MIRION
TECHNOLOGIES

MULTI-USE HPGe SPECTROMETER

Aegis™

Portable HPGe Spectrometer

Remotely controlled via a wired or wireless connection, the Aegis Portable HPGe Spectrometer allows high resolution spectroscopy measurements to be made from a safe, comfortable location.

The Aegis transportable, battery-powered HPGe gamma spectrometer offers many state-of-the-art features, such as a thermal-cycle free cryostat, an integrated all-in-one design and laboratory-grade energy resolution. All this is combined with larger HPGe crystals and the option to integrate with a Remote Detector Chamber (RDC) cryostat, enabling detector backshielding. These features make the Aegis spectrometer easily deployable for multiple uses in the field or in the lab.

With IP65 ingress protection rating and no cooling fans, the system can be deployed in heavy rain conditions and dusty environments without the risk of contaminating internal parts. The exterior surface is designed to be easily decontaminated and put back into service quickly. With an integrated, highly efficient cooler, the detector remains cooled down in a wide ambient temperature range up to 50 °C (or 122 °F).

FEATURES

- ✔ Thermal-cycle free cryostat
- ✔ Laboratory-grade energy resolution
- ✔ Choice of large 40% and BE5030-type HPGe crystals
- ✔ RDC option enabling backshielding
- ✔ Two measurement mode options: Standard sample counting and Continuous Spectroscopy Monitoring (CSM)
- ✔ Easy to deploy all-in-one design
- ✔ System control via Genie™ software
- ✔ IP65 ingress protection rating
- ✔ Operational in -20 °C to 50 °C (-4 °F to 122 °F) ambient temperature when cooled down

The Aegis spectrometer is either controlled by Genie software when measuring in a traditional sample counting mode, either by the embedded Aegis Dashboard UI, when measuring in an automated Continuous Spectroscopic Monitoring (CSM) mode. As the all-in-one Aegis system can be easily deployed in challenging in-situ environments, the embedded CSM features provide powerful benefits:

- Monitor isotopic activity levels in real time
- Reduce worker exposure risk of manual sampling
- See risk signals and respond faster
- Make data-driven decisions to support safe and efficient operations

MULTIPLE STANDARD CONFIGURATIONS

Aegis unit is the first portable HPGe gamma spectrometer to offer a range of detector and cryostat options: three different HPGe crystal types with the ability to add a Remote Detector Chamber (RDC) to each one. The standard crystal offering is **a large 40% coaxial crystal** featuring excellent sensitivity for gamma photon energies ranging from 40 keV up to 10 MeV. If the best efficiencies are required below 100 keV (down to 15 keV), **a 40% XtRa™ coaxial crystal** is better suited. For the ultimate performance in sensitivity, the **BE5030 crystal** can be selected, offering the best possible energy resolution down to 15 keV, as well as ~45% relative efficiency at 1332 keV.

While transportable HPGe spectrometers traditionally have integrated the crystal in the body of the device, the Aegis spectrometer is also available with an optional RDC cryostat. This feature separates the HPGe crystal from the rest of the unit, enabling backshielding of the crystal.

Added design benefits are as follows:

- Along with excellent HPGe gamma-photon efficiencies and energy resolutions in all attitudes, background conditions can be easily optimized in any field or lab applications;

- The Aegis spectrometer can be deployed as a multi-use system. Emergency responders, for example, can set up the system under a standard lab lead shield and, in case of emergency, it can be moved for specific field applications;

- The unit is compatible with standard ISOCS carts as well as most laboratory HPGe Shields.

Switching between measurement setups is quick and easy, providing a multi-use portable counting system. Accurate on-line activity information is available by simply connecting a Genie computer to the Aegis spectrometer through Wi-Fi or a single Ethernet cable.

BENEFITS

- ✔ Wide energy range covering most field situations and many lab applications
- ✔ Built-in UPS and thermal-cycle free cryostat for maximum operational time
- ✔ Rugged, automated sampling for real-time decision-making
- ✔ Compatible with the Canberra™ ISOCS™ cart
- ✔ Multi-use (lab, ISOCS cart, mobile units, field)
- ✔ Allows rapid in-field ISOCS/LabSOCS™ efficiency calculations without sources for wide range of simple and complicated geometries
- ✔ Deployable in heavy rain and dusty environments with no risks of internal contamination

The Wi-Fi interface simplifies the measurement of difficult-to-access, uncomfortable, or contaminated areas by minimizing stay-time for the operator. Simply set the system up and move to a more desirable location to initiate and analyze a count.

