

APPENDIX D
RADIOLOGICAL EQUIPMENT INFORMATION

instadose™

BY QUANTUM PRODUCTS



Instant. Precise. Portable.

Instadose™ from Quantum Products brings radiation monitoring into the digital age. Smaller than a flash drive, this rugged, fully accredited dosimeter provides an instant read-out when connected to any computer with internet access and a USB connection. Based on a patented direct ion storage technology, instadose devices provide radiation workers with a precise measurement of radiation dose.

Instadose comes in four fashionable colors:

- Blue
- Green
- Black
- Silver

Advantages for the Practice

A monitoring program with instadose is a cost-effective way to safeguard your practice from potential legal claims. Employees will be more likely to wear this stylish device, and you can reassure them of their safety and stay in compliance with Federal and State regulations at the same time.

Simplify the administration of your monitoring program. With instadose devices there is no need to send badges to a processing center, as these devices stay with your employees. You will spend less time managing your account with our robust online account management program and dose reading capabilities.

Advantages for the Radiation Worker

This revolutionary device provides radiation workers with complete control over when and how frequently they review their dose, with unlimited readings included for one low price. Concerns about a possible exposure can be addressed immediately, as opposed to other services which provide readings on a quarterly or monthly basis. Instadose devices can be re-read without loss of exposure data, with cumulative exposure maintained.

Instant Dose Readings

With AMP (Account Management Program), you will have easy access to up-to-the-minute exposure reports. If there is ever a concern of radiation exposure, you can log in to your secure account page and check your dose level. Devices can be read on any computer with a USB connection and internet access.

Account administrators can also manage all the elements of a radiation monitoring program with AMP. From account administration to managing individual wearers, devices, and locations, AMP provides real-time access to account details, device assignments, reports, and pertinent account information.

AMP has multiple security levels, restricting users within an account from viewing other wearers' data or changing account information. Users can only perform readings for devices assigned to them.

With AMP, administrators can:

- View current and historical exposure readings
- Perform readings for devices within the account
- View graphical representation and comparative review of user exposure readings
- Manage how frequently devices are read
- Update account information

AMP is also your source for information. Keep up-to-date on radiation monitoring articles for your industry by logging into your AMP account. Whether your industry is veterinary, dentistry, or radiology, you will be able to view and search the news that is relevant to your industry.

PRODUCT COMPARISON

	instadose	Luxel dosimeters	TLD dosimeters
Instant reading of dose	X		
Measures exposure to gamma and x-ray	X	X	X
Multiple reads	X	X	
No need to send badges in for processing	X		
No reader required	X		



APPLICATIONS

Federal and State regulations limit the amount of radiation that workers are allowed to receive. Radiation monitoring should be considered for those who work in occupations where risks may be prevalent due to exposures from X-ray equipment. Instadose is the perfect device to measure photon dose.

FEATURES

- USB compatible detector
- Measures doses as low as 1 millirem
- Instant read results
- User identity is stored on a built-in memory chip

TECHNICAL SPECIFICATIONS*

Badge name	instadose
Badge Type	1=instadose 1.0
Description	Direct Ion Storage device with USB connector
Holder Type	Whole body
Wear Location	Collar or upper torso
Minimum Reportable Dose	1 mrem (0.01 mSv)
Lower Limit of Detection	1 mrem (0.01 mSv)
Useful Dose Range	1 mrem - 500 rem (0.01 mSv - 5 Sv)
Energy Response	Photon 15 keV - 6 MeV
Accreditations/Approvals/Licenses	NVLAP

*Technical specifications subject to change.

instadose™
BY QUANTUM PRODUCTS

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FEATURES

The DMC 2000XB is an X-ray/gamma and beta detection dosimeter, featuring dose rate and programmable alarms. The DMC 2000XB is user friendly, lightweight and water resistant.

- X-ray/gamma energies: 20 keV to 6 MeV
- Beta energies 60 keV to 3.5 MeV
- Dedicated to simultaneous measurements of X-ray, gamma and beta radiations
- Small, light, ergonomic, compact and rugged
- Compliant with international standards and local rules
- Hand free communication reading system with data centralization

DMC 2000XB

Personal Electronic Dosimeter

The use of β particle emitters for radiation therapies (treatments of eye tumors, coronary arteries, or inflammatory joint diseases) has significantly increased during recent years, and this has made the use of dedicated β dosimeters essential.

