



JCC-41™

Flat-Squared Neutron Coincidence Counter



The JCC-41 is a high-performance, well-type neutron coincidence counter designed for in-plant measurement of large plutonium samples. With Monte Carlo-optimized geometry, enhanced shielding and a large sample cavity, it delivers superior efficiency, uniform response, and precision – making it ideal for both high-mass and low-level plutonium assay in operational environments.

The JCC-41 counter, based on Monte Carlo design calculations performed at Los Alamos National Laboratory¹, measures the effective ²⁴⁰Pu mass in a sample by detecting coincidence neutrons from the spontaneous fission of the even numbered isotopes of plutonium.

FEATURES

- ✓ Well-type neutron coincidence counter for in-plant applications
- ✓ Uniform Axial Response: special design features (graphite end plugs, cadmium/polyethylene liner) ensure flat spatial response, reducing sensitivity to sample positioning and matrix effects
- ✓ Advanced Detector Configuration: Twenty-four ³He tubes arranged in a single optimized ring, grouped into six pre-amp channels with external LED diagnostics
- ✓ Fast pre-amp electronics with greater performance
- ✓ Large (61 x 24 cm) sample cavity accommodating a wide variety of sample types – including PuO₂, MOX, fuel rods, solutions, and scrap – in a 61 x 24 cm cylindrical cavity
- ✓ Dual cadmium external shielding minimizes background and provides advanced radiation protection during operation
- ✓ High Efficiency & Precision: >22% detection efficiency and >28 cps/g ²⁴⁰Pu response rate enable high throughput and 2.4% precision in 1000 seconds

JCC-41 FLAT-SQUARED NEUTRON COINCIDENCE COUNTER

The JCC-41 unit is designed for in-plant measurements of large plutonium samples (up to several kg Pu), but can be used for plutonium waste samples with milligram quantities of plutonium. The JCC-41 counter has a higher efficiency, larger sample size and flatter axial response than the previous transportable unit. The system consists of a JCC-41 counter head and sample hoist mechanism.

The JCC-41 counter has a cylindrical-shaped sample cavity intended to assay plutonium samples including PuO_2 , mixed oxides ($\text{PuO}_2\text{-UO}_2$), metal carbides, fuel rods, fast critical assemblies, solution, scrap, and waste. A cadmium sleeve surrounds the sample cavity to prevent the reentry of thermalized neutrons into the sample, which could induce fission in the sample and adversely affect the results.

Outside the cadmium sleeve is a polyethylene/cadmium liner to flatten the axial response. Twenty-four ^3He tubes are embedded in the high-density polyethylene. The tubes are arranged in a single ring around the sample with optimal spacing between the tubes for maximum counter efficiency.

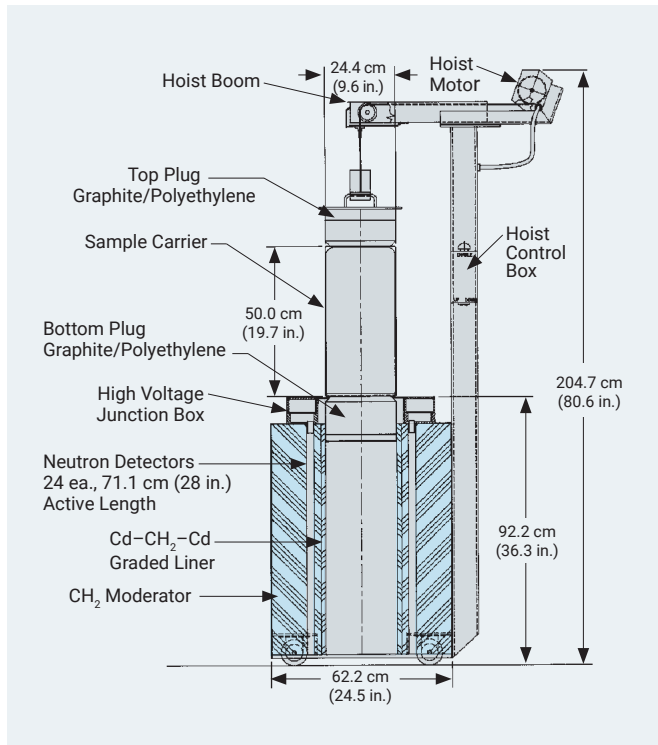
The tubes are divided into six groups of four with each group wired together and connected to one of the six Amplifier/Discriminator circuit boards, which are mounted inside a high voltage junction box. LED indicator lights are placed externally on the junction box to indicate proper operation of each pre-amp channel. Electrical connections between the JCC-41 counter and the JSR-15™ unit include +5 V and HV. The combination of signals will be combined into a logical OR.

A cadmium sleeve wrapped around the outside of the JCC-41 unit provides radiation protection for personnel as well as background reduction.

The external polyethylene shielding and special design (graphite end plugs and polyethylene/cadmium liner) give uniform response axially over the sample cavity, making the counter relatively insensitive to matrix effects.

A JSR-15 Neutron Analysis Shift Register, a computer and analysis software are required for coincidence counting but are sold separately.

JCC-41 FLAT-SQUARED NEUTRON COINCIDENCE COUNTER



SPECIFICATIONS

Performance:

- HV Setting: 1680 V
- Gate Setting: 64 μ s
- Die-Away Time: 53.5 μ s
- Detector Efficiency: 22.8%
- Sensitivity¹: 28.3 cps/g ²⁴⁰Pu, effective
- Precision¹: 2.4% for 0.06 g ²⁴⁰Pu
- Axial Response¹
 - $\pm 5\%$ for Totals using ²⁵²Cf source
 - $\pm 2\%$ for Totals using PuO₂ sample
 - $\pm 12\%$ for Reals using ²⁵²Cf source
 - $\pm 4\%$ for Reals using PuO₂ sample
 - $\pm 2\%$ for multiple-corrected Reals for a PuO₂ sample

Physical:

- Overall Size: 204.5 x 62.2 x 62.2 cm (80.5 x 24.5 x 24.5 in) H (including sample hoist mechanism) x L x W
- Counter Size: 92.5 x 62.2 x 62.2 cm (36.4 x 24.5 x 24.5 in) H x L x W
- Weight: 318 kg (700 lb)
- Sample Cavity Size: 50.0 x 24.4 cm (19.7 x 9.6 in) H x Dia
- ³He Tubes: 24
- ³He Rings: 1
- ³He Active Length: 71 x 2.5 cm (28 x 1 in) L x Dia
- Cladding: Aluminum

Options:

- ²⁵²Cf neutron source (one each) with source strength of 5×10^4 neutrons/sec for making routine normalization measurements. An aluminum source rod that reproduces the position of the source is included with the counter

REFERENCE:

1. Menlove, H.O., Palmer, R., Eccleston, G.W., and Ensslin, N. (1989). Flat-Squared Counter Design and Operation Manual. Report LA-11635. Los Alamos, New Mexico: Los Alamos National Laboratory.

