ORTEC®

AMETEK

ISO-CART-85

Mobile Low-Level Waste Assay System

"Complete In-Situ NDA Gamma-Ray Analysis Solutions for a Wide Variety of Samples, including "Free-Release" Decommissioning Waste."

ISO-CART-85

ISO-CART™-85 : A Complete Turnkey Solution

ISO-CART-85 is a new mobile system for radioactive waste assay by high-resolution gamma spectroscopy. Through the use of a single very-large-area high purity germanium (HPGe) detector, and a modular collimation system, ISO-CART-85 achieves, in many cases, free release levels in reasonable count times, for in-field measurements.

The HPGe detector is provided in the form of the ORTEC IDM-200-V, a revolutionary all-in-one integrated Gamma Spectrometer, which requires no liquid nitrogen to cool to operational temperature. Instead, a miniature Stirling cycle cryocooler is employed. An internal battery powers the cooler and the highly stable digital signal processing electronics for up to 3 hours or longer with battery life extending options or battery hot swap.

The new ISO-CART-II which is the measurement system transport represents the latest generation of ISO-CART from ORTEC, enhanced through operational experience, and with some new options, such as the useful bottle-counting shield option which allows the system to be used as an “in-field counting room” to count bulk assay samples on the face of the HPGe detector. The tried-and-tested ISOPLUS software, in its latest version now offers 64-bit compatibility with the latest Windows operating systems.

ISO-CART-85™ Ready When You Are!

ISO-CART-85 systems are provided “ready to go”, traceably calibrated at our factory. The standard configuration comprises:

- ISO-CART-II.[1]
- IDM-200-V large area, fully integrated HPGe spectrometer.[2]
- ISO-2-IDM-SHD Modular Collimator Kit. Includes three field of view collimators (2”, 4”, and 6”) and three 2” FOV collimator shields.
- Mounting hardware
- ISOPLUS waste assay software.
- Laptop computer with software installed.
- Factory calibration.
- All necessary cables and connectors.

Optionally for those who wish to supply their own laptop, a “user install and calibrate” version is available. If calibration is required but not a laptop, the calibration files can be provided for installation on the user’s own computer. The ISOPLUS software allows calibration or recalibration of the system by use of a traceable point source at any time. IT IS NOT NECESSARY TO RETURN TO OUR FACTORY TO RECALIBRATE.

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ISO-CART-II Optimized Transport System

ISO-CART-II represents a generational advancement over previous models, with improvements in several areas:

- Supports new and “legacy” spectrometry hardware
- Lightweight materials used wherever feasible in the interests of maneuverability.
- Adjustable front and rear track for extra stability even in tight spaces.
- Easy assembled and disassembled for transportation.
- Continuously and easily adjustable detector height and variable tilt adjustment.
- Unrestricted direct detector view of ground for soil assays.
- New modular collimator system allows minimum weight configuration (ISO-CART-85).
- Bottle counting option (ISO-CART-85).

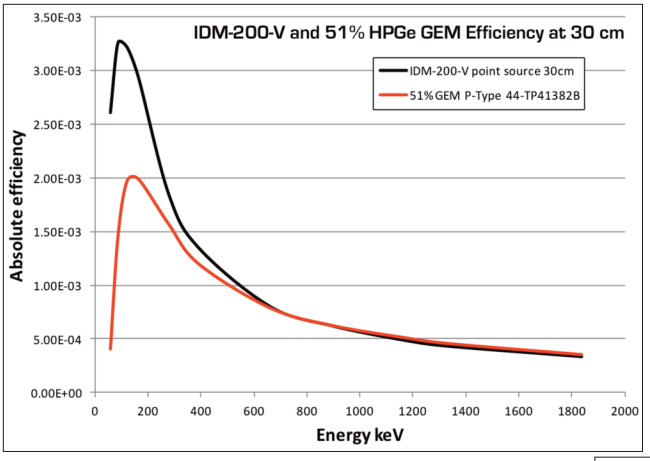
IDM-200-V the Measurement Foundation of the ISO-CART-85

The IDM-200-V is a completely self-contained package, comprising a single, large-area, mechanically cooled high-purity germanium (HPGe) detector of standardized crystal dimensions and all necessary spectrometry electronics in a RUGGED, low-power configuration which can be easily transported while operating.

