MIRION TECHNOLOGIES

LEMC™

Large Epi-Thermal Multiplicity Counter

The LEMC large epi-thermal multiplicity counter is a high-efficiency, fast-response neutron multiplicity counter engineered for high-precision, non-destructive assay of plutonium and uranium materials, including impure and mixed-oxide (MOX) scrap. With advanced epi-thermal neutron detection and high-efficiency design, the LEMC counter delivers fast, accurate results — ideal for nuclear safeguards, waste management and inventory control.

The LEMC Large Epi-Thermal Multiplicity Counter is a high-performance neutron coincidence counter designed for measuring the multiplicity of the neutron emission from spontaneous fission and induced-fission reaction in plutonium and uranium. The LEMC system measures impure plutonium and mixed-oxide (MOX) scrap materials for safeguards and inventory control applications. Intended for the measurement of items up to 40 liters (10 gallons) in volume, the counter offers improved measurement precision through use of multiple cadmium layers and high-pressure (10 atm) ^{3}He proportional tubes.

FEATURES

- Designed for quantitative passive neutron analysis
- High Detection Efficiency: >50% for ^{240}Pu spontaneous fission neutrons
- Faster Die-Away Time for Greater Measurement Accuracy: 24 µs
- Large sample cavity accommodates items up to 40 liters, ideal for bulk materials, scrap and MOX fuel
- Fast pre-amp electronics with greater performance
- Low Deadtime for Faster Throughput, Higher Count Accuracy: 41 ns
- Internal de-randomizing board for accurate, orderly data acquisition
- Operated using JSR-15™ shift registers
- Available with NDA 2000™ software, compatible with all Mirion neutron counters and gamma-ray systems

Epi-Thermal Neutron Detection

The typical neutron well counter detects neutrons after they have slowed to thermal energies, resulting in a characteristic die-away time of about 50 µs. The LEMC system is designed to detect the fission neutrons within the sample *before* they fully thermalize, resulting in a shorter characteristic die-away time (24 µs) and allowing the operation of the neutron coincidence analyzer with a shorter coincidence window. The LEMC counter operates with a coincidence gate width of 32 µs compared to 64 µs for the traditional multiplicity counter, providing a factor of 2 improvement in the measurement precision or a 4x reduction factor in required count times.

The counter provides a neutron detection efficiency of 50% for ^{240}Pu spontaneous fission neutron emitted within the center of the assay cavity. The combination of high efficiency and fast die-away times makes the LEMC system an ideal counter for the assay of plutonium product, waste or scrap material. Measurement precision of less than 1% for clean or slightly impure product materials is readily achievable in multiplicity mode over the mass range of one gram to several kilograms of plutonium oxide and MOX.

System Configuration

The LEMC system configuration requires minimal setup time — consisting only of the neutron counter, multiplicity shift register and personal computer loaded with operating software.

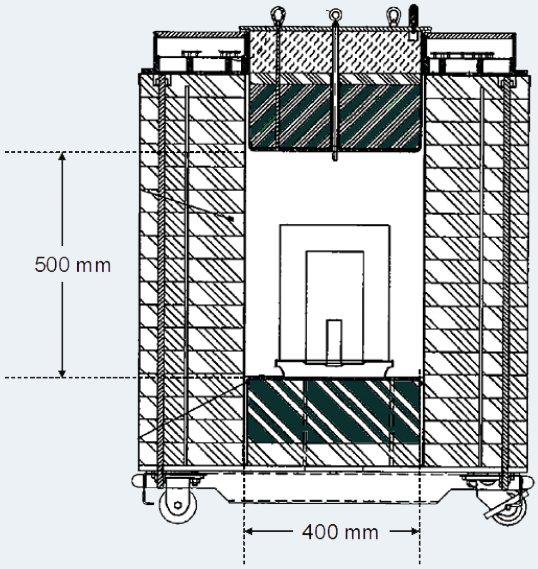
JSR-15 Multiplicity Shift Register

The JSR-15 Neutron Analysis Shift Register is a portable, fully computer controlled neutron analyzer that provides neutron coincidence and multiplicity capability. Provided software allows users to select and program the system to their specifications.

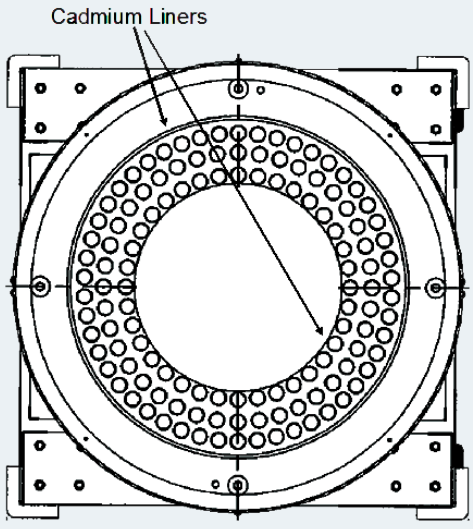
The JSR-15 internal clock rate is 50 MHz, with a pulse pair resolution of 20 ns. Internal diagnostics continuously monitor the state of the data acquisition, providing internal flagging of under and over flows whenever they occur. A second and third totals counter is provided for an additional channel input.

The JSR-15 unit is a data acquisition and analysis electronics package used in the measurement of plutonium and uranium (high and low-enriched) materials. The added flexibility of coincidence and multiplicity counting ability provides the user with analysis capability for a broad range of material configurations. These configurations include: Pu pellets, powder, solutions, Mixed Oxides, MOX fuel pellets, Pu fuel assemblies, HEU and LEU in metals, oxides, powders, fuel pellets and rods, as well as uranium hexaflouride (UF_6) samples.

The JSR-15 unit is supplied separately.



Cross-Section of the LEMC system.



Relative Placement of the Cadmium layers about the three concentric rings of ^{3}He tubes.

LEMC LARGE EPI-THERMAL MULTIPLICITY COUNTER

SPECIFICATIONS

Detector Assembly:

- The detector assembly consists of a cylindrical high-density polyethylene (HDPE) moderator with embedded ^{3}He proportional tubes.
- ^{3}He detectors are threaded into a conductive junction box containing a pre-amplifier/amplifier/ discriminator board to provide low-noise signal processing.
- Outputs from each detector bank are combined though a de-randomizer board located within the junction box.
- The cavity is lined with a 1 mm (0.040 in) cadmium liner and a second cadmium layer between the outermost ring of ^{3}He tubes and the HDPE shield.
- Lockable casters for movement of the system.

Cavity Dimensions:

- Inner diameter: 400 mm (15.7 in)
- Cavity height: 500 mm (19.7 in)

Outer Dimensions:

- Footprint: 889 x 889 mm (35 x 35 in)
- Height: 1156 mm (45.5 in)

Neutron Detection:

- One Hundred Twenty Six (126) ^{3}He proportional tubes
- Active length: 762 mm (30 in)
- Outer diameter: 25.4 mm (1 in)
- ^{3}He partial pressure: 10 atm

Performance:

- Detection Efficiency: 50% for ^{240}Pu spontaneous fission neutrons in cavity center
- Die-Away Time: 24 µs
- Sensitivity: 53 Reals/s/g $^{240}Pu_{eff}$

Inputs:

- +5 V LVPS (BNC connector), 2.5 A
- +1680 V HVPS bias supply (SHV connector)

Outputs:

- TTL pulse (BNC connector)
- One output for each of three rings
- Summed from all detector banks

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ISO 9001 SYSTEM CERTIFIED MERIDEN CT ATLANTA GA OAK RIDGE TN CONCORD ON

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