



Automatic waste assay system GAMS4 is designed for characterization (radionuclides composition and their activities measuring) of low-activity radioactive waste stored in 200L drums. The assay system is manufactured according to the nuclear industry standards and safety regulations. The measured values (gamma spectrometric profile of the waste material) are used for radionuclides content declaration and hot-spots identification for further treatment of characterized materials or package sets (identifying, quantifying, and sorting radioactive wastes).

## Benefits

- Waste-packages activity measurement ISO 14850
- Electromagnetic compatibility (EMC) EN 61000-4 (corresponding parts and levels)
- Automatic feeder system with capacity for automatic changing up to 3 drums – 200L (loaded drum, currently measured drum and already measured drum ready to unload)
- Barcode identification system including barcode reader and barcode labels printer

## Key Figures

### 3 x HPGe

*Number of detectors*

### 8 Drums/hour

*Maximum measuring capacity*

### 100 mm

*Lead shielding*

## Product Description

The system consists of three main parts:

### Automatic feeder system

With capacity for automatic changing up to 3 drums – 200L volume (capacity for loaded drum, currently measured drum and already measured drum ready to unload).

### Low background measuring chamber

With automatic shielded sliding door and integrated drum station. The drum station (drum rotator and weighting module with interface to automatic feeder system) is dedicated for the controlled rotating weighing of the charge.

### Measurement and evaluation part

The spectrometric apparatus contains 3 pc of HPGe semiconductor detectors, electric mechanical cooling (optionally liquid nitrogen cooling system LN2), spectrometric measurement lines consisting of digital MCA, backup UPS power supply and control and power systems.

The system include compact graphic/touch terminal (control unit) for manual in-site control of system components, system diagnostics and setting of the system parameters. The system includes standard LAN and Wi-Fi interface and can be controlled by means of remote management (conduct of measurement, diagnostics and setting of the system).

## Control software

### GAMWIN SW FULL (included)

Comprehensive Spectroscopy Analysis Software package

### GAMSControl

Management of the whole proces of measuring and checks. This SW controls the entire device and all of its components, allows to configure and manage all the system settings

### EffTrace

Software for rapid estimation of gamma-pectrometric detection efficiency (scintillation and HPGe) for arbitrary objects; it uses an analytical solid-angle calculation with attenuation corrections in a 3D geometry and user-supplied efficiencies versus distance, angle, and energy, making it compatible with any detector.

## Product Specifications

### Detectors

3 pcs of Coaxial HPGe Detectors (PopTop, SMART version)

### MCA

ORTEC DSPEC jr 2.0 – 16k channels portable HPGe MCA

### Cooling system

3 pcs of electromechanical cooler

### Measuring chamber

Measuring chamber with integrated drum station shielded by 100 mm low background lead with shielded sliding door. Copper and tin coating – 1 mm copper and 0.5 mm tin liner. Heavy shielded sliding door with optical safety sensors and electrically controlled.

### Automatic feeder

T type automatic feeder system (five segments conveyor belt fully demountable) with capacity for automatic changing up to 3 drums – 200L (loaded drum, currently measured drum and already measured drum ready to unload).

### Drum station

Integrated drum rotating station/unit ensuring uniform drum rotation during the measurement process with certified tensometric scale. Weighting range from 0 to 600 kg with accuracy of 0.2 kg.

### Collimators and shields

Automatically adjustable collimator according to the activity and/or geometry – slot opening angle of 0-90° (three default positions). Low-background Lead shielding 70 mm coated of 1mm of stainless steel.

### System calibration

Factory efficiency calibration for 200L drum. The efficiency calibration is selected based on drum weight, or based on the description in the waste package database (Monte Carlo Techniques).

### Dimensions

Height 2600 mm, width 3300 mm, depth 2500 mm

### Drum station dimensions

Height 500 –570 mm, width 850 mm, depth 850 mm

### Weight

7500 kg (fully assembled)

### Start-up time

< 5 min (without detector cooling time)

### Power supply

3 NPE ~ 50Hz 230/400V TN-S (220/380V)

### Operating and storage temperature

From 5 up to 40 °C (operating), from 5 up to 60 °C (storage).

### Relative air humidity

< 80 % (non-condensing)

### Power consumption

9.5 kVA (MAX), surge protection type 3

### Backup power supply

AC 230V / 6A, time coverage of power interruption: 10 min (measuring part)

## Operational Information

The automated assay system is equipped with a low background measuring chamber with integrated drum station due to which is achieved an excellent sensitivity necessary for free release measurement (detection limits easily meet free release levels). The measuring chamber is composed from construction segments assuring easy assembly and installation.

