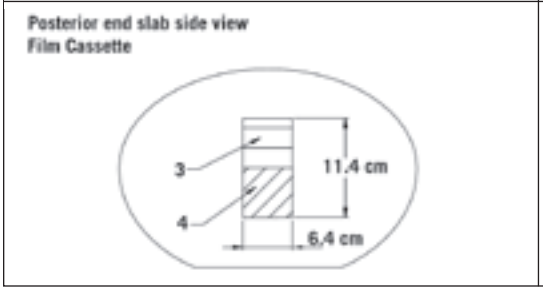


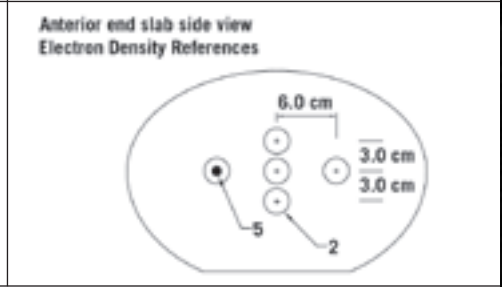
Specifications Advanced Pelvic 3D (74-034)

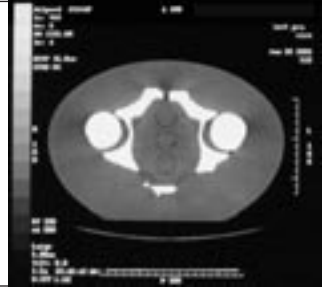












1 Holes plugged with rods (diameter 2.5 cm) **2** Holes for electron density inserts **3** Spacers
4 Film stack (cube 2.5 inches) **5** Bone core (diameter 1 cm in water background)

74-007, 74-008 and 74-034

IMRT Phantoms

FLUKE® Biomedical

Rod with ion chamber cavities

Rods with chamber cavities are included with each phantom. See specific phantom description for details. The rods are 1 inch in diameter and are 15 cm long. They are available in water, bone, or lung equivalent material. Should your chamber not be listed below, contact Fluke Biomedical for assistance. When ordering, specify part number and cavity code. (Example: 74-024-501)

Cavity code	Accommodates
501	0.6 cm^3 Farmer-type Chambers without buildup cap, PTW, Nuclear Enterprise (NE)
502	0.6 cm^3 Farmer-type chambers with buildup cap, PTW, Nuclear Enterprise (NE)
506	Capintec PR-06G with buildup cap
507	Capintec PR-06C without buildup cap
511A	Nuclear Enterprise (NE) 2533 without buildup cap
511B	PTW N31003 0.3 cm^3 without buildup cap
511C	PTW N31002 0.125 cm^3 without buildup cap
513	Exradin A-12
515	Exradin T-14 Microchamber
517	0.2 cm^3 Farmer-type Chamber without buildup cap
518	PTW 31006 without buildup cap
520	PTW 23331 without buildup cap
521	Wellhöfer IC3
522	Nuclear Enterprise (NE) 2611A without buildup cap
523	Fluke Biomedical 550-6A Ion Chamber with buildup cap (X-10)
524	Fluke Biomedical 550-6A Ion Chamber without buildup cap
525	Wellhöfer IC15 Ion Chamber without buildup cap
526	Capintec PR-06G without buildup cap
527	Wellhöfer IC70 with buildup cap
528	Exradin 14SL
531	Exradin 1SL
532	Wellhöfer CC13/IC10
533	Wellhöfer CC01

Optional accessories

74-012 Single Breast Attachment

89-002 Foam Lined Carrying Case

74-015 CT to Film Fiducial Markers

74-028 Electron Density Reference Plugs (set of 4: lung, bone, muscle, adipose)

74-013 Film Stack for Small Volume 3D Image Reconstruction

74-014 Gel Dosimetry Cassette

74-017 Homogeneous Section that accommodates 74-013 or 74-014 cassettes

74-018 Thorax Region Section that accommodates 74-013 or 74-014 cassettes

74-019 Pelvic Region Section that accommodates 74-013 or 74-014 cassettes

74-020 Bone Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

74-022 Lung Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

74-024 Water Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

74-011 Water Equivalent Rod Inserts (5 cm) for TLD's (set of 5)

74-016 Holding Device

74-010 Alignment Device

Custom accessories are available for diodes, MOSFET, and other detectors. Contact Fluke Biomedical for more information.

Ordering information

Homogeneous includes (74-008)

(2) Tissue Equivalent Sections, one drilled to accommodate rod inserts, 15 cm thick

(5) **74-015** CT to Film Fiducial Markers

(5) Water Equivalent Rod Inserts, 15 cm long

(1) **74-024** Water Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

(1) **74-010** Alignment Device

(1) **74-016** Holding Device

Thorax includes (74-007)

(1) Thorax Region Section drilled to accommodate rod inserts, 15 cm thick

(12) Thorax Region Sections, 1 cm thick

(1) End Section, approx. 2 cm thick

(1) **74-024** Water Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

(1) **74-010** Alignment Device

(1) **74-016** Holding Device

(1) **74-020** Bone Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

(1) **74-022** Lung Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

(5) Water Equivalent Rod Inserts, 15 cm long

(1) Bone Equivalent Rod Insert, 15 cm long

(4) Lung Equivalent Rod Inserts, 15 cm long

Advanced Pelvic 3D includes (74-034)

(1) Tissue Equivalent Electron Density Reference Section with interchangeable inserts, 5 cm thick

(10) Contiguous 3D Pelvic Sections each drilled to accommodate rod inserts, 1 cm thick

(1) **74-017** Homogeneous Section that accommodates 74-013 or 74-014 cassettes

(1) **74-024** Water Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long

(5) Water Equivalent Rod Inserts, 2.5 cm Ø x 5 cm long

(1) **74-010** Alignment Device

(1) **74-016** Holding Device

(4) Electron Density Reference Plugs (set of 4: lung, bone, muscle, adipose)

(1) Section for Electron Density Reference plugs, 5 cm thick

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Biomedical

74-001

IMRT Phantom Head and Neck

The 74-001 IMRT phantom is designed to address the complex issues surrounding commissioning and comparison of treatment planning systems and verification of individual patient plans and delivery.

The phantom is circular in shape, approximates the size of an average patient, and is manufactured from unique proprietary materials that faithfully mimic bone and water within 1 % from 50 keV to 25 MeV. This enables thorough analysis of both the treatment planning and delivery systems.

Tissue-equivalent interchangeable rod inserts for ionization chambers allow for point-dose measurements in multiple planes in the phantom and film calibration. The phantom also supports film dosimetry with not only standard radiographic films but also GAFCHROMIC® media. Optional inserts are available to support a variety of other detectors including TLD's, MOSFET, and diodes.

The 74-001 accommodates one Ready Pack 10 in x 12 in film in transverse orientation, two radiochromic or radiographic 10 cm x 10 cm films in transverse orientation and/or a stack or thirteen radiochromic pre-cut to 63.5 mm x 63.5 mm in three different orientations.

The 74-001 includes five different Electron Density reference plugs that can be interchanged in five separate locations within the phantom. The surface of the phantom is etched with grooves to ensure proper orientation of the CT slices and accurate film to plan registration. An optional cranial bone ring is also available.

Key features

- Verify heterogeneity corrections
- Correlate CT units to electron density
- Check dose distributions in sensitive areas
- Check depth doses and absolute dose
- Measure 2D and 3D isodoses
- Verify individual patient treatment plans
- Calibrate film with ion chamber

Electron density reference inserts

	Density	Electron density per cc x 10^{23}	Electron density relative to H_2O
H_2O	1.00	3.34	1.000
Lung	0.21	0.69	0.207
Bone	1.60	5.03	1.506
Muscle	1.06	3.48	1.042
Adipose	0.96	3.17	0.949
Plastic Water® – diagnostic/ therapy range	1.04	3.35	1.003

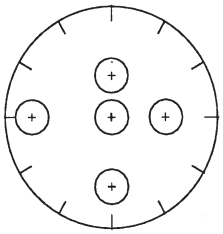
74-001

IMRT Phantom Head and Neck

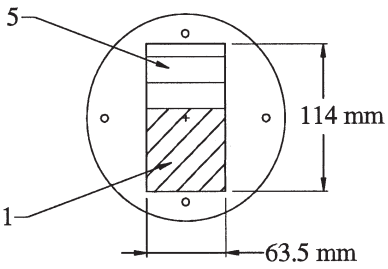
FLUKE® Biomedical

Specifications

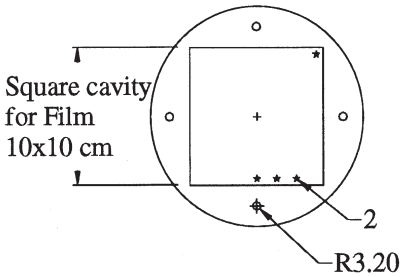
Phantom front view



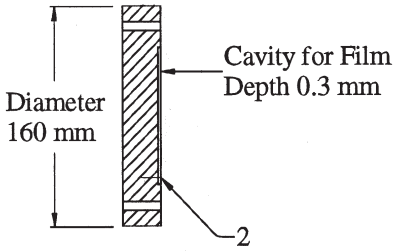
Cavity slab front view



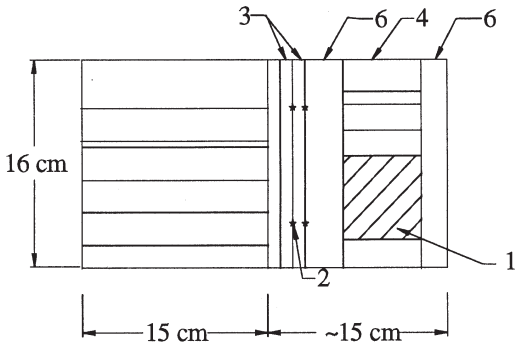
Film dosimetry slab front view



Side view



Phomtom side view



1 Film stack or gel cassette **2** Fiducial markers **3** Two 1 cm slabs for film dosimetry
4 Cavity slab **5** 1 and 2 cm spacers for film stack positioning **6** 2 and 1 cm spacer slabs

Optional accessories

74-011 Water Equivalent Rod Inserts (5 cm) for TLD's (set of 5)
74-014 Gel Dosimetry Cassette
74-028 Electron Density Reference Plugs (set of 4: lung, bone, muscle, adipose)

Included accessories

(1) Water Equivalent Homogeneous Section drilled to accommodate rod inserts, 15 cm thick
(1) Cavity Slab to accommodate Film Stack or Gel Cassette, 6.4 cm
(2) Film Slabs, 1 cm, Film Cavity 10 x 10 cm
(1) **74-013** Film Stack for Small Volume 3-D Image Reconstruction
(2) **74-015** CT to Film Fiducial Markers in Film Slabs
(2 Spacer Slabs, 1 cm
(1) Spacer Slab, 2 cm
(1) **74-020** Bone Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long
(1) **74-024** Water Equivalent Rod Insert with Ion Chamber Cavity, 15 cm long
(2) End Slabs
(5) Water Equivalent Rod Inserts, 15 cm long
(1) Bone Equivalent Rod Insert, 15 cm long
(1) **74-010** Alignment Device
(1) **74-016** Holding Device

Rod with ion chamber cavities
See page 40 for ordering details.

