ORTEC®

Micro-Detective

Ultra-Light, High-Fidelity Hand-Held Radioisotope Identifier

AMETEK®
ADVANCED MEASUREMENT TECHNOLOGY

Micro-Detective Overview

- Accurate nuclide identification based on high resolution gamma spectroscopy with confirmatory neutron detection.
- Definitive detection of illicit special nuclear materials (SNM) trafficking in seconds, in a battery operated instrument.
- Fast, Simple and ULTRA-Reliable Classification of NORM, Medical, Industrial, SNM and Natural isotopes, shielded and unshielded: ANSI N42-34 compliant.
- Multiple uses (e.g.): Hand-Held Nuclide Identifier, Emergency Whole-Body Counter, Ad-hoc Portal Monitor, Search System, Food Monitor.
- Gamma-Ray, SNM and Neutron Search Modes.
- Rugged design for rough handling: dust and water proof (IP67 capable).
- USB and Wireless 802.11 communications; built in GPS.
- Secure Digital (SDIO) slot.

Latest Improvements

- Operating time of up to 5 hours on single battery.
- "Snap-open" battery door for rapid battery exchange with minimal down-time.
- New improved silent running, low-power cryo-cooler.

Introduction

The latest version Micro-Detective® products build on the ORTEC pedigree of HPGe nuclide identifiers which began with the introduction of the ORTEC Detective® in response to the 9-11 aftermath and the realization that it was vital to provide an effective solution to the problem of potential illicit trafficking of nuclear materials by terrorists.

Since 2004, the ORTEC Detective product line capabilities have broadened in scope and now cover a range from large installed freight monitoring systems, search systems and the light weight Micro-Detective products for in-field hand-held operation. All share the same ORTEC HPGe technology and advanced Detective analysis algorithms.

In the latest version Micro-Detective and Micro-Detective-DX instruments, new technology provides an impressive increase in the lifetime of the internal battery: up to 66% longer or 5 hours typical operation on a single charge. A new "snap open" battery door allows an exhausted battery to be replaced in seconds and the instrument re-started with a full battery with almost no interruption to operation.

A new generation low-power cryo-cooler provides "silent running" operation and improved operational lifetime.

A Long and Distinguished Pedigree

ORTEC Detective products are already deployed widely in the battle against illicit nuclear trafficking. Hundreds are being used worldwide by (among others):

Departments of Homeland Security
Emergency Management Teams
Departments of Defense
Civil Support Teams
National Security Organizations
Police Departments
Bomb Disposal Teams
Nuclear Safeguards Organizations
Airport Security Orgainzations
Emergency Response Teams
Nuclear Fuel Manufacturers
Customs and Border Control
Nuclear Researchers
Navy, Army and Air Forces
US NNSA second line of defense "Megaports" initiative
International Atomic Energy Agency

Micro-Detective Overview

Hardware

There are two models of Micro-Detective available:

- Micro-Detective: Lightweight, Portable HPGe Identifier with Gamma and Neutron detection.
- Micro-Detective-DX: "Gamma only" version of the Micro-Detective.

Both models of the Micro-Detective feature the same compact, light weight and rugged hardware. A 50 mm diameter HPGe crystal in a "hardened" cryostat is cooled by an integrated low-power Stirling-cycle cryo-cooler. The latest revision Micro-Detective features a new cooler offering reduced levels of acoustic noise and vibration, and longer operation life. The hardened cryostat is entirely free of conventional molecular sieve allowing the instrument to be turned off or on at any point in the detector cool down or warm up cycle without risk. This is impossible with conventional HPGe cryostat systems which require careful temperature cycling procedures to avoid damage.

A built-in digital MCA system and powerful data processor are included. All models feature the same bright and clear VGA resolution display, readable in direct sunlight, with a touch sensitive operator screen. Menu navigation is highly intuitive. The radionuclide gamma-ray spectrum may be displayed and manipulated (e.g., vertical scale, zoom) like a conventional multichannel analyzer.

Gamma and neutron count rate and gamma dose rate are displayed continuously both numerically and in bar graph form.

In the latest version, the Micro-Detective internal battery provides enough power for up to 5 hours of operation and is easily replaced in seconds, allowing continuous in-field operation.

At just under 16 lbs. in weight, the Micro-Detective sets a world record for portable, high resolution nuclide identifiers, by a wide margin.

The snap-open battery compartment makes battery changing simple.

