

# Combined Isotopic and Plutonium Scrap Multiplicity Counter for cans

## Introduction

The ANTECH B2308 Combined Isotopic and Plutonium Scrap Multiplicity Counter for cans quickly and accurately determines the plutonium content of Special Nuclear Materials (SNM), scrap and residues. It combines the functions of the Model N2098 Plutonium Scrap Multiplicity Counter and a high resolution gamma spectrometer. Combining the two instruments shortens measurement times and reduces the dosage received by operators handling sample containers.

The neutron component performs passive neutron multiplicity counting. The moments of the neutron probability distribution are used to determine the number of totals, doubles and triple neutron coincidence events. This neutron multiplicity data is used to solve the Point Source model for three unknown parameters: spontaneous fission rate, detection probability, and source term (or multiplication, as appropriate), and thus to identify the  $^{240}\text{Pu}_{\text{effective}}$  mass. The Point Source developed by Dr W. Hage of JRC Ispra is the basis of all neutron multiplicity analysis. The B2308 can be operated using either the ANTECH N1003 Neutron Time Correlation Analyser or a Multiplicity Shift Register.

The neutron measurement requires knowledge of the plutonium isotopic ratio (and  $^{241}\text{Am}$  content) at various stages of the calculations in order to convert the measured  $^{240}\text{Pu}_{\text{effective}}$  content from the passive neutron system to a total plutonium mass. A High Purity Germanium (HPGe) detector views the sample through a collimator in the bottom end plug of the measurement chamber and measures the relative intensities of gamma-rays from the gamma-ray spectrum of a plutonium bearing sample. Spectral data and known fundamental nuclear constants are used to obtain the plutonium isotopic ratios. The atom ratio of pairs of isotopes (at known energies) are related to the relative counting intensities for those gamma-rays, given the relevant known branching ratios, half-lives and detection efficiencies. The analysis codes de-convolute the spectra to produce isotopic ratios independent of sample size, shape, packaging, and physical and chemical composition. No calibration with standards is necessary.

Two types of analysis codes are available:

1. PC/FRAM: developed by the Los Alamos National Laboratory (LANL) in the United States and licensed to ANTECH Corporation
2. MGA: developed at the United States Department of Energy (DOE) Lawrence Livermore National Laboratory and licensed to ANTECH's strategic alliance partner Ametek-ORTEC for use in non-destructive assay equipment

A safeguards coaxial detector is used if PC-FRAM is selected and a planar detector is used if MGA is selected.

## Features

- Coupled to a Multiplicity Shift Register with INCC-B32 software or the ANTECH N1003 Neutron Time Correlation Analyser with ANTECH TCA Scientific Software for multiplicity distribution data collection
- PC/FRAM or MGA analysis codes
- High resolution gamma-ray spectrometer using the DSPEC digital MCA
- High Purity Germanium coaxial detector (PC/FRAM) or planar detector (MGA)
- 30 litre liquid nitrogen Dewar



## Benefits

- Very high efficiency (>50%) for the detection of  $^{240}\text{Pu}$  spontaneous fission neutrons
- Fast and accurate determination of isotopic content,  $^{240}\text{Pu}$  content and total plutonium mass
- Reduces operator exposure by eliminating one stage of container handling
- Increased measurement throughput by combining two assay procedures
- Chamber mounted on robust, transportable trolley with locking castors for safety and stability



The Model B2308 Plutonium Scrap Multiplicity Counter with an ANTECH Model N1003 Time Correlation Analyser

## Specification

<b>External dimensions (H x W x D)</b>	1300 mm x 750 mm x 1500 mm (51.18 in x 29.53 in x 59.06 in)
<b>Sample cavity dimensions (H x diameter)</b>	410 mm x 200 mm (16.14 in x 7.85 in)
<b>Weight</b>	400 kg (881.85 lb)
<b>Detectors</b>	80 x $^3\text{He}$ tubes arranged in four concentric rings,
<b>Detector dimensions</b>	25.4 mm x 711 mm active tube length at 4 atm (1 in x 27.1 in)
<b>HV Bias setting</b>	~1680 V
<b>Gate width setting</b>	64 $\mu\text{s}$
<b>Pre-delay</b>	4 $\mu\text{s}$
<b>Typical sensitivity</b>	~150 reals/s/g $^{240}\text{Pu}_{\text{effective}}$