The DMC 2000XB was designed, to allow simultaneously deep dose equivalent Hp(10) and shallow dose equivalent Hp(0.07) measurements for X-ray, gamma and beta emissions. Furthermore it can be used as an operational dosimetry system for all medical risk assessment including radiological exposures, and in addition has applications in radioactive source production facilities, nuclear power plants and other nuclear facilities.

RELATED PRODUCTS

MGP Instruments offers a range of products which can be used with the DMC 2000XB to create integrated dosimetry systems including:

- LDM 220, LDM 230 proximity readers
- LDM 2000 pass-by data exchange
- DOSISERV dosimetry centralization and access control software
- DOSIMASS dosimeter configuration software
- DOSICARE and DOSIFAST operational dosimetry software
- IRD 2000 irradiator for dosimeters

health physics

A Mirion Technologies Division

Featuring:



PHYSICAL CHARACTERISTICS

- Complies with IEC 61526 Ed 1
- **Measurement and display:**
- display units: mSv, μ Sv or mrem
- dose display: 1 μ Sv to 10 Sv (0.1 mrem to 1000 rem)
- dose rate display: 0.01 mSv/h to 10 Sv/h (1 mrem/h to 1000 rem/h)
- measurement range: 0.1 μ Sv/h to 10 Sv/h
- **Linearity:**
- < \pm 20 % up to 1 Sv/h (100 rem/h)
- < \pm 30 % up to 10 Sv/h (1000 rem/h) for X, γ > 60 keV and β
- < \pm 25 % up to 3 Sv/h (300 rem/h) for X < 60 keV
- **Energy response:**
- X, γ rays: 20 keV to 6 MeV
- β $E_{\text{mean}} > 60$ keV (E_{max} : 0.22 MeV to 2.3 MeV)
- Accuracy: < \pm 10 % (^{137}Cs , ~ 30 mSv/h, including \pm 5% of extended uncertainty K=2)

ELECTRICAL CHARACTERISTICS

- Li MnO₂ standard CR2450 battery; battery life > 9 months (8h per day in run mode)

MECHANICAL CHARACTERISTICS

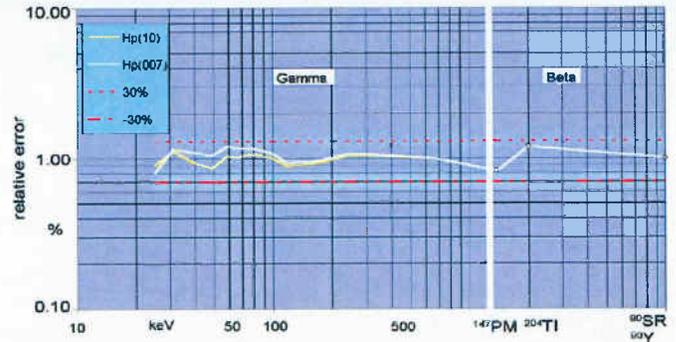
- Dimensions: 87 x 48 x 28 mm (3.4 x 1.9 x 1.1 in) with clip
- Weight with battery: < 59 g (2 oz)
- Worn by a replacable clip

ENVIRONMENTAL CHARACTERISTICS

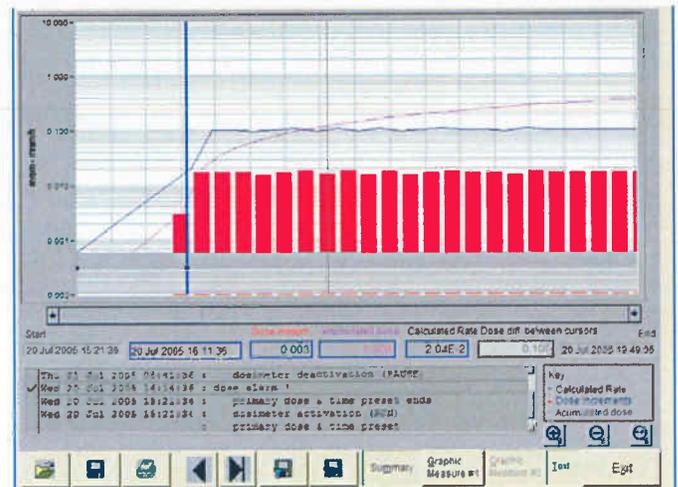
- Temperature range: -10°C to 50°C (14°F to 122°F)
- Humidity: < 90 % at 42°C (108°F)
- Storage: -30°C to 71°C (-22°F to 160°F)
- Shock, vibration and drop resistant, water resistant IP42
- EMC: complies and exceeds CE standards