- All-in-one fully integrated HPGe detector, Stirling cooler, cryostat, and signal processing electronics.
- Built in, fully integrated, high performance, digitally stable signal processing and 16k channel MCA.
- Operates from internal hot swappable battery for ~3 hours or from AC power. Longer battery life and other power options available.
- Rugged enclosure with carrying handles.
- Hardened cryostat eliminates “partial warm up” problem: no need to wait to temperature cycle HPGe detector.
- Maintenance free.
- Large area 85 mm x 30 mm HPGe crystal: high sensitivity (up to 200% of the surface area of other systems); lower MDA/faster time to MDA. Standardized crystal dimensions ensures uniform performance unit-to-unit.

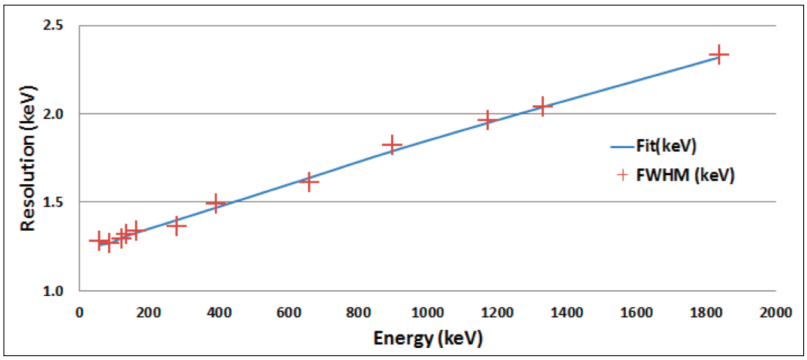
IDM-200-V: Germanium Detector

The ~50% relative efficiency HPGe detector in the IDM-200-V is of an “over-square” diameter-to-length profile. The large diameter enhances low energy efficiency. The figures below show the point source absolute efficiency curves of an IDM-200-V in comparison with a more conventionally proportioned detector of almost the same relative efficiency (51%). The IDM-200-V shows much higher efficiencies at low to medium energies, where container or matrix absorption effects are possibly the most problematic to measurements.



IDM-200-V and 51% relative efficiency HPGe GEM compared: Absolute efficiency, point source 30 cm.

Typical resolution versus energy.



IDM-200-V: Cryocooler and Cryostat

The IDM-200-V cryostat design evolved from the ORTEC Detective Hand-Held Identifier, itself a non-traditional design, which does not use molecular sieve as a cryo-pump, but does use all-metal seals and extremely clean construction methods. The all-metal seal construction results in a robust, long-life cryostat which can be temperature cycled, either completely or partially, indefinitely.

The low-power Stirling Cycle cooler can be turned off then on again at any time, with no risk, leading to operational time savings.

IDM-200-V: Digital Signal Processing Electronics

The digital signal processing (DSP) electronics subsystem used in the IDM-200-V is derived from the ORTEC DSPEC and Detective family systems. The low power design has extremely high stability in the presence of both count rate and temperature variation. During operation, approximately 30 watts of power (only) are required to operate the entire system either on DC or AC through a converter (supplied).

A low frequency rejecter feature greatly reduces the possibility of vibration induced microphonic detector performance degradation occurring in noisy non-laboratory environments.

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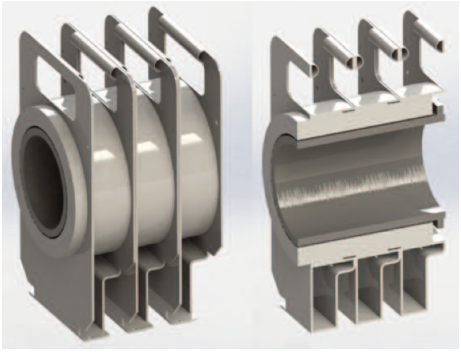
ISO-CART-85: Modular Collimator

A Minimum Weight Approach to Collimation

System weight is a major consideration in mobile assay systems which require, by definition, to be moved. As is discussed later, the ISOPLUS software operates based on the assumption that the detector “observes” a representative portion of the object through a defined “field of view” and then computes the total materials assay based on that. This requires that the detector be provided with a collimator to restrict and define a suitable field of view, representative of the sample. Another consideration is that the detector itself might be subject to external radiation from sources other than the object being measured, for example from other nearby waste samples. This might necessitate the use of a thicker collimator than otherwise needed. For this reason, and to allow choices to be made consistent with the minimization of weight, a modular collimator system has been designed in which a thinner, low-Z material-lined, field-of-view collimator can be augmented with additional detector shielding and thicker collimation as required by the background radiation.