Desktop battery charger (MICRO-DET-ACC-CHGR). Recharges battery (MICRO-DET-ACC-BAT) in ~5 hours.

Analysis Capabilities

Since initial introduction of the first Detective instruments, identification performance capabilities have iteratively been improved through taking part in many independent performance testing programs. These programs are sponsored by governmental and international organizations, such as the US DTRA, the IAEA, and most recently the on-going international ITRAP-plus 10 testing program.

Micro-Detective performance has continued to advance as a result of these rigorous test programs. As the needs and best practices of deploying organizations have also evolved, Detective software features have expanded to meet these new requirements.

Micro-Detective Overview

Summary of Operational Features

(refer to Technical Specifications for more detail)

- Three "Search Modes":

  Gamma/neutron total count rate
  SNM Search mode
  Sliding average "monitor" mode

- User choice of identification schemes:

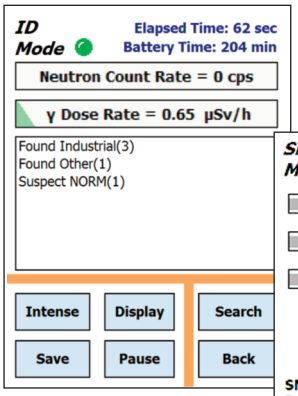
  "Classify Mode" (by nuclide type: "nuclear, natural, medical, industrial, etc.")

  "ANSI mode"

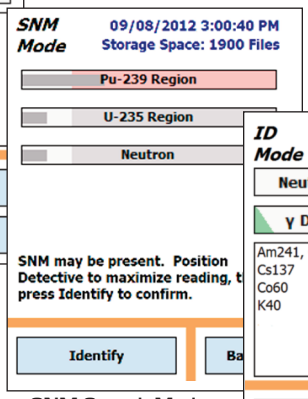
  Time preset or continuous count selectable to match CONOPS

  Suspected Nuclides (not in preset mode)

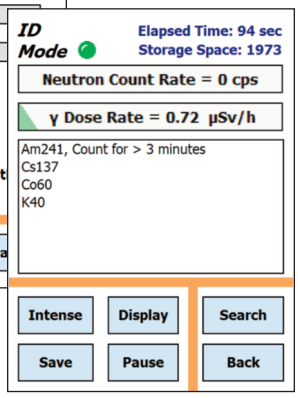
  More sensitive LCX mode for SNM detection



Classify Mode.



SNM Search Mode.



ANSI Mode.

- Background collect feature eliminates reporting of background nuclides.
- "Smart" spectrum stabilizer ensures optimum results, even with hard-to-analyze spectra.
- ANSI N42.42 format storage of spectra.

Calibration and Stabilization

The instrument is calibrated prior to shipment from the factory. The energy calibration may be checked and adjusted with any known source with a clean gamma ray between 0 and 3 MeV. A higher energy is recommended. Cs-137 is often used. Calibration can be manual or automatic. Background collection is a required part of calibration. By allowing for activities already in the background, the system will not report nuclides detected in the background. The background must be updated on a schedule which is chosen by the privileged user.