CUSTOMIZATION

- setup can be achieved by user with DOSIMASS software



DMC 2000XB energy response



The history enables detailed event reconstruction for efficient analysis of incident situation circumstances.



Hp(10) - deep dose



Hp (0.07) - shallow dose

With the display directly visible to the wearer, many functions are available using alphanumeric characters.



Technician using the hands-free capability of the DMC 2000S with LDM 2000 reader.



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STRIDE™ | Series 200
STATIONARY RADIONUCLIDE
IDENTIFICATION SYSTEMS

Detection units and systems were designed to detect the covert movement of special nuclear material or weapons into populated or other areas of concern and to identify the radionuclide.

SERIES 200 DETECTION UNITS

The Series 200 detection units have been designed primarily for fixed wired installations. The cylinder shaped housing is made of aluminum and is both dust and moisture proof. The size of the housing depends on the size of the NaI scintillation detector chosen and the presence of an optional He³ neutron detector with moderator. These units can be mounted on walls, above doorways, behind reception desks, behind passport control counters, above luggage or parcel conveyer belts, and much more. The standard 2" diameter by 3" long NaI scintillation detector provides an excellent sensitivity even to small, low activity radiation sources. A typical time-to-nuclide-identification can be from a few to 20 or 30 seconds, depending on the nuclide, the source activity, background conditions and the presence or absence of shielding material.



FEATURES

- Rapid detection of presence of radioactivity or radioactive material
- Nuclide identification
- Categorizes radiation as Innocent, Suspicious or Threat
- Alarms on dose rate changes above background
- Continually stabilizes for temperature and background changes
- RJ-45 Ethernet connection to LAN with PoE
- Server and Client software packages available
- Visible and audible alarm annunciators
- Permanent event record storage
- Remote alerts to PCs, PDAs and the like
- Open or covert installations



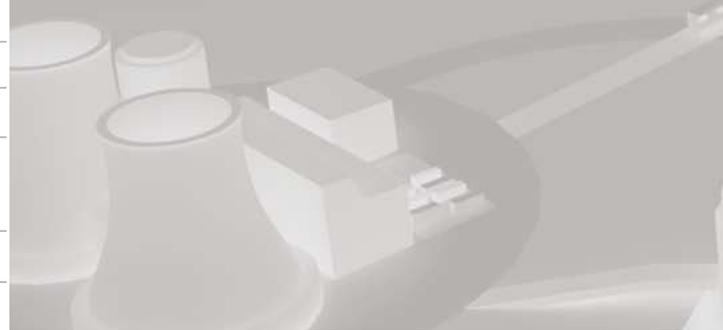
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NEW THINKING.®

SPECIFICATIONS

Gamma Detector	Nal(Tl) 2" x 3" or Nal(Tl) 2" x 4"
γ Energy Range	20 keV to 3 MeV
Energy Resolution	< 8% FWHM @ 662 keV
Neutron Detector	He ³ Gas filled ionization neutron detector with 10 mm thick PE moderator (opt.)
He ³ Detector	0.75" x 3", 8 atm pressure
Neutron Sensitivity	per IAEA specifications for Border Monitoring Equip.
Neutron Energy	0.025 eV to 15 MeV
High Doserate	Sealed GM detector (opt.)
Operating Temperature	+5°F to +122°F (-15°C to +50°C)
Storage Temperature	-40°F to +203°F (-40°C to +95°C)
Operating Humidity	10 - 80%, non-condensing
Data Throughput	>100k cps
Data Input Rate	≤ 300k cps
Corrections	Spectrum linearization
Spectrum	1024 channels 24 bits per channel
Calibration Verification	Internal K ⁴⁰ (KCl) source
Doserate Range	0 to 100 μSv/h (0 to 10 mrem/h)
Doserate Resolution	10 nSv/h (1 μrem/h)
Doserate Energy	50 keV to 1.5 MeV
Stabilization	Peak analyzing K ⁴⁰ or LED
Power	DC, Power over Ethernet
Dimensions	16.75" x 2.6" (425 x 65 mm), Nal(Tl) only
Weight	4 lbs (1.8 kg)
Material	Aluminum
Protection Rating	IP 54