Four mounting holes at the bottom and six mounting holes at each side are positioned according to the VESA 100 x 100 mm² standard, enabling easy mounting solutions for any application. With the optional AEGIS ISOXADAPT and AEGIS 7413ADAPT adapter kits, the Aegis spectrometer can also be mounted on any new or existing Canberra ISOCS cart and 7413-425 tripod, respectively.

BATTERIES

The system is equipped with two rechargeable LiFePO4 batteries, which are hot swappable and provide up to 2.5 hours of operation autonomy in a cooled-down state. The batteries are designed and sized to be UN3481-certified for shipping with equipment via air freight. The hot swappable feature allows the unit to be deployed in the field for continuous operation with the use of additional charged batteries. Fully charged batteries can then replace batteries in use, one by one, before complete depletion without interrupting the ongoing measurement. The system is provided with a total of four batteries (two internal, two spare), and additional spares can be purchased.

WHY LIFEPO4 BATTERY PACKS?

The lithium iron phosphate battery, known as LiFePO4 or LFP, is a lithium-ion battery with lithium iron phosphate as cathode material. The LiFePO4 battery pack has many advantages over standard Li-ion packs:

1 **Inherently safe:** This technology is much less likely to experience "thermal runaway" or sudden and continued overheating, possibly leading to an explosion. It is, thus, more stable and safer than Li-ion in terms of flammability and explosion risk.

2 **Longer service life:** Typically 1000-2000 charge-discharge cycles, which is more than other lithium-ion technologies. Also, LFP cells have a lower internal discharge rate and can typically support longer storage times.

3 **Environmentally friendly:** This technology does not contain any metallic chemical element or precious metals.

4 **Wide operating temperature range:** LFP cells tend to have less life cycle degradation at extreme temperature levels.

## THERMAL-CYCLE FREE CRYOSTAT DESIGN

The Aegis spectrometer comes with a thermal-cycle free cryostat design which guarantees minimal down time in case battery power is accidentally depleted when in a cooled-down state. While a conventional cryostat detector must be first completely warmed up to room temperature before it can be cooled back down, the Aegis cryostat incorporates improved technology not requiring such a full thermal cycle. As soon as the operator notices power loss, they can correct the problem at their earliest convenience and immediately cool down the system again, instead of having to wait for a full thermal cycle. This means the Aegis unit can be put back into service more quickly, in minutes or hours instead of days, in the event of a partial warm up. Cooling down from room temperature requires <12 hours at an ambient temperature of 25 °C.


CONTROL AND COMMUNICATIONS

A PC or tablet is used to control the system through an Ethernet or Wi-Fi connection. In addition, a GPS module is integrated into the unit. The Wi-Fi and/or GPS modules can be removed in the factory upon request. An RJ-45 connector is provided on the back panel along with the power supply jack and six multi-purpose GPIO connectors which enable monitoring of the amplified energy signal and processing of TTL compatible signals for:

- Sample-changer control
- PHA acquisition status
- PHA external start/stop control
- Incoming count rate
- (Anti-)concidences
- Fault status
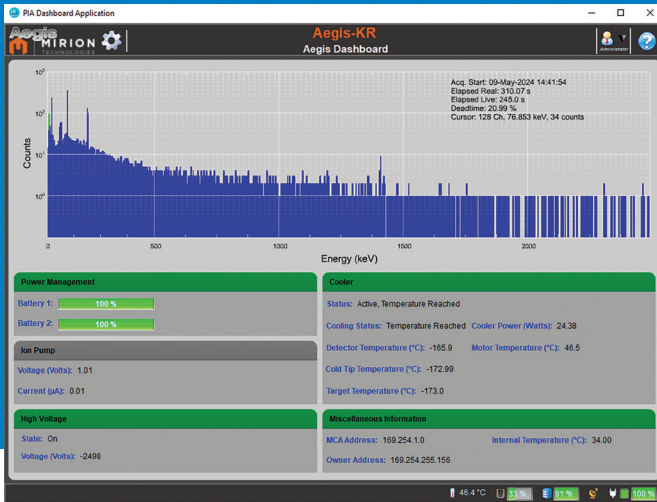
Aegis dashboard in Genie mode
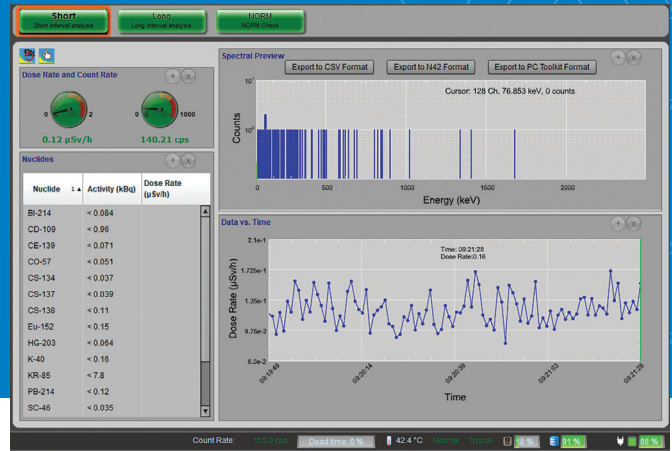
Monitoring view in Data Analyst mode

The Aegis UI, called the Aegis Dashboard, can be opened via a dedicated application on the connected PC or tablet.