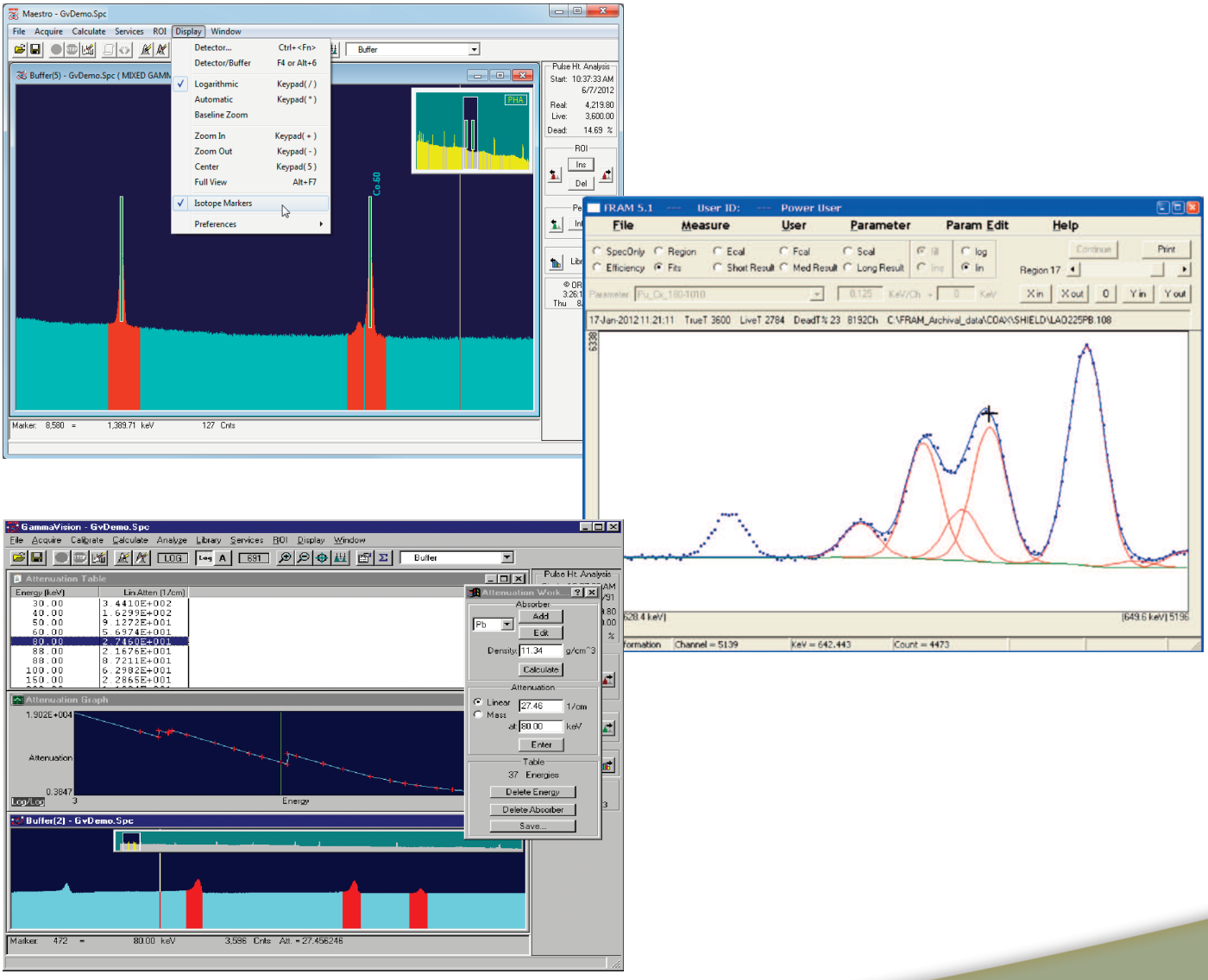
SMART Stabilizer The "smart stabilizer" stabilizes the gain very precisely on the 1460 keV peak of K-40, if present. If there is no K-40 present or if Eu-152 is detected, which could interfere with the K-40 peak, the stabilizer setting is held but not adjusted until "normal" conditions return. Even though the Detective is a highly stable instrument, the smart stabilizer allows accurate determination of more complicated mixed spectra.

Micro-Detective Overview

Optional Software for the Micro-Detective

The Micro-Detective is fully supported by the latest versions of the highly successful MAESTRO MCA Emulator as well as the well-known ORTEC Gamma Spectroscopy Packages such as GammaVision for generalized HPGe spectrum analysis, PC/FRAM and MGAHI for Pu and U isotopic ratio analysis and ISOPlus for in-situ waste assay analysis. The integral USB connection in the instrument hardware provides full PC control, real-time live MCA display, fast data transfer of single and multiple spectra to the PC, and full ORTEC CONNECTIONS network support. Separate brochures are available on request. PLEASE NOTE: MAESTRO is supplied as part of packages containing "PKG" in the model number, or it can be purchased separately at a later date.

The Micro-Detective is a member of the ORTEC CONNECTIONS family. Remote MCA control and individual spectrum download, even over a network, is achieved simply, by the use of ORTEC CONNECTIONS products such as MAESTRO MCA Emulation software. Multiple spectra may be block-transferred from the instrument controller to an external PC by the use of Microsoft ActiveSync. Third party products such SOTI "Pocket Controller Enterprise" may be used to implement the 802.11 wireless feature to provide remote wireless control of the complete instrument.



Micro-Detective Technical Specifications

Technical Specifications: Hardware

RADIATION DETECTORS

The Micro-Detective includes three separate radiation detector subsystems:

A high resolution high purity germanium (HPGe) detector for nuclide identification.

