MIRION TECHNOLOGIES

RoboCount™ 2020

Robotic Gamma Waste Assay System

FEATURES

- Robotic gamma waste assay system
- Non-destructive assay of 100-l, 200-l, 400-l radioactive waste waste packages, crates, pallets, FIBSs, etc.
- Wide range of high-purity germanium detectors, liquid nitrogen (LN2) or electrical detector cooled
- Multi-channel analyzer (MCA) with digital signal processing (DSP)
- Selection of custom collimators for any waste package size, activity, and assay type
- Separate waste package rotator with integrated scale
- Heavy-duty, low-maintenance design based on an industrial robot platform
- Powder-coated finish for ease of cleaning and decontamination
- Operated by tightly integrated RoboCount™ 2020 waste assay software
- Options including bar-code reader, dose rate sensor(s), spray-paint labelling etc.

ROBOT

The heart of RoboCount™ 2020 is a 6-axis industrial robot – COMAU Smart 5 NJ 220 2.7 Safe with a useful load of up to 220 kg. The robot is significantly over-dimensioned to virtually eliminate wear and to allow for future use of multiple detectors and/or more massive lead shielding.

A separate waste package rotator (7th robot axis) increases the flexibility of the system by allowing traditional segmented scanning (SGS) as well as measurements of homogeneous waste packages by integral gamma scanning (IGS).

DESCRIPTION

Extensive operational experience from previous models has been taken into account in the design of the RoboCount™ 2020, overcoming the shortcomings of traditional gamma scanners.

The key idea in designing RoboCount™ 2020 was to use a proven industrial robotic platform, mate it with the best available high-resolution gamma spectrometry hardware and software, and provide seamless control by a dedicated multi-platform user application.

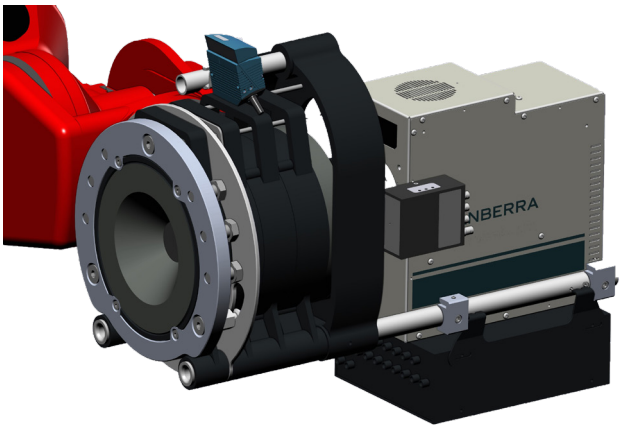
INTRODUCTION

Non-destructive assay (NDA) is an important part of any radioactive waste management operation, from nuclear power plants to institutional users of radioactive material. As radioactive waste is typically stored in waste packages, standardized solutions for NDA of specific types of waste packages have been developed in the form of ‘gamma scanners’. Traditional gamma scanners are frequently compatible with just one waste package type, e.g., the 200-l drum, and perform just one measurement type, e.g., segmented gamma scanning.

However, situations where several types of waste packages need to be assayed, a wide range of activities and/or dose rates is to be covered, more than one assay type is desired etc. are becoming increasingly common. Instead of acquiring several dedicated units, it seems preferable to employ a universal NDA systems capable of assaying any waste package in an unrestricted choice of geometries, following any current or future measurement protocol. Meet the new robotic gamma waste assay system RoboCount™ 2020!

The robust waste package rotator is capable of handling waste packages of up to 2500 kg. It features adjustable brackets for waste packages of varying diameters, rotation speed adjustable from 1 to 10 rpm with soft start/stop, and an integrated waste package scale with a resolution of + 1 kg.