DETECTION UNIT MODELS

- DU 203-Nd: 2" x 3" Nal detector, K⁴⁰ source stabilization
- DU 203-N: 2" x 3" Nal detector, LED stabilization
- DU 203-NH: 2" x 3" Nal detector, LED stabilization, He³ neutron detector
- DU 203-NGH: 2" x 3" Nal detector, LED stabilization, GM high doserate detector
- DU 204-Nd: 2" x 4" Nal detector, K⁴⁰ source stabilization
- DU 204-N: 2" x 4" Nal detector, LED stabilization
- DU 204-NH: 2" x 4" Nal detector, LED stabilization, He³ neutron detector
- DU 204-NGH: 2" x 4" Nal detector, LED stabilization, He³ neutron detector, GM high doserate detector



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FEATURES

- Rapid detection of presence of radioactivity or radioactive material
- Advanced Isotope identification
- Categorizes radiation as Innocent, Suspicious or Threat
- Alarms on dose rate changes above background
- Continually stabilizes for temperature and background conditions changes
- Wired or wireless communication to LAN
- Server and Client software packages available
- Visible and audible alarm annunciators
- Permanent event record storage
- Remote alerts to PCs, PDAs and the like
- Open or covert installations

Minimum Activities (µCi) for Nuclide Identification

	¹³³ Ba	⁵⁷ Co	⁶⁰ Co	¹³⁷ Cs	⁶⁷ Ga	¹³¹ I	¹⁹² Ir	^{99m} Tc	²⁰¹ Tl	²²⁶ Ra	
Time*	1 sec	12.8	26.3	4.8	2.9	16.1	3.8	2.7	12.8	60.2	13.3
	5 sec	6.4	14.3	1.0	1.7	8.1	1.9	1.5	6.6	30.1	2.9
	10 sec	4.0	9.6	0.6	1.2	5.4	1.1	1.1	4.9	21.1	1.6
	30 sec	1.6	3.2	0.2	0.5	2.7	0.6	0.5	1.8	9.0	0.6
	60 sec	1.1	2.0	0.2	0.3	1.6	0.4	0.4	1.1	6.5	0.4
Distance**	0.5 meter	17.3	51.8	5.2	4.7	23.3	10.3	4.1	22.1	97.9	15.6
	1.0 meter	51.9	129.6	10.5	14.2	67.0	20.5	12.3	58.1	261.2	31.3
	1.5 meter	103.7	233.2	15.7	28.4	131.1	30.8	24.6	108.0	489.7	46.9

* Listed are the minimum source activities for the various nuclides at a distance of 20" (0.5 meter) from the STRIDE detector. For distances of 1 meter, 2 meter, 3 meter and 4 meter multiply the activity values by 4, 16, 36 and 64 respectively.

**Detectable activity of unshielded source moving at a rate of 1.2 meters/second

Note: Green is for Naturally Occurring, Blue is for Medical and Orange is for Industrial nuclides

STRIDE DETECTION UNITS

Detection Units are available in a wide variety of sizes and features for nearly any application. Detection units have several things in common. A typical Detection Unit consists of a NaI scintillation detector for gamma radiation detection; DSP (Digital Signal Processing) based electronics with source or LED stabilization; a multichannel pulse height analyzer; a K⁴⁰ source in the form of KCl for calibration verification and at times, stabilization; a usage appropriate enclosure; mains, battery or PoE (Power over Ethernet) power; and a data and control communication method. An optional He³ neutron detector and high dose rate GM detector are available and wireless communication with rechargeable battery power is also available for Series 300 Stanchion Detection Units.