The ISO-2-IDM-SHD Kit comprises 3 each thin-walled steel 15 mm thick, Sn/Cu lined field of view collimators, 2”, 4” and 6” in length to provide variability in field of view, and 3 each 2" deep, 1” wall thickness, lead sectional shields for the FOV collimator, (ISO-2-IDM-SHD-2). By choosing the appropriate Field of View collimator, the additional shielding may be added as circumstances require, thereby minimizing weight.

FOV collimators ISO-2-IDM-FOV-X. X = 6", 4" and 2" (left to right).



3 each ISO-2-IDM-SHD-2, mounted on ISO-2-IDM-FOV-6 providing maximum shielding and deepest collimation (full view and sectional view).

ISO-CART-85: Bottle Counting Shield Extension Option

The “In-Field Counting Lab”, Return to Base Not Required

From time to time it can be necessary in mobile assay applications to take a small bulk sample of contaminated material, for example soil, and to assay it in the “usual” measurement geometry: i.e. inside a lead shield, perhaps for screening purposes to establish that material is NOT contaminated to a lower detection limit than might be achievable with only a collimated detector. The ISO-CART-85 bottle counting shield extension may be mounted on the upward facing 6” version modular collimator and 3 each 2” lead shields to provide a small counting shield which will allow a 1 liter bottle of material to be counted directly on the endcap of the detector, in a high efficiency counting geometry.

The ISO-2-IDM-SHD-EXT option comprises the bottle counting shield extension for ISO-2-IDM-SHD and includes 6 each 1-liter bottles. The pre-calibrated ISO-CART-85 system is ready for use with this option.

ISO-2-IDM-SHD-EXT Bottle Counting Shield Extension mounted on 3 each ISO-2-IDM-SHD-2 and ISO-2-IDM-FOV-6

ISO-CART-85

ISOPLUS: Waste Assay Software for ISO-CART-II Systems

• Quantitative assay of gamma-emitting waste samples with an emphasis on ease of use and practicality.

• Analyze all types of gamma-emitting waste, fissile and non-fissile.

• Measure containers of many shapes and sizes, surfaces and even soils; via independently verified analysis methods.

• Use with any HPGe detector(s) and electronics. Available standalone or in factory pre-calibrated systems.

• Calibrate ANY detector on site, TRACEABLY, in minutes.

• 64-bit, Windows 7 compatible.

ISOPLUS provides a practical solution to a wide range of gamma-ray measurement problems encountered in site characterization prior to remediation and decontamination and decommissioning (D&D) operations. The methodology is based on work done originally at several US DOE sites in the analysis of thousands of fissile waste containers[1] and in methods developed at the US Energy Measurements Laboratory (EML-NYC) to measure wide-area contamination of soils and surfaces. It is used widely and has also been evaluated favorably in a number of “round robin” studies.

Applicability

The following geometries are easily accommodated by ISOPLUS:

• Boxes

• Drums

• Pipes

• Surfaces (Collimated Detector)

• Wide Area Assay of Soils and Surfaces (Uncollimated Detector: M-1 Methodology)

ISOTOPIC provides a number of standard geometry "templates" from which a specific measurement configuration may be developed. These include cylinders (from top and side; including lined cylinders (pipes)), boxes, point source (far field), and infinite plane. The infinite plane (soils) mode is for uncollimated measurement of contamination, fall out or wide area spills, either washed into or on top of an infinite plane surface, most typically soil on the ground.

Methodology

In container mode, for the counting of packages, pipes and surfaces, the detector is characterized by a single point source measurement.

This primary calibration, which can be traced to a certified standard, for any detector, is extrapolated or modeled to match the physical situation of the sample; container geometry, material, and matrix composition.

A measurement geometry is established through knowledge of physical and geometrical parameters: collimator geometry, stand-off distance. From this, a field-of-view can be computed to define the proportion of the measured object actually within “view” of the detector system. Knowledge of this and of the actual physical dimensions of the object itself allows correction of the measured radiation to the total object assay. The model is based on "point-kernel" methods in which the entire measurement problem is broken down into multiple source/matrix voxels and their contribution to the composite spectrum are calculated and summed. The approach, which is similar to Monte-Carlo methods, utilizes detector parameters (crystal diameter, crystal length, dead layer, and endcap thickness) which the user supplies as part of the measurement configuration. No special separate measurements are needed to characterize the detector other than one point-source calibration.