The dashboard shows:

- The spectrum in the Aegis MCA memory

- General and detailed status: batteries, cooler, preamplifier, MCA, ion pump, system, GPS and network status indications and diagnostics

- Basic functions, such as:
  - Firmware Update
  - User account management
  - Network and Wi-Fi manager

Future firmware upgrade releases will be made available on the Mirion website and can be installed using the Firmware Update functionality from the Aegis Dashboard.

TWO MODES AVAILABLE

The Aegis unit can operate in two modes, based on user need and preference:

1. Start-Stop Measurement Routine (Genie Mode): This mode is required for the start-stop Genie measurement routine. The user can access the Aegis Dashboard UI, but data gathering and analysis is controlled from Genie software.

2. Continuous Spectroscopic Monitoring Routine (Data Analyst Mode): This mode is required for the CSM routine, where spectral and count rate data are continuously analyzed and stored based on user-defined workflows. Results and trends of nuclide activities are continuously monitored as a function of time. Data gathering and analysis is directly controlled from the Aegis Dashboard UI.

INTUITIVE DISPLAYS

The Aegis spectrometer is also provided with an integrated backlit LCD screen, LED indications and keypad control buttons on the top panel of the system. The LCD displays the State of Health (SoH) of the MCA, Cooler, Ion pump, Preamplifier and the computer unit. The four keypad control buttons are used for control of the system power, the detector bias high voltage, the cooler, and navigation through the various LCD screen pages. Two battery level indicators are provided with 25% increment indications. The screen also lists the system's IP address to simplify connection to the host Genie computer.

AUTOMATED, INTEGRATED CONTINUOUS SPECTROSCOPIC MONITORING

Automated in-situ sample collection with laboratory-grade energy resolution performance allows for accurate, continuous spectroscopic monitoring (CSM). Rugged durability combined with automated CSM and GPS capabilities makes the Aegis system a robust, all-in-one system for safe, quick spectroscopy measurements.

Designed for Versatility

The Aegis system is a versatile, multi-use solution that integrates and deploys easily through both wired and wireless connectivity, and is compatible with a variety of use cases. Key applications for Aegis in-situ CSM include:

CONTINUOUS CIRCUIT MONITORING
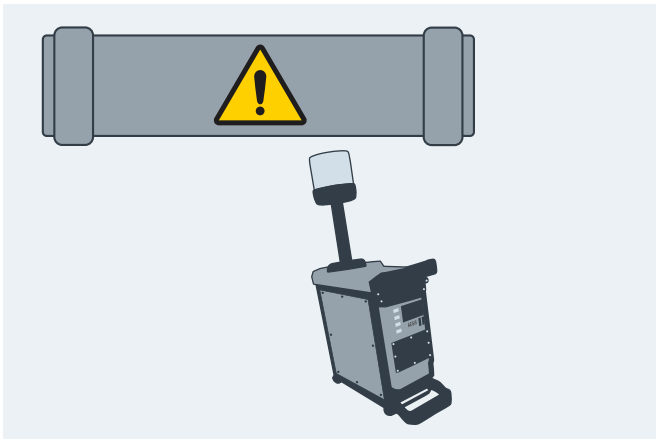
Leverage Aegis CSM capabilities to continuously monitor the nuclide activities within ducts and pipes of a nuclear facility. While the primary circuit in a nuclear power plant might be too active for the large Aegis HPGe crystal models, the high Aegis sensitivity could be well leveraged for monitoring of the secondary circuit. The Aegis system offers a reliable and efficient way of monitoring nuclide activities in pipes — in a safe way to protect workers from radiation exposure.