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The covert movement of special nuclear material or weapons into populated areas represents possibly the greatest threat to the security of our world. Radionuclide detection and identification systems are required to effectively detect or deter this threat by recognizing the presence or movement of radioactive material across borders, into government buildings, at large public gatherings or events and much more. Stride™ Detection Units and Systems were designed for this very purpose. They can be openly or covertly installed in building entrances, at airports, bus or train stations, above or beside luggage or freight conveyer belts, by stadium entrances, ship ports and many more similar locations of potential risk.



DETECTION UNITS

Depending on the amount of radioactive material present, the pace of the transporter, and the detection unit chosen, radionuclides can be detected and properly identified in a few seconds. The type of material is classified as medical, industrial, naturally occurring (NORM) or special nuclear material (SNM), as well as whether it is innocent, suspicious or threatening. In addition, the specific isotope is identified and security personnel are alerted via visible or audible annunciators.



Series 200

Basic Detection Units are housed in a dust and moisture proof Aluminum enclosure, with a 2" diameter by 3" NaI detector, RJ-45 Ethernet communication and PoE (Power over Ethernet). An optional He³ neutron detector and high dose rate GM detector are available.



Series 300

Stanchion Detection Units are housed in a security stanchion with a 2" diameter by 3" NaI detector, RJ-45 Ethernet communication and PoE (Power over Ethernet). An optional He³ neutron detector and high dose rate GM detector are available. Wireless communication with rechargeable battery power is also available.



Series 400

Ruggedized Detection Units are housed in a watertight Stainless Steel enclosure that is deployable down to depths of 165 feet with a 2" diameter by 2" NaI detector, RS-232C communication with rechargeable batteries for power.



Series 700

Security Detection Units are housed in an Aluminum pedestal with wood top and base with a large 2" thick by 4" wide by 16" long NaI detector, DSP electronics, uninterruptable power supply (UPS) with an RJ-45 Ethernet communication. An optional He³ neutron detector and high dose rate GM detector are available.



Series 800

Portal Detection Units are enclosed in an Aluminum housing with a wood top and base with two (2) large 2" thick by 4" wide by 16" long NaI detectors, DSP electronics, uninterruptable power supply (UPS) with an RJ-45 Ethernet communication. An optional He³ neutron detector and high dose rate GM detector are available.

SPECIFICATIONS

Gamma Detector	Series 200 and Series 300; 2" diameter by 3" or 4" long NaI Series 400; 2" diameter by 2" long NaI Series 700 and Series 800; 2" thick by 4" wide by 16" long NaI
γ Energy Range	20 keV to 3 MeV
Neutron Detector	He ³ Gas filled ionization detector with moderator for thermal neutrons
Neutron Energy	0.025 eV to 15 MeV
High Dose rate Det.	Sealed GM detector
Operating Temp.	+5 °F to +122 °F (-15 °C to + 50 °C)
Storage Temp.	-40 °F to + 203 °F (-40 °C to +95 °C)
Operating Humidity	10% to 80%, non-condensing
Data Throughput	>100k cps
Data Input Rate	≤300k cps
Corrections	Spectrum linearization
Spectrum	1024 channels; 24 Bits per channel
Dose rate Range	0 to 100 μSv/h
Dose rate Resolution	10 nSv/h
Dose rate Energy	50 keV to 1.5 MeV
Stabilization	Peak stabilized on K40 gamma line or LED peak

PERFORMANCE DATA FOR 2" DIAMETER BY 3" LONG NaI DETECTOR

Count Rates (cps) for 1 mCi sources*

	¹³³ Ba	⁵⁷ Co	⁶⁰ Co	¹³⁷ Cs	⁶⁷ Ga	¹³¹ I	¹⁹² Ir	^{99m} Tc	²⁰¹ Tl	²²⁶ Ra
0.5 m	63000	42000	72000	34000	37000	53000	92000	39000	33000	90000
1 m	16000	10000	18000	8600	9200	13000	23000	9700	8200	22000
2 m	3900	2600	4500	2100	2300	3300	5700	2400	2100	5600
3 m	1700	1100	2000	950	1000	1500	2600	1100	910	2500
4 m	970	640	1100	540	570	820	1400	600	510	1400

*Each source (37,000,000 dps = 1 mCi) is positioned perpendicular to the detector axis at a height equal to the center of the detector.