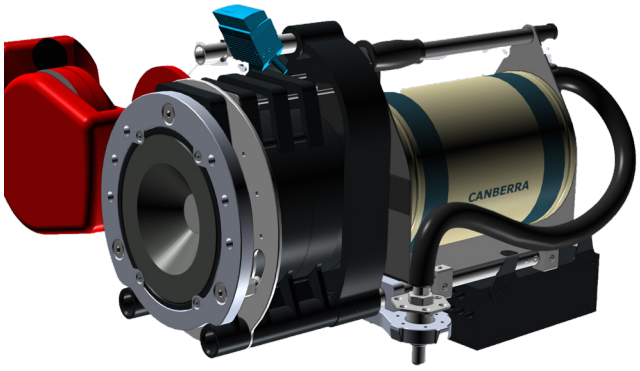
RoboCount™ 2020 is fully computer controlled from the system PC through a COMAU C5G industrial robot controller with a teach pendant. A number of system functions are also accessible via a touch screen panel on the teach pendant



DETECTOR & CRYOSTAT

A wide variety of high-purity germanium HPGe detector types are supported by RoboCount™ 2020, including standard coaxial detectors as well as broad energy detectors. The detector of choice is mounted in a remote detector chamber cryostat. This allows a back shield to be used, minimizing any interfering radiation that may enter the rear of the detector. Whichever type and size of detector is chosen, its energy response can be determined by mathematical or empirical calibration.

RoboCount™ 2020 is designed to accommodate a multi-attitude liquid nitrogen (LN2) cryostat with a LN2 capacity of 7 l and a holding time of up to about 5 days. LN2 refill from a 50-l or larger supply Dewar is fully automated. At pre-determined intervals, the robot connects the detector Dewar to a docking station and a refill is initiated. It stops when the temperature sensor in the outlet port detects the change from gaseous to liquid nitrogen. The robot then undocks the detector.



If a central building LN2 supply is available, even the supply Dewar exchanges could be eliminated For ultimate convenience, an electrical cryostat is available as an option.

COLLIMATOR

RoboCount™ 2020 features a unique collimator consisting of three fixed cylindrical shielding elements and an exchangeable collimator segment which is automatically selected by the software based on the waste package and assay type, detector dead time, waste package dose rate etc. The selected collimator segment is picked up by the robot from a collimator tray and attached to the front of the detector shield assembly.

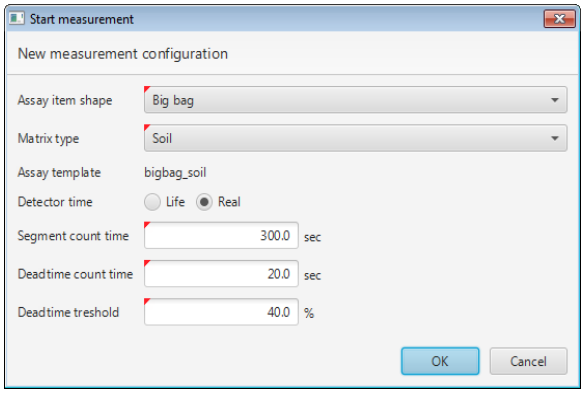
A set of custom collimators is supplied with each RoboCount™ 2020, their number and type determined by package type/size, activity, and assay type. They might include a collimator with a rectangular aperture (horizontal slit) optimized for SGS of drums, conical aperture for IGS of large waste packages, etc. Collimator selection is made by the control software based on the measured detector dead time or measured waste package dose rate, waste package type, and assay type. In addition to the robotic collimator change, the distance between the detector and the waste package is also automatically adjusted to provide an optimal detector field of view.

MCA

The selection of a multi-channel analyzer (MCA) is guided by the necessary compatibility with the HPGe detector, performance specifications, mechanical robustness, physical size, and the available communication interface. An MCA with digital signal processing (DSP), capable of being mounted as close as possible to the detector for minimum interference, is recommended. Undisturbed communication with the remote-control PC requires a LAN connection.

SOFTWARE

The RoboCount™ 2020 is operated by dedicated software designed to be a complete acquisition, analysis and archival package for use specifically and exclusively with RoboCount™ 2020. The software is seamlessly integrated with the award-winning CANBERRA Genie™ 2000 software, providing the ease and flexibility of operation found in the popular gamma-ray spectroscopy applications.