In “soil mode” for uncollimated wide are soil measurements, the M-1 or “Beck” methodology is used. More details of both of these methods may be found in the ISOPLUS brochure.

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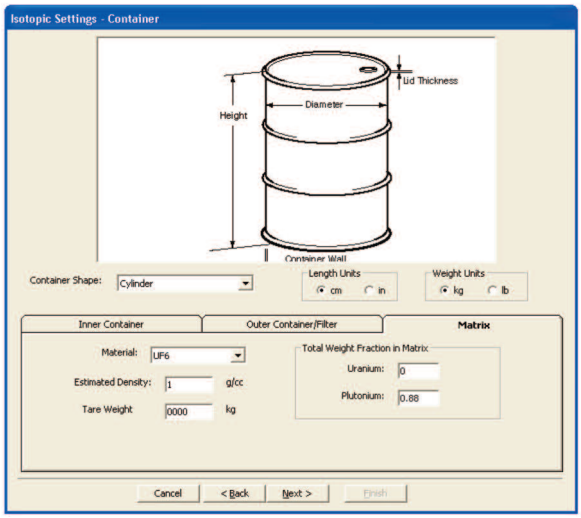
Container Mode Operation

There are two operational modes: supervisor and operator. The operator need make choices only from the minimum subset of system options defined by the supervisor. The supervisor mode defines what operations the operator is allowed to carry out. A wizard guides the supervisor through the process of setting up the operator procedures. The wizard presents the parameters on logically grouped screens, with an emphasis on clarity of approach. A "field-of-view" calculator provides a simple way to set up the detector-to-sample distance for the current collimator.

Supervisor mode calibrates the system, creates libraries, defines sample geometries, matrices, collimators to be used, and other functions for later use by the operator. Supervisor can also define which features operator may access.

In routine use, for container analysis, the operator need only start the acquisition, select the configuration (nearest standard container configuration), and enter the "book keeping data" such as container ID, type, weight, and the critical measurement data, such as detector-to-container distance, or “stand-off”.



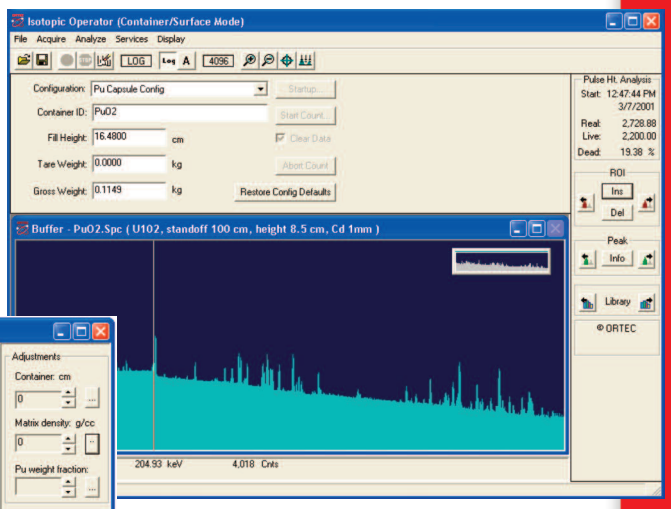
Supervisor Mode Drum Configuration Setup.

The standard container configurations and collimator configurations are defined and specified by the supervisor. A container configuration includes the default dimensions, materials, and matrix detail. Any number of these configurations may be specified and recalled by the operator when needed.

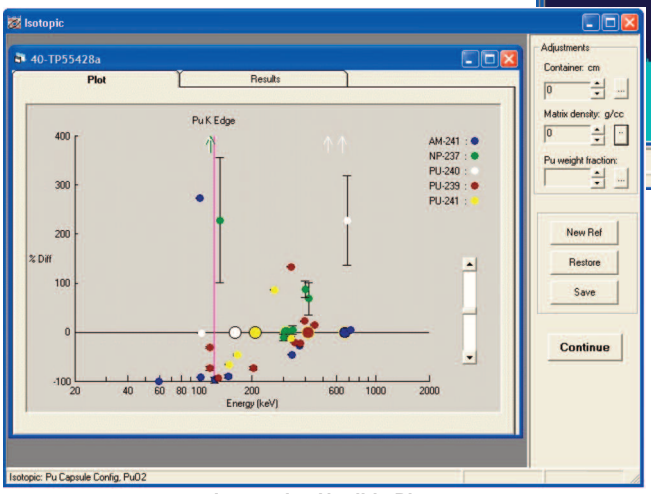
When the analysis is complete, the operator can adjust the container/matrix physical parameters (such as matrix density or container wall thickness) to optimize the results by use of the interactive nuclide plot.The plot shows the percentage difference between the corrected measured activity and the activity calculated for the reference peak for each nuclide.