Thermo Scientific's newest RadEye instrument
for contamination and dose rate measurements

The perfect solution for

- **Civil Defence**
- **Fire Brigades**
- **Hospitals**
- **Nuclear Industry**
- **Pharmaceutical Industry**

RadEye B20 / B20-ER

Multi-Purpose Survey Meter

Features of RadEye B20 and RadEye B20-ER

- Light Weight (300 g), excellent grip with and without gloves
- Rugged and compact design, thick rubber protective cover
- Low cost of ownership with > 500 h operation time with 2 AAA batteries – rechargeable NiMH-cells can be used
- Menu-driven user interface results in low training cost and immediate familiarity
- Huge internal data memory for both scaler results and continuous data recording
- Bright backlit LCD display – plain text messages - different languages can be selected
- Easy adaptation to different tasks by supervisor configuration, calibration, selection of measuring units
- Versatile operation modes:
 - Scaler / Timer with preset count and preset time for sample measurements
 - Continuous ratemeter mode for frisker operation
 - Dose rate mode
- Audible indication: single pulse or chirper mode proportional to count rate
- Earphone output for operation in loud environment



Order number: 4250685

The RadEye B20 is a modern compact multi-purpose contamination meter for alpha, beta, gamma and X-ray radiation. By virtue of an optional gamma energy filter, gamma dose rate measurements from 17 – 1300 keV can be performed. For emergency response purposes alpha and beta contamination can be discriminated using another optional filter.

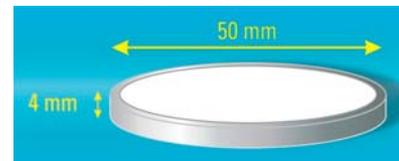
The instrument is part of the growing RadEye family of high-end stand-alone meters, which are designed to exceed the most demanding user expectations.

RadEye B20 / B20-ER

Accessories

High precision, low energy test adapter for performance verification **Order number: 425068571**

- 9 g natural Lutetium-Oxide with 50 Bq/g (1.4 nCi/g):
non radioactive in respect to StrSchV and NRC 49 CFR 173.403(y)
- Lu-176: half life 37,000 Million years
 - No error prone half life correction by the user
 - Check sources with short half-live are no longer required
- Extremely uniform activity content and surface emission rate
- Identical surface emission rate for each check source



Energy Filters

- Removable energy filter for X-ray & gamma dose rate measurements in Sv/h or Rem/h from 17 keV. **Order number: 425068582**
- Removable alpha-rejection filter for quick estimation of alpha contamination in emergency response situations. **Order number: 425068581**



Car Adapter Interface **Order number: 425067065**

- AAA NiMH cells can be charged in the instrument
- Continuous monitoring in the car / fire truck with illuminated display
- RS 232 / USB / Bluetooth communication options



First Responder Laboratory Kit
Without RadEye: **Order number: 425069011**

Pelican Case containing:

- Sample changer for use with the RadEye B20
- Sample planchets with different lip heights
- Disposable gloves, spatula
- 50 mm paper filters

Space for:

- Data cable
- User manual
- Lutetium-Oxide test adapter
- Additional RadEye (PRD or N)



Detector	1 pancake GM-tube, window dia. 44 mm (1.7"), 1.8 – 2.0 mg/cm ²
Measuring Range (gamma dose rate) Uncompensated or with opt. energy filter	0 - 2 mSv/h [0 - 200 mR/h] RadEye B20 0 - 100 mSv/h [0 - 10 R/h] RadEye B20-ER
Measuring Range (contamination)	0 - 10 kcps RadEye B20 0 - 500 kcps RadEye B20-ER
2 π Efficiency (ref. to 50 mm diameter without rubber sleeve)	Am-241: 28%; Co-60: 25%; Sr/Y-90: 36%; C-14: 19 %
Energy Range (with gamma energy filter)	17 keV – 1.3 MeV
Weight and maximum dimensions	300 g (0.7 lb); 13 cm x 7 cm x 6 cm (5.2" x 2.8" x 2.4")
Alarm indication	LED, sound, vibrator

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