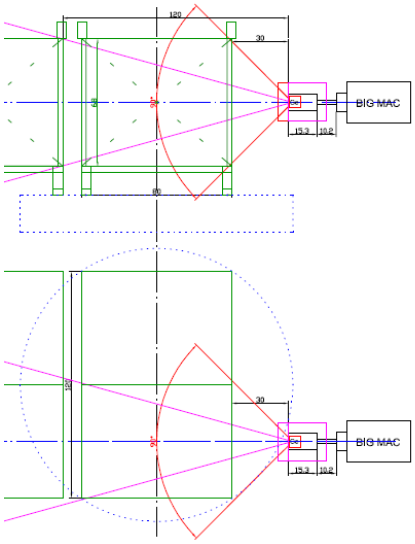
Following setup, operation can be as simple as a single click of the mouse where a full assay sequence is launched requiring little or no operator intervention. The software supports a variety of analysis types to provide flexibility in sample assay. With the Genie™ 2000 Analysis Sequence Editor it is possible to select which type or types of analysis is to be performed for a given sample. Various counter arrangements, detector arrangements, analysis sequences, hardware control, and reports can be generated from the standard software.

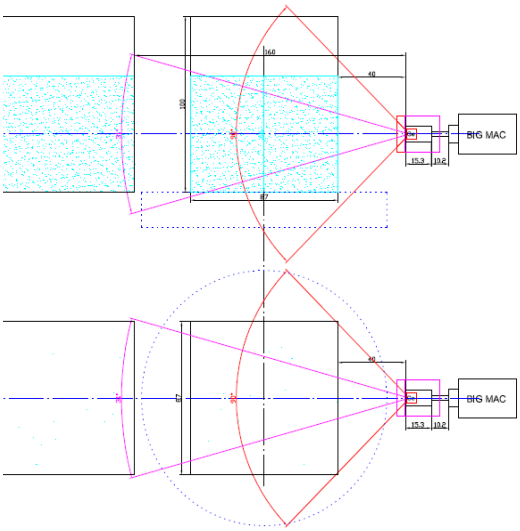
A variety of standard reports have been created. However, a special feature of Genie™ 2000 and the RoboCount™ 2020 software is the capability for the customer to edit existing or create new report templates which will fit particular site requirements. All report structures can be easily edited in a standard ASCII editor. Any parameter which is stored in the CAM file can be included in a report.

Analysis is performed automatically during and following completion of the assay. The data may also be completely re-analyzed using the Data Review menus. Data storage utilizes the Genie™ 2000 CAM file format. Data files may be re-analyzed one at a time or if many assay results require the same parameter correction, a batch reanalysis capability is provided.

PERFORMANCE

Actual measurement performance depends on detector size, assay time, measurement geometry, etc. Measurement geometries for crates (90o cylindrical collimator, 30 cm detector – WP distance; (30o cylindrical collimator, 120 cm detector – WP distance) and FIBCs (90o collimator, 40 cm detector – WP distance; (30o collimator, 160 cm detector – WP distance), respectively, are depicted below.





Typical results evaluated for steel scrap (1.5 g/cm3) in crates and concrete rubble (2.0 g/cm3) in FIBCs, respectively, are shown below.

Waste Package	Crate, 1200 x 800 x 800 mm		
Matrix Material	Steel Scrap		
Matrix Density / kg.m^{-3}	1.5		
Geometry	90°, 30 cm		
Nuclide	^{137}Cs	^{60}Co	
Energy / keV	661.6	1173.2	1332.5
Peak Efficiency	4.51E-6	3.79E-6	3.66E-6
Count Rate @ 10^5 Bq / cps	0.4	0.4	0.4
Counts @ 10^5 Bq in 240 s	92	91	88
Count Rate @ 10^9 Bq / cps	3842	3790	3660
Counts @ 10^9 Bq in 240 s	922 205	909 600	878 400
Geometry	30°, 120 cm		
Nuclide	^{137}Cs	^{60}Co	
Energy / keV	661.6	1173.2	1332.5
Peak Efficiency	1.77E-7	2.09E-7	2.18E-7
Count Rate @ 10^9 Bq / cps	151	209	218
Counts @ 10^9 Bq in 120 s	18 120	25 080	26 160