Ordering information

74-001 IMRT Phantom; Head and Neck

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76-417

CT Simulation Phantom

A CT simulator consists of a dedicated, fast CT scanner (often a spiral scanner), a virtual simulator (a set of computer software), and a laser marking device to mark the center of target volume. Therefore, methods of designing and implementing quality control procedures must include quality control on each segment of the process.

Quality control of a virtual simulator is a very complex issue and difficult to verify, due to the nature of software quality. Since geometrical planning is the core of CT simulation, periodic quality control is essential for maintaining optimum image quality and patient care. Hence, the quality control of a virtual simulator consists of testing every segment of the software for possible flaws. The test should include imaging parameters such as low contrast resolution and high contrast detect ability of a DRR.

Various 3D treatment planning systems can also generate DRR. Hence, the quality control of DRR generation needs to be addressed. This versatile phantom provides essential quality-control tools for geometrical 3D treatment planning systems and imaging tools for CT-simulation as well, which are capable of generating DRR for portal design.

Key features

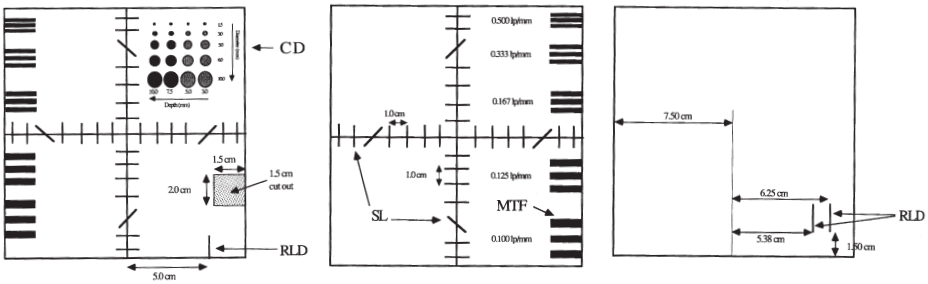
- Designed for use with spiral CT scanners and may be used with conventional scanners
- Simplifies quality control for the radiology physicist and radiation oncology physicist
- Verifies the accuracy of the digitally reconstructed radiograph (DRR) reconstruction for 3D treatment planning systems

References

1. K.P., McGee, I.J. Das, "Commissioning Acceptance Testing and Quality Assurance of a CT Simulator," in A Practical Guide to CT Simulation," L.R. Coia, T.E. Schultheiss, and G.E. Hanks, eds. (Madison, WI.: Advanced Medical Publishing, 1995), 39–50.
2. K.P., McGee, I.J. Das, C. Sims, "Evaluation of Digitally Reconstructed Radiographs (DRRs) Used for Clinical Radiotherapy: A Phantom Study," Medical Physics, 22 (1995),1815–1827.

Phantom sections

Material	Acrylic
Dimensions	15 cm x 15 cm (5.906 in x 5.906 in)
Weight	4.19 kg (9.24 lb)



Schematic representation of the phantom developed to evaluate DRRs: (a) Top face of the DRR phantom showing the contrast-detail, MTF, ray line divergence (RLD), and spatial linearity (SL) test patterns. (b) Side face of the phantom showing the MTF and SL test pattern. (c) shows the third face of the phantom containing the RLD pattern. The two lines represent the rods embedded at distances of 5.38 cm and 6.25 cm from the central axis of the phantom.

Ordering information

76-417 CT Simulation Phantom

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76-462

Electron Density Phantom

The Electron Density Phantom (76-462) is used in CT (computed tomography) treatment planning. The accuracy of radiation oncology treatment planning systems is heavily dependent upon precise CT analysis of the patient anatomy which is to be irradiated. Physicists performing treatment planning need accurate tools to evaluate CT scan data, correct for inhomogeneities and to document the relationship between CT number and tissue electron density. The Electron Density Phantom is designed to meet this requirement.

Key features

- Can be configured to simulate head or abdomen
- Manufactured from durable epoxy
- Tissue-equivalent plugs can be positioned at 17 different locations within the scan field
- Special marker plugs enable quick assessment of distance registration
- All material accurately simulates indicated tissue within the diagnostic energy range
- Includes a rugged carrying case

Specifications

	Electron density phantom components	Head insert components	Physical density	Electron density per cc x 10^{23}	Electron density relative to H_2O
Phantom head	1	1			
Phantom body (water equivalent)	1	0			
Inserts					
Syringe H_2O	1	1	1	3.34	1
Lung (inhale)	2	1	0.195	0.634	0.19
Lung (exhale)	2	1	0.495	1.632	0.489
Breast (50/50)	2	1	0.991	3.261	0.976
Dense bone, 800 mg/cc HA H_2O with 10 mm dia rod	2	1	1.609	5.052	1.512
Trabecular bone	2	1	1.161	3.73	1.117
Liver	2	1	1.071	3.516	1.052
Muscle	2	1	1.062	3.483	1.043
Adipose	2	1	0.967	3.18	0.952
Distance Marker	2	2	1.007		

Material	Epoxy resin
Weight	6.8 kg (15 lb)

Included accessories
Carrying case

Ordering information
76-462 Electron Density Phantom

Service and Calibration

World-class facility. World-class service.

Fluke Biomedical's Global Calibration Lab is NVLAP Lab Code 200566-0 accredited, adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA, and CNSC, and is traceable to national and international standards.

Fluke Biomedical offers one-stop, bulk contracts for managing larger instrument pools, including various asset-management alternatives for pools larger than 150 units. Fluke Biomedical's asset-management program takes over your grueling task of instrument tracking and allows you to use your time more productively.

If you have a large number of instruments that require service, you can greatly benefit from this quality service. Proper protocols are strictly followed, eliminating the problems with inspectors and audits that can result when other less-qualified labs perform the calibrations. Instrumentation includes Fluke Biomedical as well as other industry models.

Fluke Biomedical's Global Calibration Laboratory is equipped to calibrate and repair the following types of instruments:

- Area Monitors
- Barometers
- Blood Pressure Simulators
- Defibrillators/External Pace Maker Analyzers
- Densitometers
- Diode Detectors
- Dosimeters
- Electrical Safety Analyzers
- Incubator Analyzers
- Ion Chambers
- IV Pump Analyzers
- kVp Meters
- mAs Meters
- Electrical Multimeters
- Oscilloscopes
- Patient Simulators
- Pressure Meters/Parameter Testers
- Radiation Multimeters
- Sensitometers
- SpO2 Simulators/Analyzers
- Thermometers
- Test Lungs
- Ultra Sound Analyzers
- Velometers
- Ventilators/Gas flow Analyzers

Calibration Beam Specifications

Radionuclide Calibrations		
Radionuclide Sources	**Minimum Rate**	**Maximum Rate**
2000 Ci Cs-137	0.02 R/hr	850 R/hr
20 Ci Cs-137	0.1 mR/hr	4 R/hr
4 Ci Cs-137	0.5 mR/hr	1 R/hr
500 mCi Cs-137	0.04 mR/hr	150 mr/hr
1300 Ci Co-60	0.01 R/hr	450 R/hr
Collimated 2200 Ci Co-60	2575	3530

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Tel: 440-498-2560
Toll free: 800-850-4608 ext 2564
Email: globalcal@flukebiomedical.com

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Fax: +31 (40) 267 5436
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www.flukebiomedical.com/service

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Publications

The following Fluke Biomedical catalogs are also available

Fluke Biomedical Diagnostic Imaging QA

The Diagnostic Imaging QA catalog is a comprehensive source book of solutions for the Imaging QA Technologist, Physicist, Biomedical/Clinical Engineer, or Service Engineer. The catalog contains information about the test devices, phantoms, and accessories needed to manage diagnostic imaging QA and maintain regulatory-compliance.

For more information, contact sales@flukebiomedical.com

Fluke Biomedical Radiation Safety

The Radiation Safety catalog highlights devices used to measure radiation levels, manage regulatory QA requirements, and aide in radiation emergencies. These devices are intended for Radiation Safety Officers (RSOs), Health Physicists, Emergency Responders and other radiation-minded professionals. The catalog contains information about a variety of survey meters and probes, area monitors, and other radiation-monitoring accessories.

For more information, contact sales@flukebiomedical.com

Fluke Biomedical Test

The Biomedical Test catalog emphasizes the complete line of biomedical test and simulation products for Biomedical/Clinical Engineers and Technicians. The catalog contains information about Fluke Biomedical's test and simulation products, including standalone electrical safety testers, patient simulators, and performance analyzers, as well as fully integrated and automated performance-testing and documentation systems.

For more information, contact sales@flukebiomedical.com

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Email: sales@flukebiomedical.com
Web access: www.flukebiomedical.com

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FLUKE®

Biomedical

Radiation Safety

Product Catalog

2011

451P Pressurized µR Ion Chamber Survey Meter

190N Portable Neutron Survey Meter

ASM990 Advanced Survey Meter (ASM)

05-443 PRIMALERT® Digital Area Monitors

VICTOREEN

Featuring industry-standard Victoreen technology

Fluke Biomedical.

Better products. More choices. One company.

Radiation Safety Product Catalog

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Biomedical

Providing solutions, not just products
Today, biomeds, physicists, RSO's, other medical personnel must meet increasing regulatory pressures, higher quality standards, and rapid technological growth, while performing their work faster and more efficiently than ever. Fluke Biomedical provides a diverse range of software and hardware tools to meet today's challenges.

Service
Fluke Biomedical is dedicated to providing the best service within the healthcare industry. Equipped with the best-credentialed facilities, onsite experts, and full asset-management capabilities, Fluke Biomedical's service team is always on call to take care of its customers. Fluke Biomedical's world-class staff leads the industry in post- and pre-sale support, including helping customers choose the best products and accessories for their needs, technical support, product calibration, and repairs.

Regulatory compliance
Fluke Biomedical's benchmark quality operates to the most rigorous standards in the industry, including compliance with ISO 9001:2000, ISO 13485:2003, FDA/QSR, and NRC/ Part 50, Appendix B/Part 21 and adheres to ISO 17025:2005, ANSI Z540, Mammography MQSA and CNSC. Many of the Fluke Biomedical products are CE-marked and CSA-certified. In addition, the Global Calibration Laboratory holds its NVLAP Lab Code 200566-0 certification and is traceable to both the NIST & PTB.