A Compensated GM Tube for dose rate.

A moderated ^{3}He neutron detector (absent on DX model).

HPGe Detector P-type high-purity germanium. Coaxial construction.

Crystal Nominal Dimensions: 50 mm diameter x 40 mm deep.

Cryostat/Cooler: "Hardened" cryostat, with high reliability, low-power Stirling Cooler. The cryostat design is such that the Micro-Detective may be switched off at any time and power subsequently re-applied, without having to wait for a full thermal cycle (full warm up before cool down), as is normal practice with a HPGe detector system. This feature greatly increases system availability during measurement campaigns.

Digital Noise Suppression: LFR Filter.

HPGe Cool Down Time: The high reliability cooler is designed for continuous operation. Between making measurements the unit is powered from a DC supply, car battery or other high capacity device. The cooler life is expected to exceed 50,000 hours continuous operation. Initial cool down time depends on ambient temperature, but is typically <12 hours at 25°C.

Gamma Dose Rate Detector Two detectors determine the gamma dose rate over a wide range from <0.05 µSv/h to >10,000 µSv/h, a dose-rate range of around six decades. For low dose rates, below ~20 µSv/h, the dose rate is determined from the Ge detector spectrum. For dose rates above this value, the internal compensated GM tube is used. Instrument switches between the two automatically.

Dose rate uncertainty < (–50% to +100%); continuous audible alarm at dose rates >10,000 µSv/h (fixed maximum threshold), user settable threshold below this.

Neutron Detector Module (non -DX model only) Single ^{3}He tube: 4" active length, 0.5" diameter, 20 atm ^{3}He fill pressure. High Density Polyethylene moderator.

DIGITAL MCA AND DATA PROCESSOR

Display VGA 640 x 480 TFT sunlight readable touch sensitive, operate with finger or stylus.

Data Processor Marvel 806 MHz XScale.

Data Storage (Spectrum, Search Data, ID Results) To internal RAM and removable SD card.

Communications Ports External connectivity to system:

- 1 SD (Secure Digital) card slot (3.3 V).
- 1 USB connection for "ActiveSync" capability or MCA operation with external computer (ActiveSync and remote display software included).
- WiFi 802.11 communication software optional.
- 1 Audio headphone jack.

Computer Interfacing USB connection to laptop. Spectral transfer by Microsoft® ActiveSync. Remote control via Microsoft "remotedsp.exe" (supplied). Wi-fi (802.11) communication software optionally available.

GPS Internal NMEA compliant WAAS capable.

Digital MCA with Internal Storage of Multiple Spectral Data. "Smart" digital spectrum gain stabilizer.

Digital Noise Suppression LFR Filter.

Conversion Gain 8k channel.

Storage of Data (spectrum, search data, ID results) To internal RAM and removable SD card. Maximum Number of stored spectra unlimited on removable media.

PHYSICAL SPECIFICATIONS

Maximum Overall Dimensions (including handle, Ge detector end cap and shock absorbers) 14.7" L x 5.75" W x 11" H (37.4 cm L x 14.6 cm W x 27.9 cm H)

Height with handle removed 9.23" (23.4 cm).

Weight 15.2 lbs (6.9 kg)

Internal Battery Lithium Ion, 14.4 V, 6.2 Ah, 89 Wh, nominal. Up to 5 hours of battery life at 25°C when HPGe detector is cold. <4 hour time to charge. Internal battery is easily swapped through removal of snap shut battery door.

External Battery Option Battery lifetime may be extended indefinitely by the use of external battery packs. DETECTIVE-OPT-15 is recommended, weighs less than 3.25 lbs and extends lifetime to >10 hrs.

Input Power 10 to 17 V DC from battery or DC power supply (universal mains supply included). Battery charger circuit is inside instrument . External battery charger option also available.

Power Usage Strongest during cool down: <100 Watt. While charging battery: 5A nominal. Cold with fully charged battery <2A.

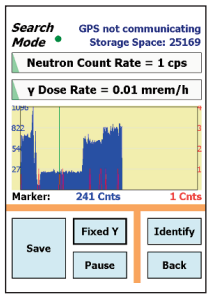
External Power DC Input and battery Charge Input. 2.5 mm coaxial connector with locking screw on collar.

Temperature
Operation Range: –10°C to 40°C.
Relative Humidity: <90% at 35°C, non-condensing.