Waste Package	FIBC, 870 x 870 x 1000 mm		
Matrix Material	Concrete Rubble		
Matrix Density / kg.m^{-3}	2.0		
Geometry	90°, 40 cm		
Nuclide	^{137}Cs	^{60}Co	
Energy / keV	661.6	1173.2	1332.5
Peak Efficiency	4.20E-6	3.45E-6	3.32E-6
Count Rate @ 10^5 Bq / cps	0.4	0.3	0.3
Counts @ 10^5 Bq in 240 s	86	83	80
Count Rate @ 10^9 Bq / cps	3578	3450	3320
Counts @ 10^9 Bq in 240 s	858 816	828 000	796 800
Geometry	30°, 160 cm		
Nuclide	^{137}Cs	^{60}Co	
Energy / keV	661.6	1173.2	1332.5
Peak Efficiency	1.15E-7	1.31E-7	1.35E-7
Count Rate @ 10^9 Bq / cps	98	131	135
Counts @ 10^9 Bq in 120 s	11 760	15 720	16 200

The accuracy of the measurement is based on the assumed uniformity of the activity as well as matrix density distribution within the waste package. Typical accuracies are ±20% for waste packages with matrix densities up to 1 g/cm3.

SAFETY

RoboCount™ 2020 is compliant with all applicable safety regulations, in particular 2006/42/EC and equipped with software and hardware motion range limiting devices.

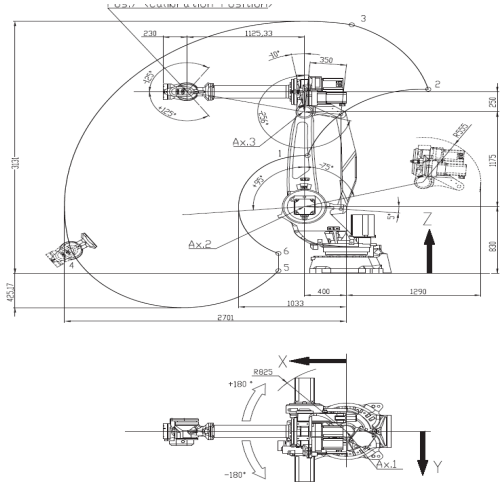
For added personnel protection, the entire robot work area is surrounded by a light curtain. Interruption of any light beam will result in an immediate cessation of all mechanical motions of the robot. In situations where the safety perimeter around the robot is not rectangular, a safety scanner can replace or complement the light curtain.

SPECIFICATIONS

Waste package weight up to 2500 kg
Waste package diameter up to 1500 mm
Detector positioning around 6 axes
Liquid nitrogen HPGe detector cooling, automatic refill from 50-200 l supply Dewar
Set of custom collimators, robotic change
Waste package rotation speed range 1 - 10 rpm with soft start/stop
Integrated waste package scale, precision + 1,0 kg
Weights (nominal)

- Robot 2500 kg
- Rotator module 475 kg
- Control cabinet 305 kg

Dimensions of work area 5500 mm (l) x 5500 mm (w) x 3200 mm (h)
Power requirements 3L+N+PEAC 400 V, 50 Hz, 18 A, 12/30 kVA
Environmental conditions 0 – 50 oC, max. 80% rel. humidity



OPTIONS & ACCESSORIES

- Electrical HPGe detector cooling
- Dose-rate sensor(s) for pseudo-contact, 1m, or other measurements, maximum and average value determination, dose rate mapping
- Bar-code reader, 1D laser-based or 2D/QR camera-based, fixed location or find/read
- Unattended QA measurements – check source measured without collimator, periodically or as needed
- One or two additional HPGe detectors and a field-of-view lead shielding for low-MDA clearance measurements
- Attachment for taking smear samples of waste package surfaces
- Attachment for industrial spray marking of waste packages
- Transmission source robotic module, sealed radioactive source in a lead shield, enabling matrix density correction and/or transmission tomography
- Automatic assay of more than one waste package in a batch – infeed/outfeed conveyors or integration with a robotic pallet truck or fork lift

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