Legacy
You may be familiar with some of our legacy brand names, including:

- Victoreen®
- Nuclear Associates
- Keithley
- Metron
- DNI Nevada
- Bio-Tek Instruments

Fluke Biomedical has taken the best elements and products of these former brands and have incorporated them into the Fluke Biomedical culture and product line available today.

Our newest catalog
Our Radiation Safety catalog contains a variety of survey meters and probes, area monitors, and other monitoring accessories that can help Radiation Safety Officers (RSOs), Health Physicists, Emergency Responders and other radiation-minded professionals manage diagnostic imaging QA, regulatory compliance and radiation emergencies.

If you are interested in receiving catalogs or information about any of Fluke Biomedical's other product-lines, please visit www.flukebiomedical.com/catalogs.

Catalogs are also available for the following product lines:

- Biomedical Test
- Diagnostic Imaging QA
- Radiation Oncology QA
- Service

About Fluke Biomedical

Fluke Biomedical leads the world in the manufacture of biomedical test and simulation products, including standalone electrical safety testers to fully integrated and automated performance testing and documentation systems. Fluke Biomedical also provides some of the most trusted and accurate radiation safety, medical imaging, and oncology quality-assurance solutions for regulatory compliance.

About Fluke Corporation

Fluke Biomedical is a division of Fluke Corporation. Fluke Corporation is the world leader in the manufacture, distribution, and service of electronic test tools and software and is a wholly owned subsidiary of Danaher Corporation (NYSE:DHR).

FLUKE®
Biomedical

451B

Ion Chamber Survey Meter with Beta Slide

The auto-ranging 451B measures radiation rate and accumulated dose from beta, gamma and x-ray radiation sources. The 451B's site surveying capabilities make it well suited for a wide range of end users, including: police and fire departments, x-ray manufacturers, government agencies, state inspectors, emergency response and HAZMAT teams, nuclear medicine labs, hospital radiation safety officers, and nuclear power workers.

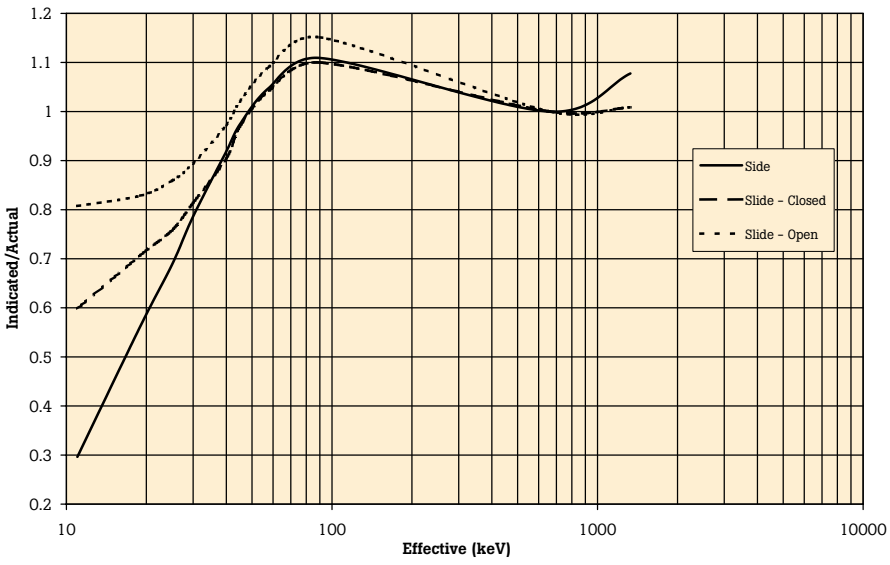
The ion-chamber detector allows for a fast response time to radiation from leakage, scatter beams and pinholes. Additionally, the low-noise chamber bias supply provides for fast background settling time. A sliding beta shield serves as an equilibrium thickness for photon measurements and enables beta discrimination.

The digital display features an analog bar graph, 2.5 digit digital readout, low battery and freeze ("peak hold") mode indicators, and an automatic backlight function. User controls consist of an ON/OFF button and a MODE button. The case is constructed of lightweight, high-strength materials and is sealed against moisture. The RS-232 interface can be connected directly to a computer for use with the Excel add-in for Windows® (451EXL), enhancing the functionality of the instrument. This software allows for data retrieval, user parameter selection and provides a virtual instrument display with audible (requires sound card) and visual alarm indication.

Key features

- High sensitivity measurement of rate and dose simultaneously, with the capability to record peak rate
- Auto-ranging and auto-zeroing
- RS-232 communications interface with optional Windows-based Excel add-in for data logging
- Ergonomic, anti-fatigue handle with replaceable grip, wrist strap and tripod mount
- Programmable flashing LCD display and audible alarm
- Easily-accessible battery door (operated by two 9-volt alkaline batteries) on the outside of the bottom case
- Available with dose equivalent energy response (SI units)
- Shoulder strap and handle which can be easily decontaminated (Nuclear Power plant specific unit)

451B typical energy dependence



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451B

Ion Chamber Survey Meter with Beta Slide

Specifications

Radiation detected	Alpha above 7.5 MeV, Beta above 100 keV, and Gamma above 7 keV	
Operating ranges		
	0 to 5 mR/h or 0 to 50 µSv/h	
	0 to 50 mR/h or 0 to 500 µSv/h	
	0 to 500 mR/h or 0 to 5 mSv/h	
	0 to 5 R/h or 0 to 50 mSv/h	
	0 to 50 R/h or 0 to 500 mSv/h	
Accuracy	Within 10 % of reading between 10 % and 100 % of full scale indication on any range, exclusive of energy response. Calibration source is ^{137}Cs.	
Detector		
Chamber	349 cc volume air ionization	
Chamber wall	246 mg/cm^2 thick phenolic	
Chamber window	6.6 mg/cm^2 mylar, protected by steel mesh, 46 cm^2 detection area	
Beta slide	440 mg/cm^2	
451B-DE-SI	In order to achieve energy response consistent with measurements of H*(10) as required by ICR4-47, aluminum has been added to the back wall, 38 % of the side wall area, and to the beta slide. With the Beta Shield open, the 451B can measure skin dose at 10*(0.07), and Deep Dose H*(10) with Beta Shield closed.	
Controls	ON/OFF and MODE	
Automatic features	Auto-zeroing, auto-ranging, and auto-backlight	
Response time	**Range**	**Response**
	0 to 5 mR/h (0 to 50 µSv/h)	8 s
	0 to 50 mR/h (0 to 500 µSv/h)	2.5 s
	0 to 500 mR/h (0 to 5 mSv/h)	2 s
	0 to 5 R/h (0 to 50 mSv/h)	2 s
	0 to 50 R/h (0 to 500 mSv/h)	2 s
Display LCD analog/digital with backlight		
Analog	100 element bar graph 6.4 cm long. Bar graph is divided into 5 major segments, each labeled with the appropriate value for the range of the instrument.	
Digital	2.5 digit display is followed by a significant zero digit depending on the operating range of the instrument. The units of measurement are indicated on the display at all times. Digits are 6.4 mm (0.25 in) high. Low battery and freeze indicators are also provided on the display.	
Modes		
Integrate mode	Operates continuously 30 seconds after the instrument has been turned on. Integration is performed even if the instrument is displaying in mR/h or R/h.	
Freeze mode	Will place a tick mark on the bar graph display to hold on the peak displayed value. The unit will continue to read and display current radiation values.	
Environmental		
Power requirements	Two 9 V alkaline, 200 hours operation	
Warm-up time	One minute	
Temperature range	-20 °C to 70 °C (-4 °F to 158 °F)	
Relative humidity	0 to 100 %, @ 60 °C	
Geotropism	Less than 1 %	
Dimensions (WxDxH)	10 cm x 20 cm x 15 cm (4 in x 8 in x 6 in)	
Weight	1.11 kg (2.5 lb)	

Optional accessories

451EXL 451 Assistant for Excel, includes RS-232 interface cable

190HPS Single Unit Carrying Case

450UCS Check Source, ^{238}Uranium, 0.064 µCi, impregnated 2 x 2 in yellow card

Ordering information

451B-RYR Ion Chamber Survey Meter with Beta Slide and standard chamber

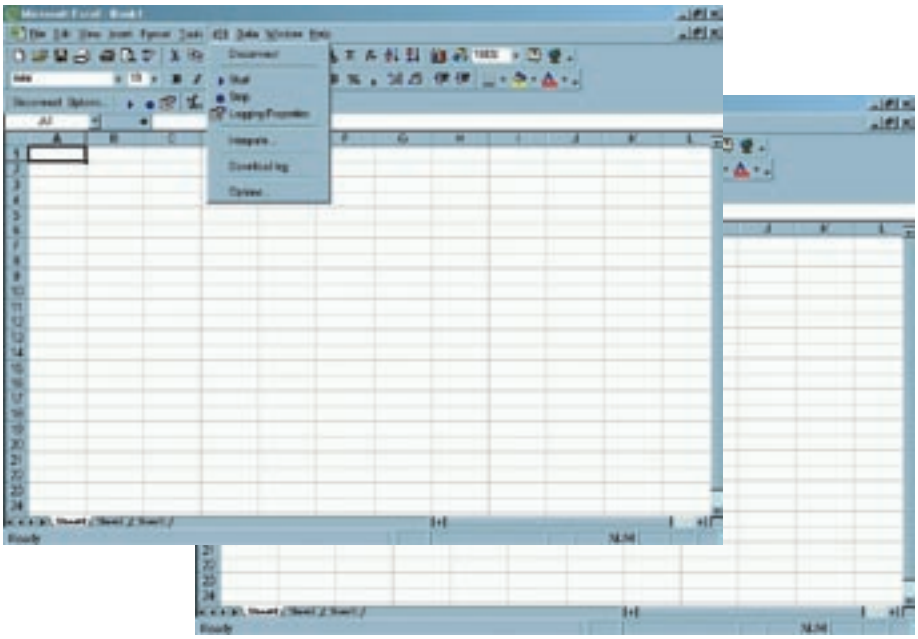
451B-DE-SI-RYR Ion Chamber Survey Meter with Beta Slide and dose equivalent chamber

451EXL

Assistant for Excel

The 451EXL provides remote control for many of the 451B and 451P functions via a Microsoft® Excel–based user interface, including real–time data logging with user–defined alarm parameters, upload of the internal data log into Excel worksheet, real–time virtual instrument display, and accumulated dose measurement over a user–defined integration period. This information management software is ideal for the facility Radiation Safety Officer or anyone responsible for maintaining a permanent record of spills and accidents for adherence to state and NRC requirements.

The 451EXL's data logging function automatically records real–time measured data into an Excel worksheet. The 451 Assistant provides user–configurable audible and visual alarms for the real–time–logged data, including the color coding of each data entry for quick identification for radiation levels and alarm acknowledgment status. This 451EXL information management software program is ideal for the facility radiation safety officer or anyone responsible for maintaining a permanent record of spills and accidents for adherence to state and NRC requirements.