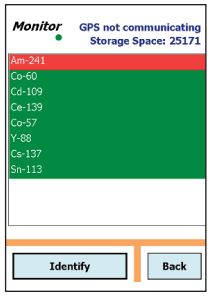
Instrument Enclosure is sealed against ingress of dust and water. All perforations are sealed by rubber plugs (connectors, memory cards, etc.).

Technical Specifications: Operation Modes

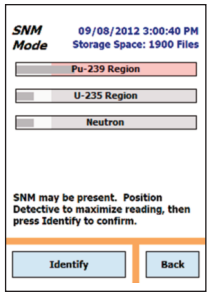
SEARCH
Scanning mode for location of radioactive sources, with audio alert using an external ear piece. Both neutron and gamma search is simultaneous; speed settings 0.1 to 50 seconds/point: Neutron counts are displayed in red and gamma counts in blue.



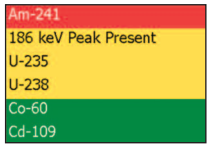
MONITOR Mode
The instrument collects one spectrum per second and runs the ID algorithm against an 8 second sliding average. This mode is more sensitive to sources which move relative to the instrument.



SNM Search Mode™
Nuclide-specific search mode for U-235, Pu-239 and neutron counts. Ba-133 surrogate detection may be turned on for training purposes. Bar graph display of nuclide confidence level. An aid to Identify mode.

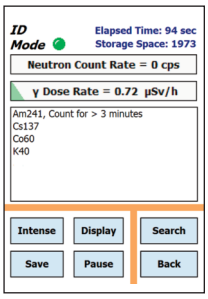


LCX (Low Confidence Expert) ID Mode
Intended for expert users. Displays suspected threat alarms and identifications at a lower confidence level than ANSI and Classify modes. Results in more hits on suspected threat nuclides. Password protected.

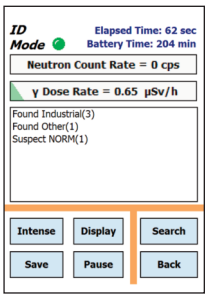


IDENTIFY Gamma Proprietary scheme for identification and classification of radionuclides. Background subtraction.

ANSI Mode See following nuclide list. Preset Time counting allows for CONOPS* in which it is required to count for a preset time, e.g., 60 seconds. At the end of the preset period, only what has been found is reported, no suspects are reported. The operator can request a count time extension, if desired, adding multiples of the original preset period.



Classify Mode Nuclides classified according to: Industrial, Medical, Natural (NORM), and Nuclear. Classifications are based on an internal, fixed library according to ANSI N42.34. Customized libraries for specific applications can be supplied by special order.



Dose Rate Visual over range indication and continuous audible alarm, user settable. Over-ride alarm at dose rates >10,000 μSv/hr.

Neutron Count Rate (if applicable) Displayed continuously. Data can be quickly saved and transmitted for further off site analysis.

GPS Position Information Internal GPS receiver displays GPS coordinates which may be saved along with spectrum data for future use.

Technical Specifications: Instrument Nuclide ID Messages: Classify Mode

The form of the primary ID messages is:

"Found CLASS(#)" or "Suspect CLASS(#)"
where "CLASS" is

- Medical
- Industrial
- NORM
- Bremsstrahlung
- Other
- Nuclear Uranium
- Nuclear Plutonium
- Nuclear Neptunium

And "#" is the number of nuclides of that class identified.

The table lists the Detective Library v8.5 radionuclides according to their categories in the "Classify" ID mode.

Classify Mode Message Rationale

The following explains the criteria for selected Classify ID Display Mode messages.

HEU (highly enriched uranium): This message is displayed if the major lines of uranium are detected and the ratios of the intensities of the lines indicates the U-235 content to be above about 70%.

Am241 (unshielded) in the "Industrial" category: This message is displayed if the 59 keV peak is located. It could mean that an Am-241 source such as a smoke detector is present. Move closer to the source and/or count longer. This will allow the higher-energy gamma rays to accumulate in the spectrum, in case plutonium is also present.

Unknown Peak and **Unknown/Beta Emitter**: This indicates the gamma count rate is higher than can be accounted for based on the peaks in the library. The implication is that either an unexpected nuclide or a beta emitter is present (beta emitters typically producing counts over a broad range of energies). Move closer to the source and count longer to determine the nature of the suspect item. If another ID is found, then the Unknown Peak or the Unknown/Beta Emitter ID are suppressed.