Reports

These results may then be printed and archived. The report files are written in either a database summary or as complete reports showing all input and correction information. Custom reports may be generated by the use of the report generator option. The tabulated components of error estimates can be used to help reduce overall uncertainties, for example, by extending count time or repositioning the detector. The user is also warned if any of the corrections appear to be excessively large. Minimum Detectable Activities (MDA) are calculated for each nuclide. Activities, grams of U or Pu, or MDAs from multiple measurements may be reported as weighted averages. The weighting is user definable.



Example Operator Mode Screen.



Interactive Nuclide Plot.

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System Performance and Detection Limits (MDAs and MDCs)

Actual count times to specific detection limits will always depend on the nuclide in question, the density of the sample, the container, the counting geometry and the radioactivity in the environmental background as "seen" by the detector. The bottle counting option geometry is more closely defined than the geometry for counting waste containers. For waste containers, the limit of detection also depends on the field of view of the collimator. If the whole of the container is in the field of view of the collimator a larger field of view will increase (degrade) the MDA. If less than the whole of the container is in the field of view of the collimator, the smaller the field of view, the higher the MDA. The following may be used as an approximate guide to the minimum detectable concentrations (MDCs) achievable:

Bottle mode, light waste 0.3 to 0.4 g/cc, count time 2000 sec.

Nuclide	MDC (bq/kg)
Cs-137	3.5
Co-60	4.4

Container Assay mode, light waste 0.3 to 0.4 g/cc, count time 2000 sec depending on field of view.

Nuclide	MDC (bq/kg)
Cs-137	2–4
Co-60	2.5–5.5

Ordering Information

Model	Description
ISO-CART-85-PC	**Complete ISO-CART-85 System, Factory Calibrated.** Includes ISO-CART-II, IDM-200-V-ISO-2-DCC Detector-Collimator carrier for IDM-200-V, ISO-2-IDM-SHD modular collimator, IDM-200-V Integrated HPGe spectrometer, ISOPLUS (ISOTOPIC) software, ISO-CAL point source factory calibration, and Laptop computer with software loaded (printer not included).
ISO-CART-85-NOPC	**ISO-CART-85 System Without PC or Factory Calibration.** Includes ISO-CART-II, IDM-200-V-ISO-2-DCC Detector-Collimator carrier for IDM-200-V, ISO-2-IDM-SHD modular collimator, IDM-200-V Integrated HPGe spectrometer, and ISOPLUS (ISOTOPIC) software.
ISO-2-IDM-SHD-EXT	**Optional Bottle Counting Extension** for ISO-2-IDM-SHD. Includes 6 each 1-liter bottles.
Individual Components (for use on ISO-CART-II only)	
ISO-2-IDM-SHD	Modular collimator kit for use with IDM-200-V, includes 1 each ISO-2-IDM-FOV-2 2" Steel Field of View Collimator 1 each ISO-2-IDM-FOV-4 4" Steel Field of View Collimator 1 each ISO-2-IDM-FOV-6 6" Steel Field of View Collimator 3 each ISO-2-IDM-SHD-2 2" deep lead sectional shield for FOV collimator.
ISO-CAL	Point source calibration at the factory (if PC not ordered, files will be supplied separately)
ISO-CART-II	Cart only (no Detector-Collimator carrier (DCC) or collimator)
IDM-200-V-ISO-2-DCC	Detector-Collimator Carrier for IDM-200-V
ISO-2-IDM-FOV-2	2" Steel Field of View Collimator for use with IDM-200-V, Sn/Cu lined
ISO-2-IDM-FOV-4	4" Steel Field of View Collimator for use with IDM-200-V, Sn/Cu lined
ISO-2-IDM-FOV-6	6" Steel Field of View Collimator for use with IDM-200-V, Sn/Cu lined
ISO-2-IDM-SHD-2	2" deep lead sectional shield for FOV collimator. 1" wall thickness
IDM-200-V	Integrated HPGe spectrometer
ISOPLUS-BW	ISOTOPIC Waste Assay analysis software

Specifications subject to change
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