Key features

- Real time data logging and uploading of 451 internal data log into protected Excel worksheet
- Virtual instrument display with user–defined audible and visual alarm indication
- Compatible with Windows® 2000 and above, and Excel 97, 2000
- Package includes manual, diskette set, and 25 ft RS–232 cable, Model 1020039000

System requirements

- Windows 2000 and above
- Microsoft Excel 97 or 2000
- One serial port (COM1 through COM4)

Ordering information

451EXL 451 Assistant for Excel

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ASM-990 Series

Advanced Survey Meter

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The ASM-990 Series Advanced Survey Meter can detect alpha, beta, gamma, or x-ray radiation within an operating range of 1 µR/hr to 1 R/hr (1 to 5,000,000 CPM), depending on the selected probe (Geiger-Mueller, neutron, proportional counter, scintillation). With the proper probe combination, this meter can be used as a general survey meter, an area monitor, a wipe-test counter, and a contamination monitor.

Designed to meet the high-technology requirements of health physics, medical physics, and nondestructive testing applications, the ASM-990 Series is well-suited for a wide range of end users, including: radiation safety officers, nuclear medicine laboratories, diagnostic x-ray and hospital emergency-room technicians, environmental-health physicists, and emergency responders.

The unit, with purchased probe, is shipped calibrated and ready-to-use and includes a MHV connector to ensure compatibility with all Fluke Biomedical probes. The 992 includes a fully-calibrated internal energy-compensated 1 R/hr GM detector. The 993 features a fully-calibrated internal pancake detector as well as an internal energy-compensated 1 R/hr GM detector.

Key features

- Simultaneous auto-scaling measurement of rate and dose with the capability to record peak rate
- Up to five different probes can be calibrated with one unit
- Data-logging survey mode feature allows user to store up to five separate survey sequences
- Saved data can be uploaded to a PC via included Infrared Data (IrDA) transmitter
- Easy-to-use multifunction keypad for intuitive menu navigation
- Backlit analog/digital LCD display with full-range audio output capability
- Barcode scanner (optional)
- Auto power-down feature extends battery life

Specifications

ASM-990 and ASM-992

Operating modes	• Rate • Integrate	• Scaler (dual option: "based on measurement" or "based on time")	• Timed Peak Hold • Data Logging
Operating rate ranges (dependent on selected probe)	**µR/hr**	**mR/hr**	**R/hr**
	µrem/hr	mrem/hr	rem/hr
	µSv/hr	mSv/hr	Sv/hr
	CPM	CPS	
	DPM ^{99m}Tc	DPS ^{131}I	
	Bq ^{125}I	kBq ^{123}I	MBq ^{201}Tl
	µCi ^{67}Ga	mCi ^{18}F	Ci ^{57}Co
	µR	**mR**	**R**
	µrem	mrem	rem
Complementary units in the integrate mode with the integrated time value in seconds	µSv	mSv	Sv
	C (counts)	kC	MC
	D (distintigrations)	kD ^{99m}Tc	MC ^{131}I
Accuracy (dependent on selected probe)	Within 10 % of reading between 10 % to 100 % of full scale indication on any range, exclusive of typical energy dependence		
Detector	Accepts GM detectors and scintillation probes operating at high voltages between 500 volts and 1300 volts		
Temperature range	-10 °C to 50 °C (14 °F to 122 °F)		
Relative humidity	0 % to 95 %, non-condensing		
Warm up time	5 second diagnostic check		
Check source	Natural uranium, mounted on the case		
Power requirements	Two "D" cells, 150 hours operation, automatically indicates when battery is low		
Housing material	Proprietary polycarbonate, splash-proof case		
Display	Liquid crystal display, 5.6 cm x 5.6 cm (2.2 in x 2.2 in)		

ASM-990 Series

Advanced Survey Meter

Data logging modes
The ASM-990 Series Log Data feature can easily be accessed via the setup sub-menu. The unit can log/save a maximum of 500 data points in any of three separate modes (manual and survey modes can utilize the optional barcode scanner.)

Manual: Individual rate data points can be saved by pressing the Start/Stop/Rst/Save button.

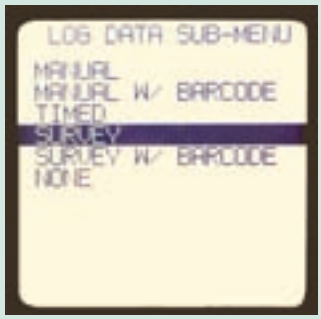
Timed: Data points automatically saved at user-selectable time intervals in the range of 1 second to 255 seconds.

Survey: Programmed sequences accessed via the menu system. Pressing the Start/Stop/Rst/Save button saves the current reading and displays the next survey location.

Programming of survey sequences, as well as retrieval of logged data, is accomplished via the built-in IrDA port.

Label names up to 20 characters can be programmed into the unit to identify the individual survey locations.

Probe connector: The unit is available with a MHV connector. The unit can be used with multiple probes (5 total) by selecting the appropriate probe from the main menu. All calibration data for each probe is stored in the unit's EEPROM.

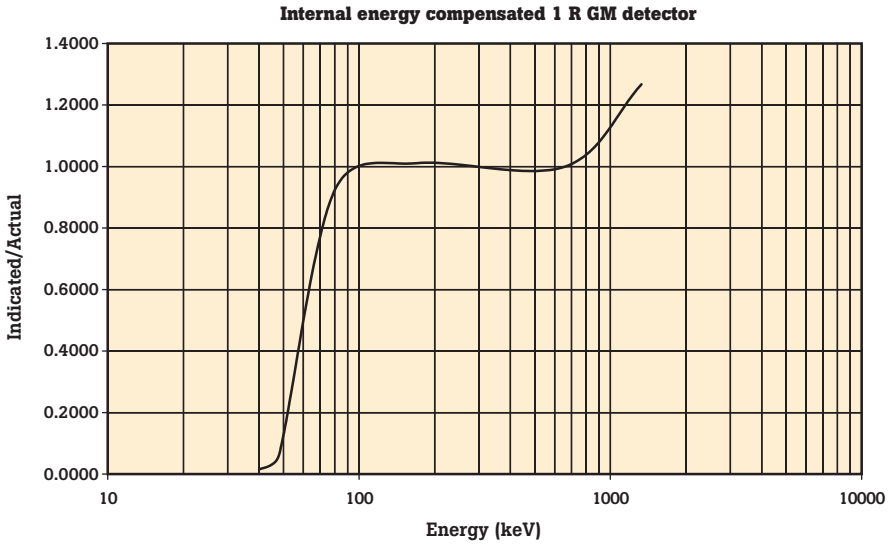


Specifications

ASM-992 and ASM-993

Range	0.1 mR/hr to 1 R/hr
Radiation detected	Gamma above 60 keV
Accuracy	± 10 % of reading between 10 % and 100 % of full scale on any range, exclusive of energy dependence
Weight (without probe)	ASM 990, 992: 0.95 kg (2.1 lb) ASM 993: 1.09 kg (2.4 lb)
Dimensions (WxDxH)	10.47 cm x 27.71 cm x 6.35 cm (4.125 in x 10.91 in x 2.5 in)

Typical energy dependence



ASM-990 Series

Advanced Survey Meter

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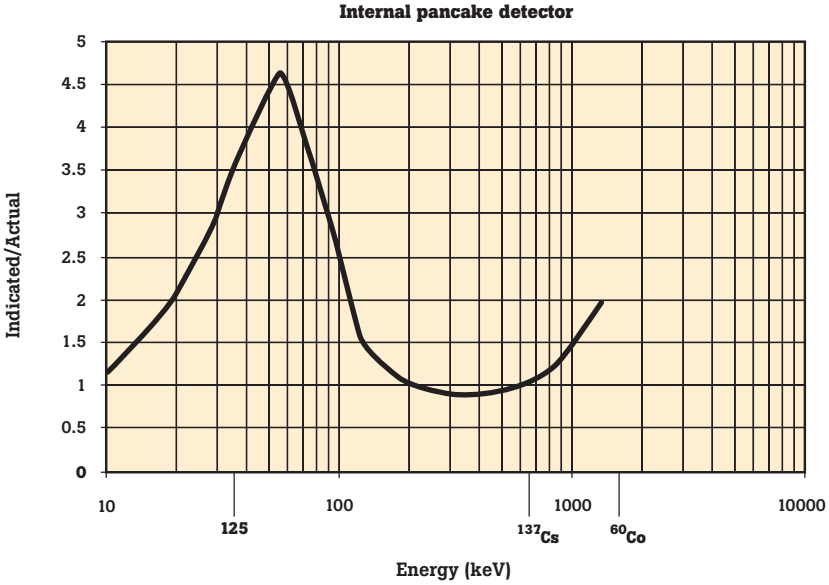
Specifications

ASM-993

Radiation detected	Alpha above 3.5 MeV, beta above 35 keV and gamma above 6 keV	
Range	Background to 80 mR/hr	
Window	15 cm^2 (1.75 in Ø) mica, 1.4 mg/cm^2 to 2.0 mg/cm^2	
Typical background	30 CPM	
Protective screen	Stainless steel, hexagonal pattern providing 86 % open area	
Accuracy	± 10 % of reading between 10 % and 100 % of full scale on any range, exclusive of energy dependence (protective cover open)	
Efficiency The internal pancake detector efficiency is shown below. In a recent performance check, the numbers shown represent typical results obtained:	**Isotope**	**%Efficiency**
	^{14}C	5 %
	^{99}Tc	12 %
	^{137}Cs	24 %
	^{90}Sr	59 %
	^{36}Cl	26 %
	^{241}Am	8 %
Note: The efficiency formula used to calculate the %Efficiency is: Eff. % = (CPM x 100)/DPM	^{129}I	2 %
	^{230}Th	15 %
	^{239}Pu	12 %

Typical energy dependence



Model comparison

Model	Advanced survey meter	Barcode reader	Internal energy compensated 1 R/hr GM detector	Internal pancake detector
990	•			
990BC	•	•		
992	•		•	
992BC	•	•	•	
993	•		•	•
993BC	•	•	•	•

Optional accessories

990-IR-USB USB Port IrDA Adapter
990CC Carrying Case
990WM Wall Mounting Bracket
990PH Probe Holder for 489-110D
990UPH Universal Probe Holder
990SH Soft-Sided Holster
990SA Shoulder Strap Assembly

Note: The shoulder strap assembly is only available for the ASM-993 and must be ordered with the instrument and factory installed.

Note: The ASM-990 Series, with the customer-selected probe is calibrated to NIST standards. The ASM-990 series with GM probe standard calibration is in R, Sv, and rems. Scintillation detectors are calibrated in counts. Radionuclide-specific efficiency calibrations are available upon request. For probe selection and calibration services, see next page.