The measured drums are put on the "T" shape automatic feeder system. The system automatically shifts the drum to the measuring chamber on the drum station (rotating and weighting unit) to set the drum to the start measuring position. The drum station ensures the measurement of a drum contents on required position. All charges are weighed using integrated certified weighing system. After loading of the drum the system automatically close the sliding door.

Measurement is performed using 3 pcs of semiconductor detectors in the fixed positions with variable measurement time. Semiconductor detectors are placed in a vertical axis to ensure the measuring of the entire height of the drum. The measurement is automatically adjusted in accordance to the activity of the charges in the drums. Radionuclides are identified using spectrometers including HPGe detectors.

Any standard HPGe detectors may be used with the assay system (with conventional LN2 cooling Dewar vessel or with electro-Mechanical cooler.

Measurement process is initiated after the system stability and background check. After loading of the drum to the measuring chamber on the drums station (shifting on the automatic feeder from the store position to the measuring position) and its identification and registration the system starts the measurement according to the settings. Measurement process can run in manual or in a fully automatic mode. The measuring system has an internal diagnostics of the state of individual subsystems.

After introductory initialization and start of the measuring the Operator has the possibility to observe current measured data (spectra) and diagnostic status during the measurement and to control the measurement output data sets, results and reports after completion and evaluation of the measurement.

After initiating of the measurement the drum starts to spin (in order to average out matrix attenuation effects). The measurement is completed after the measurement time or if the spectrum is acquired. In case of detector overloading the measurement is automatically elongated.

Activities of particular radionuclides are determined using GamWin and GAMSCONTROL software packages. Measured values from individual lines are compared and the activity distribution based on homogeneity of measured sample/charge is assessed. The results of each measurement analysis are stored in a local database on the evaluation PC.

The low level assay system allows measuring of the radionuclides emitting gamma photons in the energy range from 50 keV. The photons generate electric pulses that are amplified in a pre-amplifier, and subsequently processed and digitized in a digital signal processor. Digital signal is stored in a multichannel analyzer as gamma-ray spectrum. Measured spectra are transferred to a computer, and using professional gamma spectrometric application GamWin displayed, analyzed and evaluated.

The result of the measurement is a registration record in GAMSCONTROL application and output protocol which comprises an identification of the load, radionuclide composition, total mass activity, MDA, combined measurement uncertainty and other necessary information.



## Options & accessories

### Conveyor

Automated conveyor line / feeder for selectable number of the 200L drums. Conveyor line shape «I» - through direct open, «U» - semicircle open or «O» - circular closed. Adaptation for different material packages (20L, 50L or 100L drums) is available on user request.

### Advanced MCA

ORTEC DSPEC 50 - DSP-Based Gamma Ray Spectrometers for Germanium Detectors for High-Rate Spectroscopy Applications. 16k channels MCA, highly stable against variations in count rate and temperature, PHA and List Mode acquisitions, automated set-up (Automatic Pole Zero Adjust, Baseline Restorer, and Optimize), digital spectrum stabilizer, USB 2.0 and Ethernet capability (TCP/IP protocol), large front panel display for system status information, support for all HPGe detector types, advanced DSP Algorithms (ZDT "loss free" dead-time correction with uncertainty calculation, Low Frequency Rejection (LFR) mode, Resolution Enhancer, Enhanced Throughput Mode).

### Integrated system

ORTEC IDM - Interchangeable HPGe Detector Module - All-in-one integrated HPGe detector, cooler (Stirling-cycle), cryostat, and signal processing electronics, internal battery for ~2.5 hours following power failure. Large HPGe detector (85 mm x 30 mm HPGe crystal), coaxial construction, P-type high-purity germanium. Relative Efficiency >50% typical (ANSI/IEEE 325-1996), energy resolution  $\leq 1400$  eV @ 122 keV and  $\leq 2.3$  keV @ 1332 keV, peak shape 1.9 typical (FWTM/FWHM). Integral Dose Rate Monitor, 16k channels digital MCA, USB connectivity.

### Verification source/kit

Point source for energy calibration, volume source for efficiency calibration checks (selected mix).

### Reduction for small packages

A fourth intermediate detector position, with removable plug, between the bottom and middle detectors positions to facilitate the counting of smaller waste packages.

### LN2 cooling system

ORTEC M7L - Gamma Gage Cryostat with 7-liter Multi-Orientation Dewar (five day holding time).

### LN2 filling system

50-liter self-pressurized dewar, 6-foot transfer line, pressure-fill bayonet, and withdrawal device.

### System Calibration

Factory efficiency calibration for 100L and/or 50L and/or 20L drums. The system automatically changes the efficiency calibration according to used type of drums (Monte Carlo Techniques).

### Application interface

Application interface from/to external application (XML).

### Camera system

The camera system allows monitoring of the entire space with a measuring apparatus and automatic feeder.

## Product Application

- Gamma spectrometric measurement of waste
- Decommissioning of nuclear facilities