"Found Nuclide" Screen Messages

RDD Detected: This message is posted when estimated activity is >100 mCi, whether the activity is from threat or innocent nuclides. The gamma count-rate and dose-rate meters on the Survey Mode and ID Mode screens display a flashing red background and extremely high count and dose rates.

Classification Industrial

Am-241
Am-241 (unshielded)
Cs-137
Ho-166m
Ho-166m (shielded)
Ir-192
Ir-192 (shielded)
W-187
Ac-227
Ag-110m
Ar-41
As-72
Au-198
Ba-133
Ba-140
Be-7
Bi-212 (Th-232/U-232 daughter)
Br-77
Ca-47
Cd-115
Ce-144
Cm-242
Cm-243
Cm-244
Co-55
Co-57
Co-57 (shielded)
Co-60
Cs-134
Hf-181
Hg-203
I-126
I-126 (shielded)
I-132
I-133
I-134
I-135
Kr-87
Kr-88
Kr-88 (shielded)
Mn-52
Mn-56
Nb-92m
Nb-94
Nb-95
Nb-96
Nb-96 (shielded)
Nd-147
Pa-231
Pb-203
Pr-144
Ra-223
Rh-105
Ru-103
Ru-97
Sb-124
Sb-124 (shielded)
Sb-125
Sb-127
Sr-85/Kr-85
Tc-96
Te-132
Th-229
Th-230
Tm-171
W-188/Re-188

Classification Medical

F-18
I-125
Lu-177
Lu-177m
Mo-99
Pd-103
Se-75
Sm-153
Sm-153 (shielded)
Tc-99m
Xe-133
Ac-225
As-74
Ce-139
Ce-141
Co-58
Ga-67
Ga-67 (shielded)
Ge-68/Ga-68
I-123
I-123 (shielded)
I-124
I-131
I-131 (shielded)
In-111
Lu-172
Na-24
Rb-83
Rb-86
Ru-106/Rh-106
Sc-46
Sr-82/Rb-82
Sr-89
Tl-201
Tl-204
Tm-170
V-48
Xe-133m
Yb-169
Zn-62
Zn-65
Zr-95

Classification NORM

La-138
Ra-226
Bi-214 (Ra-226 daughter)
K-40
Lu-176
Th-232

Classification Other

Cr-51
Cu-64
Eu-152
Gd-159
La-140
Mn-54
Neutrons on Fe
Neutrons on Hydrogen
Unknown Peak
Unknown/Beta emitter
Xe-131m
At-211
Bi-207
Br-76
Br-76 (heavily shielded)
Br-76 (shielded)
Cd-109
Co-56
Co-56 (shielded)
Eu-154
Eu-155
Eu-156
Fe-59
Ga-64
Ga-64 (shielded)
Gd-153
Ho-166
Ir-194 (shielded)
Na-22
Neutrons
Os-194/Ir-194
Po-210
Sn-113
Ta-182
Tl-200
Tl-202
Xe-135
Y-88

Classification Bremsstrahlung

Beta emitter

Classification Nuclear Uranium

Enriched Uranium
HEU
U-232
U-233
U-235
U-238
186 keV peak present
2614 keV peak present

Classification Nuclear Plutonium

Pu-239
Pu-238
375/414 peak present
Am-241 (shielded)

Classification Nuclear Neptunium

Np-237

Technical Specifications: Instrument Nuclide ID Messages: ANSI Mode

The table below is divided according to the threat category used to determine ID background color in Monitor Mode and on the Found and Suspect Nuclide reports, e.g., green for innocent IDs, yellow for LCX-mode suspects, and red for threats. NB: if desired and under password protection, the color coding, and therefore the threat classification can be disabled.