Due to recent international airline shipping policies/restrictions, radioactive "Check Source" will not be shipped with the main unit outside US.

Ordering information

990 Advanced Survey Meter
990BC Advanced Survey Meter with barcode reader
992 Advanced Survey Meter with an internal 1 R GM detector
992BC Advanced Survey Meter with an internal 1 R GM detector and barcode reader
993 Advanced Survey Meter with an internal 1 R GM detector and internal pancake detector
993BC Advanced Survey Meter with an internal 1 R GM detector, internal pancake detector, and barcode reader

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489-200WTF

Wipe Test Fixture for Advanced Survey Meter

The Wipe Test Fixture for Advanced Survey Meter (Model 489-200WTF) uses a high efficiency NaI(Tl) scintillation probe (Model 489-200) in conjunction with a lead-shielded sample holder. It employs a removable wipe-test holder or tray positioned below the shielded probe. Under these conditions, background radiation is minimized and wipe-test counting is maximized.

Applications

The Wipe Test Fixture evolved from the need to more-accurately measure Technetium-99m (^{99m}Tc). Most users don't realize they are not accurately measuring ^{99m}Tc when using a Geiger-Mueller pancake probe. Because of an inherently poor ^{99m}Tc efficiency, Geiger-Mueller pancake probes are incapable of accurately measuring ^{99m}Tc samples in a timely fashion. In order to meet current NRC and Agreement state regulations, it is necessary to count ^{99m}Tc samples for a minimum of 30 minutes per sample. The Wipe Test Fixture is designed to precisely measure ^{99m}Tc within 30 seconds at efficiencies far surpassing those currently in use. It counts effectively in rate mode and displays in any known unit, including "dpm ^{99m}Tc" or "µCi ^{99m}Tc". When used with the ASM-990, or 992 advanced survey meters, the Wipe Test Fixture can be calibrated to various other isotopes, thereby expanding its role as a wipe-test counter.

Key features

- Effectively detects removable radioactive contamination (wipe testing)
- High ^{99m}Tc efficiency
- Direct reading capability with ASM-990 and 992 Advanced Survey Meters and isotopic calibrations
- Removable wipe test sample holder positioned below shielded probe, minimizes background radiation and maximizes wipe test counting

Specifications

Model 489-200WTF	Size: 127 x 127 x 83 mm Weight: 2.45 lb (1.11 kg) Shielding: 6 mm lead Sample tray spacing: 23 mm and 16.5 mm Sample size: 47 mm
	Efficiency: ^{99m}Tc: 22 % efficiency (4 pi), 0.0005 MDA µCi ^{131}I: 24 % efficiency (4 pi), 0.0004 MDA µCi ^{201}Tl: 25 % efficiency (4 pi), 0.0004 MDA µCi ^{89}Sr: 23 % efficiency (4 pi), 0.0004 MDA µCi ^{90}Sr: 4 % efficiency (4 pi), 0.0020 MDA µCi ^{137}Cs: 9 % efficiency (4 pi), 0.0010 MDA µCi ^{60}Co: 16 % efficiency (4 pi), 0.0006 MDA µCi ^{241}Am: 2 % efficiency (4 pi), 0.0050 MDA µCi
Probe (Model 489-200)	Type: NaI (Tl) pancake, scintillator optically coupled to PMT Radiation detected: gamma and x-ray above 25 keV, beta above 100 keV Applications: beta, gamma frisker for nuclear medicine is 10 times more sensitive than GM probe Crystal dimensions: 2 x 2 x 0.5 in (50.8 x 50.8 x 12.7 mm) Calibration tolerance: ± 10 % Weight (approx).: 0.78 lb (0.35 kg)

Ordering information

990WTF Probe Wipe test fixture
990BCWTF Probe Wipe test fixture Barcode reader
992WTF Probe Wipe test fixture
992BCWTF Probe Wipe test fixture Barcode reader Internal GM detector

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489-110D

GM Pancake Probe

CE

Designed for use in conjunction with the ASM-990 Series and other standard GM survey meters, the 489-110D can detect alpha, beta, and gamma radiation. It is configured for operating convenience in table-top and floor surveys as well as surveys of personnel and equipment. Prime applications for this probe include nuclear medicine counter tops and frisker stations, leakage detection for low energy diagnostic x-ray machines, geological and environmental surveys or any place where there exists the suspicion that some form of radiation is present, especially emergency response teams.

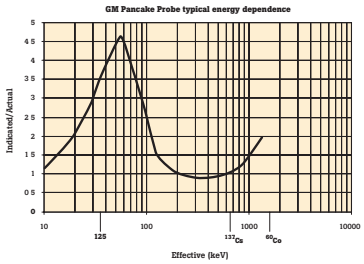
For storage and carrying ease, the probe fits into the standard handle clip on a survey meter.

The GM probe comes in two configurations: 489-110D with an ABS plastic housing, MHV connector, and foam grip, or 489-110E with a BNC connector. This selection of connectors provides the ability to attach the GM probe to most GM survey meters on the market. Replacement foam grip handles are available: 489-130-44. This same probe design is available in a rugged metal housing as 489-110C.

Key features

- All purpose GM Pancake Probe detects alpha, beta, gamma, and x-ray radiations
- High detection efficiency
- Lightweight, ergonomic design
- Detachable probe cable
- BNC or MHV connector
- Easy to decontaminate

Typical energy dependence



Efficiency

489-110D GM Pancake Probe efficiency is shown below. In a recent performance check, the numbers shown represent typical results obtained:

Isotope	%Efficiency
^{14}C	5
^{99}Tc	12
^{137}Cs	24
^{90}Sr	59
^{36}Cl	26
^{241}Am	8
^{129}I	2
^{230}Th	15
^{239}Pu	12

Note: The efficiency formula used to calculate the % Efficiency is: Eff. % = (CPM x 100)/DPM

Specifications

Detector	Halogen-quenched "Pancake" GM tube
Radiation detected	Alpha above 3.5 MeV, beta above 35 keV and gamma above 6 keV
Operating voltage	900 V; compatible with all GM survey meters
Window	15 cm^2 (1.75 in Ø) mica, 1.4 to 2 mg/cm^2 thick
Typical background	30 CPM
Sensitivity	3500 CPM/mR/hr
Protective screen	Stainless steel, hexagonal pattern providing 86 % open area
Housing material	ABS plastic housing and foam grip handle
Cable	Shielded cord; approximately 4.5 ft long MHV coaxial connector or BNC connector
Dimensions	Detector housing (WxDxH): 6.36 cm x 2.2 cm x 10.8 cm (2.50 in x 0.875 in x 4.25 in) Handle (excluding connector): 2.5 cm Ø x 16.5 cm dia. (1 in Ø x 6.25 in dia.)
Weight (pancake probe only)	0.28 kg (0.625 lb)

Replacement parts

489-130-44 Foam Grip Handle

Ordering information

489-110D GM Pancake Probe with ABS plastic housing, MHV connector, and foam grip handle

489-110E GM Pancake Probe with ABS plastic housing, BNC connector, and foam grip handle

489-110C GM Pancake Probe with metal housing, MHV connector, and foam grip handle

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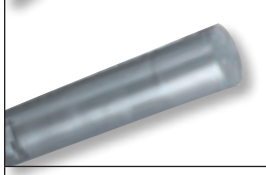
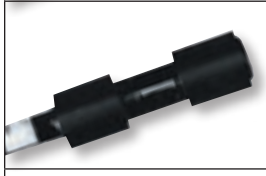
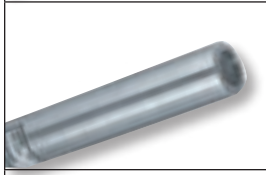
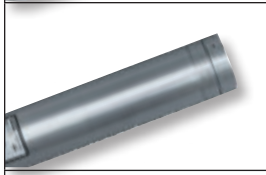
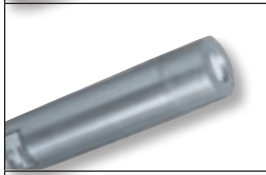
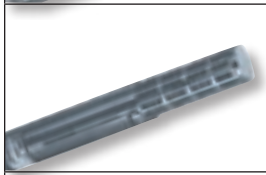
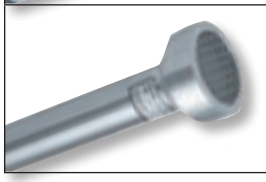
489-XXX, 90-12, 425-XXX

Geiger-Mueller and Scintillation Probe Selection Guide

Key features

- Rugged and reliable designs
- GM probes are available in pancake style, energy compensated and with beta discrimination
- Scintillators are test selected and optically coupled to photomultiplier tubes

	**489-110D GM Pancake Probe** • Alpha above 3.5 MeV • Beta above 35 keV • Gamma and x-ray > 6 keV • To 80 mR/hr (800 µSv/hr)
	**489-50 Gamma Scintillation Probe** • Gamma and x-ray > 60 keV • 1 in x 1 in, 1.5 in x 1.5 in and 2 in x 2 in NaI (Tl) detectors available
	**489-200 Scintillation Pancake Probe** • Beta above 100 keV • Gamma and x-ray > 25 keV • NaI (Tl) rectangular
	**90-12 Energy Compensated GM Probe** • Beta above 200 keV • Gamma and x-ray > 12 keV • Up to 1 R/hr (10 mSv/hr)
	**489-35 Thin End Window GM Probe** • Alpha above 4 MeV • Beta above 70 keV • Gamma and x-ray > 6 keV • Up to 80 mR/hr (800 µSv/hr)
	**489-60 Alpha Scintillation Probe** • Alpha above 4 MeV • 1.5 in Ø ZnS (Ag)
	**425-110 Low Energy Gamma Scintillation Probe** • Gamma and x-ray > 10 keV • NaI (Tl) 1 mm thick
	**491-40 Utility 1 R/hr GM Probe** • Beta above 200 keV • Gamma and x-ray > 12 keV • Up to 1 R/hr (10 mSv/hr)
	**425-200 Alpha/Beta Scintillation Probe** • Alpha above 350 keV • Beta above 14 keV • Plastic scintillator

GM probes for qualitative radiation detection—the Geiger-Mueller (GM) detectors fulfill a wide variety of radiation measurement needs for alpha, beta, gamma and x-ray sources. Some probes have are provided with a 360° shield to permit discrimination between penetrating and non-penetrating radiation.

The GM detectors have a field-proven design to ensure dependable performance, reliability and ruggedness. Standard MHV type connectors readily allow interchange of all detector probes. The life expectancy of the counters ranges from 108 total counts to unlimited life depending on the type of quench gas utilized. Enhanced sensitivity to low-level alpha, beta, gamma and x-ray radiation is achieved when using the unique 498-110D Pancake GM Probe.