EMERGENCY RESPONSE
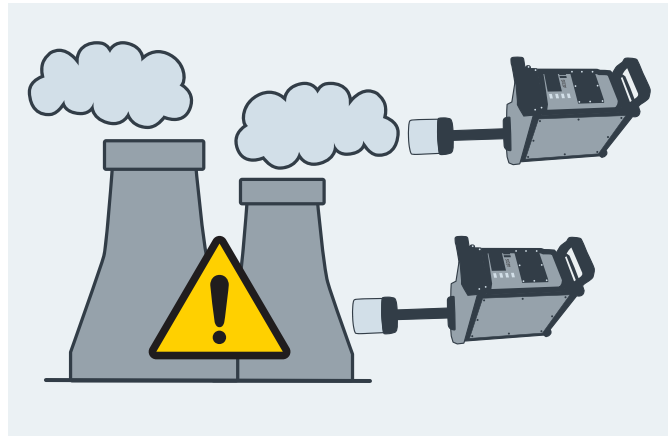
The all-in-one Aegis spectrometer can be easily transported and deployed in various in-situ setups. The optional ISOCS characterization enables a method to rapidly and accurately determine absolute efficiencies without sources for a wide range of simple and complicated geometries. This flexibility makes the Aegis spectrometer perfectly suited for emergency response use cases. Having the additional option to perform continuous spectroscopic monitoring makes the Aegis spectrometer very powerful to assess concerns with release points, like stacks or municipal water intakes. By pointing the detector to the released plume or stack itself, or to the water pipe, the situation can be automatically monitored in the most efficient way.

CONVEYOR MONITORING

For use with conveyor-monitoring applications, Aegis system can support nuclide-specific screening and sorting to automatically identify if a package or debris/dirt moving up the belt is contaminated.

SPECIFICATIONS

NUCLEAR

MODEL NUMBER	TYPICAL REL. EFF. (%)	TYPICAL ENERGY RANGE (KEV)	GUARANTEED FULL WIDTH HALF MAX (FWHM) RESOLUTION (KEV)		ENDCAP DIAMETER MM (IN.)
			AT 122 KEV ENERGY	AT 1332 KEV ENERGY	
AEGIS-GC40	40	40 – 10,000	1.4	2.1	83 (3.25)
AEGIS-GC40-RDC	40	40 – 10,000	1.4	2.1	83 (3.25)
AEGIS-GX40	40	15 – 10,000	1.4	2.1	83 (3.25)
AEGIS-GX40-RDC	40	15 – 10,000	1.4	2.1	83 (3.25)
AEGIS-BE5030	45*	15 – 3,000	1.0	2.0	102 (4.0)
AEGIS-BE5030-RDC	45*	15 – 3,000	1.0	2.0	102 (4.0)

Above specifications are in accordance with IEEE Std 325-1996, as measured at 23 °C (74 °F) ambient temperature. In addition to the guaranteed FWHM specifications as indicated in the table, the maximum 122- and 1332-keV FWHM variances between horizontal and vertical orientations are 100 eV.

* Note: Relative efficiency for the AEGIS-BE5030 and AEGIS-BE5030-RDC models is a typical value, not a spec limit.

ELECTRICAL COOLER
- Type: Stirling
- Time to cool: <12 hours at 25 °C (77 °F)

MCA
- 256-32,768 channels, support for two memory groups of equal size
- Live Time correction
- High Voltage Inhibit: High Voltage is automatically inhibited until the detector has reached operating temperature
- Coarse Gain: x2.0 – x430.5 in 19% increments
- Fine Gain: x0.8 – x1.2 in 0.004% increments
- Gain Attenuator: ON/OFF; when ON is selected it enables a divide by four input attenuator to minimize overload due to preamp signals with large pulse amplitudes
- Three MCA General Purpose I/O (GPIO) signals

ERGONOMIC

DISPLAY
- Small character LCD display on top of Aegis unit with different screens for system health status

HANDLE
- Two removable handles on top of instrument

OPERATING CONTROLS
- Keypad:
  - Power On/Off
  - Cooler On/Off
  - HV On/Off
  - Page navigation for LCD

COMMUNICATION

BETWEEN AEGIS SYSTEM AND PC
- Wireless: Wi-Fi 802.11b,g,n (physical access point required), option to physically remove in factory
- Wired: RJ-45 (Ethernet cable)

GPS
- Accuracy: <5 meters
- Option to physically remove in factory

GP I/O PORTS
- Six buffered input/output MCX signal connectors, of which:
  - Three GP I/O ports are controlled by MCA enabling processing of TTL compatible signals
  - One Fault Status GPIO
  - One Monitor Out GPIO: A real-time image of the internally-shaped energy signal for use with an external oscilloscope
  - One GPIO for future use

ENVIRONMENTAL
- Ambient Temperature:
  - Keeping the unit cooled down: -20 °C to 50 °C (-4 °F to 122 °F)
  - Cool down from environmental temperature: -20 °C to 25 °C (-4 °F to 77 °F)
- IP65 ingress protection rating