Identification	Classification
Innocent	
Ac-225	Medical
Ac-227	Industrial
Ag-110m	Industrial
Am-241 (unshielded)	Industrial
Ar-41	Industrial
As-72	Industrial
As-74	Medical
At-211	Other
Au-198	Industrial
Ba-133	Industrial
Ba-140	Industrial
Be-7	Industrial
Beta emitter	
Bremsstrahlung	
Bi-207	Other
Bi-212 (Th-232/U-232 daughter)	Industrial
Bi-214 (Ra-226 daughter)	NORM
Br-76	Other
Br-76 (heavily shielded)	Other
Br-76 (shielded)	Other
Br-77	Industrial
Ca-47	Industrial
Cd-109	Other
Cd-115	Industrial
Ce-139	Medical
Ce-141	Medical
Ce-144	Industrial
Cm-242	Industrial
Cm-243	Industrial
Cm-244	Industrial
Co-55	Industrial
Co-56	Other
Co-56 (shielded)	Other
Co-57	Industrial
Co-57 (shielded)	Industrial
Co-58	Medical
Co-60	Industrial
Cr-51	Other
Cs-131	Medical
Cs-134	Industrial
Cs-137	Industrial
Cu-64	Other
Cu-67/Ga-67	Medical
Eu-152	Other
Eu-152	Other
Eu-154	Other
Eu-156	Other
F-18	Medical
Fe-59	Other
Ga-64	Other
Ga-64 (shielded)	Other
Ga-67	Medical
Ga-67 (shielded)	Medical
Gd-153	Other
Gd-159	Other
Ge-68/Ga-68	Medical
Hf-181	Industrial
Hg-203	Industrial
Ho-166	Other
Ho-166m	Industrial
Ho-166m (shielded)	Industrial
I-123	Medical
I-123 (shielded)	Medical
I-124	Medical
I-125	Medical
I-126	Industrial
I-126 (shielded)	Industrial
I-131	Medical
I-131 (shielded)	Medical
I-132	Industrial
I-133	Industrial
I-134	Industrial
I-135	Industrial
In-111	Medical
Ir-192	Industrial
Ir-192 (shielded)	Industrial
Ir-194 (shielded)	Other
K-40	NORM
Kr-87	Industrial
Kr-88	Industrial
Kr-88 (shielded)	Industrial
La-138	NORM
La-140	Other
Lu-172	Medical
Lu-176	NORM
Lu-177	Medical
Lu-177m	Medical
Mn-52	Industrial
Mn-54	Other
Mn-56	Industrial
Mo-99	Medical
Na-22	Other
Na-24	Medical
Nb-92m	Industrial
Nb-94	Industrial
Nb-95	Industrial
Nb-96	Industrial
Nb-96 (shielded)	Industrial
Nd-147	Industrial
Os-194/Ir-194	Other
Pa-231	Industrial
Pb-203	Industrial
Pd-103	Medical
Po-210	Other
Pr-144	Industrial
Ra-223	Industrial
Ra-226	NORM
Rb-83	Medical
Rb-86	Medical
Rh-105	Industrial
Ru-103	Industrial
Ru-106/Rh-106	Medical
Ru-97	Industrial
Sb-124	Industrial
Sb-124 (shielded)	Industrial
Sb-125	Industrial
Sb-127	Industrial
Sc-46	Medical
Se-75	Medical
Sm-153	Medical
Sm-153 (shielded)	Medical
Sn-113	Other
Sr-82/Rb-82	Medical
Sr-85/Kr-85	Industrial
Sr-89	Medical
Ta-182	Other
Tc-96	Industrial
Tc-99m	Medical
Te-132	Industrial
Th-229	Industrial
Th-230	Industrial
Th-232	Thorium
Tl-200	Other
Tl-201	Medical
Tl-202	Other
Tl-204	Medical
Tm-170	Medical
Tm-171	Industrial
V-48	Medical
W-187	Industrial
W-188/Re-188	Industrial
Xe-127	Industrial
Xe-131m	Other
Xe-133	Medical
Xe-133m	Medical
Xe-135	Other
Y-88	Other
Y-91	Industrial
Yb-169	Medical
Zn-62	Medical
Zn-65	Medical
Zr-95	Medical
Suspect (LCX Mode only)	
186 keV peak present	Uranium
2614 keV peak present	Uranium
375/414 peak present	Plutonium
Threat	
Am-241	Industrial
Am-241 (shielded)	Plutonium
Enriched Uranium	Uranium
HEU	Uranium
Neutrons	Other
Neutrons CR	Neutron
Neutrons on Fe	Other
Neutrons on Hydrogen	Other
Np-237	Neptunium
Pu-238	Plutonium
Pu-239	Plutonium
U-232	Uranium
U-233	Uranium
U-235	Uranium
U-238	Uranium
Unknown Peak	Other
Unknown/Beta emitter	Other

Micro-Detective Performance

Gamma-Ray Identification Performance Data for Uranium and Plutonium

(Typical values based on data obtained from actual measurements by ORTEC personnel.)