The following probe selection guide lists various probes and suggested applications. Applications include nuclear medicine counter-top surveys, leakage detection from diagnostic x-ray and linear accelerators, geological surveys, scrap metal yards and unknown wells.

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489-XXX, 90-12, 425-XXX

Geiger-Mueller and Scintillation Probe Selection Guide

Scintillation probes for quantitative radiation assessment (counts/minute) – The scintillation detectors are optically coupled to photomultiplier tubes, which are then both magnetically shielded with mu-metal and specially shock-mounted to provide trouble-free performance. The entire detector, crystal and photomultiplier, are secured in a sturdy cylindrical aluminum housing. Where appropriate, a thin window has been utilized to provide alpha or low energy gamma response.

Applications outlined in this guide include nuclear medicine labs, HAZMAT spills, radiation safety office surveys, industrial hygiene, industrial x-ray manufacturing, and geological surveys.

Specifications

Scintillation probes

Model	489-50	489-55	489-120	489-60	425-110	425-200	489-200
Type	NaI (Tl) Sodium Iodide 1 x 1, scintillator optically coupled to PMT	NaI (Tl) Sodium Iodide 1.5 x 1.5, scintillator optically coupled to PMT	NaI (Tl) Sodium Iodide 2 x 2, scintillator optically coupled to PMT	ZnS (Ag) Alpha, scintillator optically coupled to PMT	NaI (Tl) Thin Scintillator for Low Energy Gamma, scintillator optically coupled to PMT	NE 102A Plastic Scintillator Flashlight Probe, scintillator optically coupled to PMT	NaI (Tl) Pancake, scintillator optically coupled to PMT
Radiation detected	Gamma and x-ray above 60 keV	Gamma and x-ray above 60 keV	Gamma and x-ray above 60 keV	Alpha above 4 MeV	Gamma and x-ray above 10 keV	Alpha above 350 keV, beta above 14 keV	Gamma and x-ray above 25 keV, beta above 100 keV
Applications	• Nuclear medicine • Industrial hygiene • Industrial x-ray manufacturing • Geological surveys • Radiation safety office		• Nuclear medicine seed finder	• Alpha detection Uranium, Plutonium • HAZMAT • RSO	• Primary probe for nuclear medicine • Low energy x-ray manufacturing • Industrial hygiene	• Alpha, beta counting of filter paper • HAZMAT spills • Nuclear medicine missing sources	• Beta, gamma frisker for nuclear medicine is 10 times more sensitive than GM probe • Environmental surveys
Typical background (CPM)	1750	5000	6000	20	200	38	3000
Nominal sensitivity	160,000 CPM/ mR/hr ^{137}Cs	350,000 CPM/ mR/hr ^{137}Cs	700,000 CPM/ mR/hr ^{137}Cs	300,000 CPM/µCi ^{241}Am	3,000,000 CPM/ µCi ^{129}I	0.0012 CPM/DPM/ 100 cm^2 ^{63}Ni	650 CPM/µR/hr ^{137}Cs
Wall material	0.04 in Al, 1 mm thick	0.04 in Al, 1 mm thick	0.04 in Al, 1 mm thick	0.04 in Al, 1 mm thick	0.04 in Al, 1 mm thick	0.04 in Al, 1 mm thick	0.04 in Al, 1 mm thick
Window	108 mg/cm^2 Al	108 mg/cm^2 Al	108 mg/cm^2 Al	3 mg/cm^2 Al Mylar	8 mg/cm^2 Al	0.25 mg/cm^2 Plastic	130 mg/cm^2 Al
Sensitive area	5 cm^2	11.4 cm^2	20 cm^2	11.4 cm^2	5 cm^2	20.3 cm^2	59.2 cm^2
Crystal dim.	2.5 cm x 2.5 cm (1 in x 1 in)	3.8 cm x 3.8 cm (1.5 in x 1.5 in)	5.1 cm x 5.1 cm (2 in x 2 in)	3.8 cm Ø (1.5 in Ø)	2.5 cm Ø (1 in Ø)	5.1 cm Ø (2 in Ø)	5.1 cm x 5.1 cm x 1.3 cm (2 in x 2 in x 0.5 in)
Probe dia.	5.1 cm (2 in)	5.1 cm (2 in)	5.7 cm (2.25 in)	5.1 cm (2 in)	5.1 cm (2 in)	6.7 cm (2.625 in)	5.7 cm x 1.8 cm (2.25 in x 0.69 in)
Probe length	22.2 cm (8.75 in)	23.2 cm (9.125 in)	24.5 cm (9.625 in)	18.4 cm (7.25 in)	20.6 cm (8.125 in)	20.3 cm (8 in)	28 cm (11 in)
Cable length	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)
Operating voltage	900 V						
Calibration	^{137}Cs 2 pts/scale to 10 mR/hr	^{137}Cs 2 pts/scale to 100 mR/hr	^{137}Cs 2 pts/scale to 10 mR/hr	Sensitivity to ^{241}Am	Sensitivity to ^{129}I	Sensitivity to ^{90}Sr, ^{99}Tc, ^{137}Cs, ^{14}C	Sensitivity to ^{99m}Tc
Cal. tolerance	± 10 %						
Efficiency	^{137}Cs 6 % ^{57}Co 9 % ^{133}Ba 6 % ^{60}Co 2 %	^{137}Cs 13 %	^{137}Cs 26 %	^{239}Pu 13 % ^{241}Am 8 %	^{90}Sr 22 % ^{36}Cl 8 % ^{241}Am 8 % ^{133}Ba 34 %	^{90}Sr 7 % ^{99}Tc 3 % ^{137}Cs 5 % ^{14}C 1 %	^{90}SR 5 % ^{137}Cs 11 % ^{133}Ba 34 % ^{60}Co 16 %
Humidity range	0 to 95 %						
Operating temp	-40 °C to + 50 °C (-40 °F to +120 °F), maximum temperature increase of 20 °F/hr						
Weight (approx.)	0.68 kg (1.5 lb)	0.68 kg (1.5 lb)	0.91 kg (2.0 lb)	0.68 kg (1.5 lb)	0.68 kg (1.5 lb)	0.35 kg (0.78 lb)	0.35 kg (0.78 lb)

489-XXX, 90-12, 425-XXX

Geiger-Mueller and Scintillation Probe Selection Guide

Specifications

Geiger-Mueller probes

Model	489-110C/D/E*	90-12	489-35	493-50	491-40	491-30
Type	Pancake alpha, beta, gamma, and x-ray with thin pancake window	Energy compensated beta, gamma, and x-ray with 360° linear movement shield for beta discrimination	Alpha, beta, gamma, and x-ray with 0.875 inch thin end window	Beta, gamma, and x-ray with sliding 360° metal shield for beta discrimination	Beta, gamma, and x-ray with sliding 360° metal shield for Beta discrimination	Beta, gamma, and x-ray with sliding 360° metal shield for beta discrimination
Radiation detected	Alpha above 3.5 MeV, beta above 35 keV, gamma and x-ray above 6 keV	Beta above 200 keV and gamma above 12 keV	Alpha above 4 MeV, beta above 70 keV, and gamma and x-ray above 6 keV	Gamma above 12 keV and beta above 200 keV	Gamma above 12 keV and beta above 200 keV	Gamma above 12 keV and beta above 200 keV
Applications	• All-purpose sensitive alpha, beta, and gamma and x-ray probe • Nuclear medicine counter tops • Detects leakage from diagnostic x-ray machines, especially mammography • Geological surveys • Scrap metal yards • HAZMAT	• Energy compensated to eliminate low energy over response • Convenient size to fit in small spaces around linear accelerators • X-ray tube manufacturers	• Ultra sensitive alpha, beta, gamma probe with directional focus • Nuclear medicine • Emergency response	• Rugged probe with beta discrimination • Scrap metal yards • Rugged to drop down wells • Nuclear medicine		• Beta, gamma probe is more sensitive than 491-40 or 493-50, but has max. rate of 100 mR/hr
Typical background (shielded)	30 CPM	15 CPM	50 CPM	15 CPM	15 CPM	20 CPM
Maximum exposure rate	80 mR/h (800 µSv/hr)	1 R/h (10 mSv/hr)	80 mR/h (800 µSv/hr)	1 R/h (10 mSv/hr)	1 R/h (10 mSv/hr)	100 mR/h (1 mSv/hr)
Nominal sensitivity to 1 mR/hr of ^{60}Co	3500 CPM	720 CPM	3900 CPM	720 CPM	720 CPM	2200 CPM
Replacement GM tube part number	P-115	35-166	489-76	35-166	35-166	35-150
Wall material	Stainless steel with mica window	Stainless steel	Stainless steel with mica window	Stainless steel	Stainless steel	Stainless steel
Wall thickness	1.5 to 2.0 mg/cm^2	40 to 60 mg/cm^2	1.4 to 2.0 mg/cm^2	40 to 60 mg/cm^2	40 to 60 mg/cm^2	30 to 40 mg/cm^2
Active length	38 mm (1.5 in Ø)	19.1 mm (0.75 in)	102 mm (4 in)	19.1 mm (0.75 in)	19.1 mm (0.75 in)	57.2 mm (2.25 in)
Quenching gas	Neon and halogen	Neon and halogen	Neon and halogen	Neon and halogen	Neon and halogen	Neon and halogen
Diameter of probe	68 mm (2.6875 in)	35 mm (1.375 in)	33.4 mm (1.3125 in)	32 mm (1.25 in)	30 mm (1.1875 in)	30 mm (1.1875 in)
Length of probe	248 mm (9.75 in)	170 mm (6.7 in)	191 mm (7.5 in)	84 mm (3.3125 in)	136 mm (5.375 in)	136 mm (5.375 in)
Cable length	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)	122 cm (48 in)
Weight (approx.)	0.45 kg (1.0 lb)	0.26 kg (0.59 lb)	0.45 kg (1.0 lb)	0.45 kg (1.0 lb)	0.45 kg (1.0 lb)	0.45 kg (1.0 lb)
Operating voltage	900 V	900 V	900 V	900 V	900 V	900 V
Humidity range	0 to 95 %	0 to 95 %	0 to 95 %	0 to 95 %	0 to 95 %	0 to 95 %
Operating temperature range	-56 °C to +85 °C (-65 °F to +185 °F)	-56 °C to +85 °C (-65 °F to +185 °F)	-56 °C to +85 °C (-65 °F to +185 °F)	-56 °C to +85 °C (-65 °F to +185 °F)	-56 °C to +85 °C (-65 °F to +185 °F)	-56 °C to +85 °C (-65 °F to +185 °F)
Pressure range	To 5 psig	To 15 psig	To 5 psig	To 15 psig	To 15 psig	To 15 psig

Ordering information

489-110D GM Pancake Probe
489-50 Gamma Scintillation Probe
489-200 Scintillation Pancake Probe
90-12 Energy Compensated GM Probe
489-35 Thin End Window GM Probe
489-60 Alpha Scintillation Probe
425-110 Low Energy Gamma Scintillation Probe
491-40 Utility 1 R/hr GM Probe
425-200 Alpha/Beta Scintillation Probe

FLUKE®
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190N

Portable Neutron Survey Meter

The self-contained 190N Portable Neutron Survey Meter measures mRem in accordance with the classical Anderson and Braun design. The neutron probe can be attached to either a 190 Survey Meter or a 190F Frisker for continuous neutron surveys or area monitoring.