AEGIS PORTABLE HPGE SPECTROMETER

ELECTRICAL

INSTRUMENT

- Universal AC adapter with 100–240 V, 50-60 Hz input
- STANDARD and (optional) SPARE BATTERIES: Two rechargeable LiFePO4 49.5 Wh, hot swappable, providing up to 2.5 hours operation* with two batteries. Charging time inside Aegis unit <2 hours. Batteries are UN3481 certified for shipping with equipment via air freight.
- Battery charger outside of Aegis unit: Universal 100–240 V ac, 50-60 Hz input charger for one battery at a time. Charging time with external battery charger <1 hour.

*Nominal value only. Actual run time depends on application specifics.

MECHANICAL

- Housing: Painted magnesium, easy to decontaminate
- Aegis Unit Dimensions: 420 x 356 x 160 mm (16.5 x 14.0 x 6.3 in.) (L x H x W) with two handles, without RDC
- Aegis Unit Weight: 16.6 kg (36.5 lb) with two batteries installed and the AEGIS-BE5030-RDC configuration
- Battery Weight: 860 g (1.9 lb) per battery module
- Shipping Case Dimensions: 94 x 79 x 49 cm (37 x 31 x 19 in.) (L x H x W)
- Shipping Case Weight: 50 kg (110 lb) (includes Aegis unit, two spare batteries, AC power supply, two external AC battery chargers, manual and spec sheet); 22.5 kg (49.5 lb) (empty)

STANDARDS

SUPPLEMENTARY INFORMATION:

- Tested by TÜV SÜD (NRTL)

EMC STANDARDS:

- EN EN61326-1:2013

LOW VOLTAGE SAFETY STANDARDS:

- EN 61010-1:2010
- CAN/CSA C22.2 No. 61010-1:2012
- UL 61010-1:2012

Following the provisions of COUNCIL DIRECTIVE(s) 2011/65/EU (RoHS), 2014/30/EU (Electromagnetic Compatibility), and COUNCIL DIRECTIVE 2014/35/EU (Low Voltage).

AVAILABLE MODELS

- AEGIS-GC40: The Aegis HPGe spectrometer with a 40% GC crystal (and no RDC)
- AEGIS-GX40: The Aegis HPGe spectrometer with a 40% GX crystal (and no RDC)
- AEGIS-BE5030: The Aegis HPGe spectrometer with a BE5030 crystal (and no RDC)
- AEGIS-GC40-RDC: The Aegis HPGe spectrometer with a 40% GC crystal and RDC option
- AEGIS-GX40-RDC: The Aegis HPGe spectrometer with a 40% GX crystal and RDC option
- AEGIS-BE5030-RDC: The Aegis HPGe spectrometer with a BE5030 crystal and RDC option

ALL MODELS INCLUDE:

- A rugged shipping case
- Two internal batteries
- Two spare batteries
- AC power supply
- Two external AC battery chargers
- Complimentary 1-year subscription of Genie-Single Genie Spectroscopy Suite and 1-year subscription of ISOCS Software
- Manual

REMARKS:

- A laptop or tablet computer is not included
- The end cap diameters fit in a standard ISOXSHLD
- A specific ISOCS/LabSOCS characterization can be ordered via the standard ISOXCAL model number

OPTIONAL ACCESSORIES:

- AEGIS-NGW: Physically remove the GPS and Wi-Fi from the Aegis unit
- AEGIS-NGPS: Physically remove the GPS from the Aegis unit
- AEGIS-NWIFI: Physically remove the Wi-Fi from the Aegis unit
- AEGIS AC-SUPPLY: 100–240 V ac power supply
- AEGIS DC-SUPPLY: 12 V dc vehicle adapter
- AEGIS AC-BATTCHG: 100–240 V ac external battery charger for one Aegis battery
- AEGIS BATT: Spare Aegis battery
- RUGTABLET-RADIOS: Rugged tablet with camera and radios (Wi-Fi, Bluetooth® and GPS) installed
- RUGTABLET-NORADIOS: Rugged tablet without camera and radios (Wi-Fi, Bluetooth and GPS) installed
- AEGIS ISOXADAPT: Adapter kit enabling to mount Aegis unit on any Canberra ISOCS cart
- AEGIS 7413ADAPT: Adapter kit enabling to mount Aegis unit on the 7413-425 tripod

CE · TÜV SÜD C US · ISO 9001 SYSTEM CERTIFIED — MERIDEN CT · ATLANTA GA · OAK RIDGE TN · CONCORD ON

MIRION TECHNOLOGIES