Single Sources

Unless otherwise stated, these data were taken at a standard dose rate from the source of 500 nSv/h measured with a calibrated dose rate meter at the instrument detector face according to ANSI N42.34. When an absorber was present, the dose rate at the detector was measured THROUGH the absorber.

Unshielded and Shielded Uranium: DU, U-NAT, LEU, HEU

The time to identify as uranium, either unshielded or shielded by up to 5 mm steel, is <2.5 sec). For LEU and HEU samples, the type ("LEU" or "HEU") is also reported in <2.5 sec). LEU and HEU samples shielded by 1.6 mm lead are identified as Uranium in <2.5 sec.

Unshielded and Shielded Plutonium: Weapons Grade (WG), Reactor Grade (RG) (~60–93% ^{239}Pu)

Time to identify as Pu, unshielded or shielded by up to 5 mm steel or 10 mm lead: <13 seconds for all types of Pu (with Cd filter if high Am content). For WG Pu the type "WG Pu" is also reported in less than <35 sec.

Mixtures

In all cases, the mixture consists of 500 nSv/h of the "mask" nuclide, added to the specified quantity of uranium or plutonium. The "dose ratio threshold" is defined to be the standard 500 nSv/h dose rate from the mask in ratio to the smallest dose rate from U or Pu detectable in the time stated.

Uranium at 500 nSv/h in the presence of Cs-137 or Co-57 mask (unshielded)

Time to identify as uranium <2.5 sec. For LEU and HEU, the type ("LEU" or "HEU") is also reported in <2.5 sec.

Uranium Dose ratio threshold for 60 second measurement in the presence of Cs-137 or Co-57 mask (Dose from mask: Dose from uranium)

>7:1 for identification as uranium unshielded
>3:1 shielded 5 mm steel.
>2:1 for reporting as LEU or HEU unshielded
>1.5:1 shielded 5 mm steel.

Plutonium at 500 nSv/h in the presence of Ba-133 mask

Time to identify as Pu <20 sec, unshielded or shielded by 5 mm steel or 10 mm lead. Identified type as RG Pu or WG Pu in <100 sec.

Plutonium Dose ratio threshold for 5 minute measurement in the presence of Ba-133 mask

>6:1 for identification as Pu unshielded, >4:1 shielded by 5 mm steel or 10 mm lead.
>1:1 for reporting as WG Pu or RG Pu unshielded or shielded by 5 mm steel or 10 mm steel (with Cd filter if high Am content).

Micro-Detective Ordering

Ordering Information

Model	Description
MICRO-DETECTIVE	Lightweight, Portable HPGe Identifier (Gamma and Neutron). Includes GPS, mains adapter, battery cable, shoulder strap, softside carry case and Microsoft ActiveSync software.
MICRO-DET-PKG-1	Includes MICRO-DETECTIVE Lightweight, Portable HPGe Identifier (Gamma and Neutron), GPS, mains adapter, battery cable, shoulder strap, Microsoft ActiveSync software, MAESTRO software, and hardside wheeled transport case.
MICRO-DETECTIVE-DX	Lightweight, Portable HPGe Identifier (Gamma ONLY). Includes GPS, mains adapter, battery cable, shoulder strap, softside carry case and Microsoft ActiveSync software.
MICRO-DET-DX-PKG-1	Includes MICRO-DETECTIVE-DX Lightweight, Portable HPGe Identifier, GPS, mains adapter, battery cable, shoulder strap, Microsoft ActiveSync software, MAESTRO software, and hardside wheeled transport case.
MICRO-DET-OPT-1	Rugged, waterproof, wheeled transport case.
MICRO-DET-ACC-BAT	Lithium-ion battery.
MICRO-DET-ACC-CHGR	Standalone battery charger and calibrator kit.

Further battery charging and upgrade options are available.

Note: This brochure relates to instruments with the following revision levels:

Micro-Detective Rev.2.B or later

Micro-Detective-DX Rev.1.F or later

Micro-Detective

Specifications subject to change
053113

ORTEC®
www.ortec-online.com
Tel. (865) 482-4411 • Fax (865) 483-0396 • ortec.info@ametek.com
801 South Illinois Ave., Oak Ridge, TN 37831-0895 U.S.A.
For International Office Locations, Visit Our Website

AMETEK®
ADVANCED MEASUREMENT TECHNOLOGY