This product has all the salient features of an auto-scaling digital survey meter, including data logging. Using the 190-1A Infrared Communicator, manual data-logging or automatic preset-time data-logging is accessible for data handling. Neutron Probe, RP-N, can be interfaced to the 190F Frisker, with ac power for continuous monitoring.

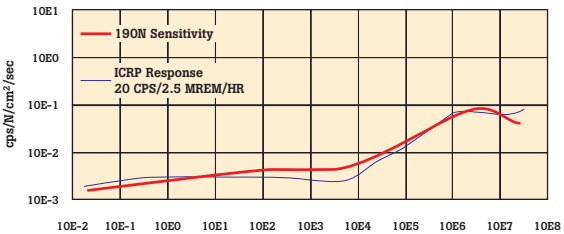
Key features

- Auto-scaling measurement of rate and dose (integrate mode includes dose and time accumulation)
- True Rem readings recorded across a wider (lower and higher) rate range
- Data logging with the 190-1A Infrared Communicator to a PC
- Ergonomic, portable design: adjustable shoulder strap and rugged handle with padded grip
- Flexible detector assembly, 190 can be removed for remote readings
- Available in SI units

Specifications

Readout	Programmable features of a standard 190 Survey Meter. Refer to the 190 data sheet for complete details.
Alarm	Audio and visual setpoint can be programmed into the 190N via the 190-1A Infrared Communicator
Logging of data	The 190-1A Infrared Communicator interfaced to a personal computer can be used to set up data logging
Detector assembly, RP-N	The detector assembly is a polyethylene cylinder, 9.5 in L x 8.5 in dia., containing a BF3 proportional counter and neutron energy compensating materials. It is based upon the standard reliable Anderson and Braun design for neutron energy response. The handle is padded for ease of gripping. An adjustable shoulder strap is provided.
BF_3 operating characteristics	The BF_3 proportional counter operates at 1150 V. Active length is 5.08 cm (2 in). Fill gas is enriched BF_3, 96 % Boron 10. Gas pressure is 20 cm Hg. Resolving time is 1 microsecond, plateau slope is 2 % per 100 V and tube life expectancy is greater than 10^{10} counts.
Typical neutron sensitivity	Nominal 2000 counts per mRem
Range	Rate: 0 µRem/h to 75 Rem/h 0 µSv/R to 0.75 Sv/h 0 CPM to 2.5 x 10^6 CPM 0 CPS to 41,660 CPS
	Integrate: 0 µRem to 1000 Rem 0 µSv to 10 Sv 0 to 10^9 counts
Gamma sensitivity/ rejection	No response in ^{137}Cs gamma radiation in fields up to 500 R/h
Accuracy	10 % of theoretical ICRP dose rate
Dimensions	31.75 Ø x 26 cm dia. (12.50 Ø x 10.25 in dia.)
Miscellaneous	Detector assembly cable length: 1.37 m (4.5 ft). An optional 9.14 m (30 ft) cable is available.
Weight	9.52 kg (21 lb) (total 190 + detector assembly)
Directionality	Less than 20 % in three orthogonal directions
Temperature range	190 operating range: -10 °C to +40 °C (14 °F to 104 °F) Detector assembly operating range: -80 °C to +80 °C (-112 °F to 176 °F)
Power requirements	Four 9 V alkaline batteries supplied, 100 hours operation
Calibration	190N is calibrated against a NIST traceable "Tissue Equivalent Proportional Counter" and uses Radium/Beryllium neutrons at a distance of 100 cm

Typical energy dependence



Ordering information

190N Portable Neutron Survey Meter

190N-SI Portable Neutron Survey Meter, SI Unit

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190F

Area Monitor/Frisker Count Rate Meter

The easy-to-use, auto-ranging 190F is compatible with GM detectors, neutron probes, proportional counters, and scintillation probes operating from 300 volts to 1,300 volts. Depending on probe selection, the 190F detects alpha, beta, gamma, x-ray or neutron radiation within an operating range of 1 µR/h to 1 R/h (1 CPM to 1,000,000 CPM). The unit is available with either an MHV or a BNC connector.

Visual indication of selected parameters, as well as measured values, are displayed on the analog/digital display.

The 190F Area Monitor/Frisker Count Rate Meter, with purchased probe, is shipped calibrated and ready-to-use.

Key features

- Auto-scaling measurement of rate and dose simultaneously
- Adjustable Alarm
- Backlit analog/digital LCD display with bar graph and operational units
- Interchangeable probe adapter module
- Data logging

Specifications

Accuracy	Within 10 % of reading between 10 % to 100 % of full scale indication on any range, exclusive of energy dependence. Accuracy is probe dependent.
Detector	Accepts GM detectors, neutron probes, scintillation probes, and proportional counters operating at high voltages between 300 V and 1300 V.
Adapter module	Contains calibration data and high voltage settings for a specified probe. The module is available with an MHV or a BNC connector. Specify the type of connector with order. **Note:** Additional adapter modules can be purchased for use with multiple probes: Specify 190060 for MHV adapter module and 190070 for BNC adapter module. By using multiple replaceable probe adaptor modules, each module can be assigned to a specific probe. The module's EEPROM stores the calibration factors for a specific probe. When plugged into a 190F Area Monitor and Count Rate Meter, it automatically sets the high voltage and activates the calibration data set for the specific probe. By using modules married to specific probes, the user has the convenience of using only one 190F with multiple probes for survey work.
Log	Logs 211 data points and sequentially labels data points. (Data retrieval requires the 190-1A Infrared Communicator). With the communicator, alphanumerics up to 16 characters can be programmed into the 190F to name the locations of individual data points to be collected. The location name is displayed when the Log button is pressed. Press the Log button again, and the data point is stored.
Power requirements	9 V dc regulated power converter
Batteries	Three 9 V batteries, 150 hours operation, automatically indicates when battery is low
Warm up time	15 second diagnostic check
Check source	Natural uranium, mounted on the case
Temperature range	-10 °C to +60 °C (14 °F to 140°F)
Relative humidity	0 to 95 %, non-condensing
Housing material	Molded ABS plastic, splash-proof case. Probe fits into side-mounted ABS plastic probe holder with Velcro® straps.
Dimensions (WxDxH)	9.2 cm x 23.4 cm x 5 cm (3.75 in x 9.2 in x 2.1 in)
Weight (without probe)	0.70 kg (1.56 lb)

Operating ranges (dependent on selected probe)

Toggles and selects rate units:

µR/hr	mR/hr	R/hr
CPM	CPS	
µSv/hr	mSv/hr	
DPM	Bq/cm²	µCi/cm²

and the complementary units in the integrate mode:

µR	mR	R
CTS	D	
µSv	mSv	
Bq	µCi	

with the integrated time value in seconds

Optional accessories

190-1A Infrared Communicator
Additional features can be activated, such as Log Mode, Alarm Setpoint, Energy Specific Calibrations, and default setting changes. Features and pushbuttons can also be locked-out to set up the 190F in a user defined mode of operation.

Note: The 190F Area Monitor and Count Rate Meter, with the customer selected probe is calibrated to NIST standards. The 190F and probe is calibrated in mR/h or µSv/h units as a standard. The end user may calibrate in additional radiation units using the 190-1A Infrared Communicator.

Ordering information

190F Area Monitor/Frisker Count Rate Meter

Due to recent international airline shipping policies/restrictions, radioactive "Check Source" will not be shipped with the main unit outside US.

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1060AM

Digital Smart Detector Area Monitor

The versatile 1060AM is designed for reliable, continuous area monitoring for gamma or x-ray sources in a medical facilities, or any other facility with radioisotope sources. Employing internal Geiger-Mueller (GM) detectors, it is available in environmental, low, medium, and high range versions, with an optional MHV interface that can accommodate a wide variety of external GM probes.

The 1060AM is suitable for stand-alone operation or in a network environment employing multiple channels, communicating via an RS485 interface to a main computer system. The optional WIN1060 PC software provides the ability to display multiple channels, to maintain both alarm and measurement history, and to access to system configuration options. An optional remote display, consisting of a visual alarm indicator and a logarithmic meter corresponding to the detector range, is available. In addition, the 1060AM provides an EMI shielded watertight National Electrical Manufacturers' Association (NEMA®) enclosure that is CE marked. The 1060AM provides two RS485 connectors to simplify connections between multiple units.

Key features

- Available in 4 operating ranges: environmental, low, medium and high
- Optional MHV interface for external probes
- Wide range of applications in NEMA 4 Enclosure
- RS485 interface for multi-drop applications
- Optional WIN1060 Windows® software monitors up to 30 channels
- Optional remote display with alarm indicator
- All versions available in SI units

Specifications

Operating range	Environmental range: 1 µR/hr to 100 µR/hr (0.01 µSv/hr to 10 µSv/hr)
	Low range: 0.01 mR/hr to 1 R/hr (0.1 µSv/hr to 10 mSv/hr)
	Medium range: 0.1 mR/hr to 10 R/hr (1 µSv/hr to 100 mSv/hr)
	High range: 1 mR/hr to 100 R/hr (10 µSv/hr to 1 Sv/hr)
Radiation detected	Gamma rays
Typical energy dependence	± 15 % from 100 keV to 1.5 MeV
High voltage	Regulated 500 V dc to 2500 V dc, < 1 mV ripple, digitally controlled with 1 V resolution, 500 microamperes at 1400 V
Input circuitry	High and low discriminator setpoints. Jam detection (anti-jam).
Power requirements	12 V dc @ 500 mA power converter
Enclosures	A plastic rectangular housing, NEMA 4 type for outdoor or indoor applications
Dimensions (LxWxH)	9.65 cm x 28.26 cm x 10.16 cm (3.8 in x 11.125 inx 4.0 in)
Mounting hole pattern	7.46 cm x 23.81 cm (2.9375 in x 9.375 in)
User interface	RS-485 supporting multi-drop applications for communications with IBM® compatible personal computer running WIN1060 applications software
Temperature range	0 °C to 50 °C (32 °F to 122 °F)
Relative humidity	5 % to 95 %, non-condensing
Shock and vibration	Mechanical shock and vibration specifications are per ANSI N42.17A, Section 8.4 and 8.5
Operating system	Real-time, interrupt driven, embedded system

Optional accessories

941060WN WIN1060 Applications Software
90-177 Converter RS-232/ RS-485 power cube, cable (US)
90-178 Converter RS-232/ RS-485 power cube, cable (Europe)
90-179 Converter RS-232/ RS-485 power cube, cable (Australia)
90-180 Converter RS-232/ RS-485 power cube, cable (UK)
External Probes (consult factory)

Custom configurations available

Ordering information

1060AM-NM-ER NEMA Enclosure, environmental range
1060DS-ER (-SI) Remote Display
1060AM-NM-LR NEMA Enclosure, low range
1060DS-LR (-SI) Remote Display
1060AM-NM-MR NEMA Enclosure, medium range
1060DS-mR (-SI) Remote Display
1060AM-NM-HR NEMA Enclosure, high range
1060DS-HR (-SI) Remote Display
1060MHV-NM External probe[1]

[1]Consult factory for external probe options

Add -SI for SI units

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FLUKE®
Biomedical

05-437

PRIMALERT® 35 Area Radiation Monitor

The PRIMALERT 35 Area Radiation Monitor contains an energy-compensated GM detector and has six range indicators (1, 2, 4, 8, 16, and 32 mR/hr) that can clearly display an increase or decrease in radiation levels. The visible and audible alarms can be set at any of the six levels by a front-panel, screwdriver-adjustable control. When each preset radiation level is exceeded, personnel are alerted by bright flashing red lights (visible over a 180° field) and a loud intermittent audio signal. The alarms stop automatically when the radiation level falls below each of the preset values. This permits instant radiation-level recognition not readily distinguishable on meter-type instruments.

Fail-safe operation is assured by a light which continuously indicates background radiation and provides visual proof that the unit is functioning. The monitor will not jam or show false readings in high radiation fields. A mounting bracket and a 110 V ac adapter/power converter are also included.

Key features

- Provides continuous visual indication of radiation levels and produces audible and/or visual alarms at any of six programmable radiation levels
- Assures reliable, continuous monitoring wherever radioactive materials are present
- Displays the radiation level in bright color-coded lights
- Optional Primalarm Remote Alarm, which functions up to 100 feet from monitor

Specifications

Power requirements	105 V to 125 V/60 Hz/8 W
Dimensions (WxHxT)	9 cm x 15 cm x 4 cm (3.5 in x 6 in x 1.5 in)
Weight	0.9 kg (2 lb)

Optional accessories

62-103 Check Source, ^{137}Cs, 10 µCi. Flat disc, 1 in diameter

Included accessories

AC adapters, specify with order
14-314 110 V ac 12 V dc 500 mA (USA, Japan)
14-400 230 V ac 12 V dc 500 mA (Europe)
14-417 230 V ac 12 V dc 580 mA (UK)
14-436 230 V ac 12 V dc 580 mA (Australia)

Ordering information

05-437 Primalert 35 Area Radiation Monitor

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FLUKE®
Biomedical

05-443 and 05-444

PRIMALERT® Digital Area Monitors

The PRIMALERT Digital Area Monitors are designed for a wide range of gamma radiation area monitoring applications. Two self-contained configurations are available, each with an internal energy compensated GM detector (detection range in parentheses): 05-443 (0.1 mR/h to 1 R/h) and 05-444 (1 mR/h to 4 R/h). Both models are ac powered with an internal battery backup, have user-settable low and high alarms, and are available with an optional remote alarm for added security.

CE

The versatile PRIMALERT Digital Area Monitors can be used in industrial applications, medical settings, or wherever there is a need to warn personnel of increasing radiation levels and/or to limit the accumulated exposure of personnel to gamma radiation.

Key features

- Simple installation and setup (calibration controls easily accessed through front panel)
- Anti-jam circuitry prevents erroneous readings at tube saturation
- LED digital display with Detector Fail indicator
- Programmable low and high alarm indicators, with an optional remote alarm available
- Data output/RS-232

Specifications

Indicated use	Radiation area monitoring
Internal GM detector range	05-443: 0.1 mR/hr to 1 R/hr; 05-444: 1 mR/hr to 4 R/hr
Display	4 digit LED display with 2 cm (0.8 in) character height; display range: 000.0 to 9999
Display units	Can be made to display in µR/hr, mR/hr, R/h, µSv/h, mSv/h, Sv/h, cpm, cps and others
Linearity	Reading within ± 10 % of true value with detector connected
Response	Typically 3 seconds from 10 % to 90 % of final reading
Status (green light)	Indicates the instrument is functioning properly
Low alarm	Indicated by a yellow light and slow beep (1 per sec) audible tone (can be set at any point from 0.0 to 9999)
High alarm	Indicated by a red light and fast beep (4 per sec) audible tone (can be set at any point from 0.0 to 9999)
Detector fail	Red light and audible tone; > 68 dB at 2 ft indicates detector overload, no count from detector, or instrument failure
Low battery (yellow)	Indicates < 2 hours of battery power remaining
Calibration controls	Accessible from front of instrument (protective cover provided)
High voltage	Adjustable from 200 V to 2500 V
Threshold	Adjustable from 2 mV to 100 mV
Dead time	Adjustable to compensate for dead time of the detector and electronics (can be read on the display)
Overload	Senses detector saturation (indicated by display reading "-OL")
Overrange	Indicates the radiation field being measured has exceeded the counting range of the instrument (indicated by display reading "----")
Data output	9 pin connector providing 5 decade log output, RS-232 output, signal ground connection, FAIL and Alarm signals (current sink), and direct connection to battery and ground
Power requirements	95 V ac to 135 V ac (178 V ac to 240 V ac available), 50 Hz to 60 Hz single phase (< 100 mA), 6 V sealed lead acid rechargeable battery (built-in)
Battery life	Typically 48 hours in non-alarm condition, 12 hours in alarm condition
Battery charger	Battery is continuously trickle charged when instrument is connected to line power and turned on
Housing material	Aluminum housing with white polyurethane enamel paint
Temperature range	-20 °C to 50 °C (-4 °F to 122 °F). May be certified for operation from -40 °C to 65 °C (-40 °F to 150 °F).
Dimensions (WxDxH)	24.6 cm x 6.4 cm x 18.7 cm (9.7 in x 2.5 in x 7.4 in)
Weight	2.3 kg (6.5 lb)

Note: audible indicators can be configured as a single beep if desired.

Ordering information

05-443 PRIMALERT Digital Area Monitor with internal energy compensated 0.1 mR/hr to 1 R/hr GM detector

05-443-2200 PRIMALERT Digital Area Monitor with internal energy compensated 1 µSv to 10 mSv/hr GM detector, 220 V ac operation

05-444 PRIMALERT Digital Area Monitor with internal energy

05-444-2200 PRIMALERT Digital Area Monitor with internal energy compensated 10 µSv to 40 mSv/hr GM detector, 220 V ac operation

05-446 Remote Display

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05-450

PRIMALERT® Digital Doorway Monitor

The highly sensitive 05-450 PRIMALERT Digital Doorway Monitor is designed to detect low levels of gamma radiation that pass through an entryway. Common installations of the 05-450 include hospital entrances, emergency rooms, laundry rooms, nuclear medicine labs and procedure rooms, waste disposal chutes and any other area of the hospital where radiation contamination could be a concern.

The system consists of a digital monitor, two shielded NaI (Tl) scintillation detectors with NEMA enclosures, associated cabling and a 10 µCi ^{137}Cs check source. The system is AC powered with internal battery backup and user-selectable alarm settings.

Key features

- Dual detectors—highly sensitive lead shielded NaI (Tl) scintillators
- Configuration with NEMA enclosures
- Fast response time with LED digital display
- Audio and visual alarms
- Battery backup

Specifications

Detectors	Two 3 in Ø x 1 in thick (7.6 cm x 2.5 cm) shielded NaI (Tl) scintillation detectors with up to 200 ft cables (NEMA 4x enclosures included)
Connectors	BNC (others available on request)
Sensitivity	Detects an unshielded 40 µCi 137Cs source at 10 ft and unshielded 10 µCi 137Cs source at 5 ft from the detector
Check source	0.875 in Ø 10 µCi ^{137}Cs check source
Display	4 digit LED display with 2 cm (0.8 in) character height
Display units	Can be made to display in µR/hr, mR/hr, R/hr, µSv/h, mSv/h, Sv/h, µrem/hr, mrem/hr, rem/hr, cpm, cps and others
Linearity	Reading within ± 10 % of true value with detector connected
Response	Typically 3 seconds from 10 % to 90 % of final reading
Status	(green light) Indicates the instrument is functioning properly
Low alarm	Indicated by a yellow light and slow beep (1 per sec) audible tone (can be set at any point from 0.0 to 9999)
High alarm	Indicated by a red light and fast beep (4 per sec) audible tone (can be set at any point from 0.0 to 9999)
Note: Audible indicators can be configured as a single beep if desired.	
Detector fail	Indicates overload, no count from detector, or instrument failure (red light and audible tone; > 68 dB at 2 ft)
Low battery	Yellow light indicates < 2 hours of battery power remaining
High voltage	Adjustable from 200 V to 2500 V
Threshold	Adjustable from 2 mV to 100 mV
Dead time	Adjustable to compensate for dead time of the detector and electronics (can be read on the display)
Overload	Senses detector saturation (indicated by display reading "-OL")
Overrange	Radiation field being measured exceeds the counting range of the instrument (indicated by display reading "----")
Data output	9 pin connector providing 5 decade log output, RS-232 output, signal ground connection, FAIL and Alarm signals (current sink), and direct connection to battery and ground
Power requirements	95 V ac to 135 V ac (178 V ac to 240 V ac available), 50 Hz to 60 Hz single phase (< 100 mA), 6 V sealed lead acid rechargeable battery (built-in)
Battery life	Typically 48 hours in non-alarm condition, 12 hours in alarm condition
Battery charger	Battery is continuously trickle-charged when instrument is connected to line power and turned on
Battery dependence	< 3 % change in readings to battery endpoint
Temperature range	-20 °C to 50 °C (-4 °F to 122 °F). May be certified for operation from -40 °C to 65 °C (-40 °F to 150 °F)
Dimensioins (WxDxH)	Electronics: 24.6 cm x 6.4 cm x 18.7 cm (9.7 in x 2.5 in x 7.4 in)
	Detectors: 43.2 cm x 21.6 cm x 33 cm (17 in x 8.5 in x 13 in)
Weight	Electronics: 2.3 kg (6.5 lb)
	Detectors: 14.5 kg (32 lb)

Ordering information

05-450 PRIMALERT Digital Doorway Monitor, Sv/hr, 220 V power

05-450-2200 PRIMALERT Digital Doorway Monitor, Sv/hr, 220 V power

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