Passive Neutron Slab Counter

N2004, N2006

Overview

The ANTECH Passive Neutron Slab Counter is a simple assay system for the portable and adaptable assay of waste drums, boxes or crates, and other irregular items by detecting coincidence neutrons from the spontaneous fission of the even numbered isotopes of plutonium. The Passive Neutron Slab Counter is easily deployable to allows for in-situ measurements, and can be combined in multiple panels to fully encompass the item. Combined with the latest ANTECH neutron counting electronics, a set of Slab Counters can provide both individual channel information or a single “OR’d” output.

Slab Counter Design

The Slab Counter consists of a number of ^{3}He detector tubes arranged in a line within a rectangular high-density polyethylene (HDPE) moderator block. A Junction Box is mounted on top of the moderator, inside of which is the distribution network for low voltage, high voltage, and signal processing. On the rear face of the assembly, an HPDE backshield sandwiches a 1 mm cadmium thermal neutron filter, to provide shielding from background neutron flux, optimising the counting statistics on the measurement sample. The Slab Counter Junction Box is connected to an ANTECH Neutron Counting Electronics module by a set of coaxial cables providing low voltage, high voltage and signal communication. The counting electronics provides and monitors the high voltage supply to the ^{3}He tubes and the low voltage supply to provide power to the head amplifier, as well as accepting the digital TTL pulse outputs from the amplification circuitry.

The Junction Box assembly ensures comprehensive electrical screening at the termination of the detector tubes, protecting the system from electrical noise contributing to the measurement statistics. It houses the fast charge sensitive amplifiers, which traditionally utilise the Amptek A111 based amplifier, but more recently utilise the ANTECH Neutron Amplifier unit. Each ^{3}He tube is connected via an HN connector to the underside of the Junction Box, with Safe High Voltage (SHV) connectors used to provide the high voltage to a distribution busbar.

The Operator Trolley provides a mounting point for the Slab Counter and allows for easy deployment and operation. A mounting plate with quick release locator pins allows for the panel to be mounted and dismounted easily for storage and operation. The trolley features two fixed and two swivel heavy duty castors for easy positioning, and an operator shelf provides a location for the system laptop and the latest ANTECH counting electronics.

Features

- Four or six ^{3}He detector tubes (25 mm diameter x 1000 mm length, 4 atm ^{3}He fill pressure with HN connectors) in a rectangular high-density polyethylene block.
- Electrically screened junction box positioned at the top of the module and combines and amplifies the detector signals and distributes high voltage to the detector tubes.
- Cadmium and HDPE backshielding for background neutron flux filtering.
- A111 Charge Sensitive Amplifier chips or ANTECH Neutron Amplifier for signal processing and TTL output.
- “Daisy-Chain” connections for Signal, High Voltage and Low Voltage for multiple panel deployment and single signal output via TTL “OR’d” signal.
- Count rate produced by a ^{252}Cf source (with certified activity) positioned at 30 cm (12”) from the mid-height of the detector module is recorded for efficiency.
- The moderator block is clad with a skin of aluminium sheet for ease of decontamination.

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Benefits

- Compatible with the ANTECH N2000 Universal Neutron Counter (UNC) and N2000-2 Network Neutron Counter (NNC) standalone counting electronics.
- Individual channel output or “OR’d” combined TTL output and daisy chained HV, LV and Signal cables for expansion.
- Inspection and testing includes measurement of high voltage bias curve, discriminator and gain setting and thermal neutron die-away time.
- Robust construction for operation in laboratory or plant.

Passive Neutron Slab Counter Configuration

The Passive Neutron Slab Counter can be operated as a single standalone unit, or as an array of multiple units, expanded out to encompass the sample(s). The High Voltage and Low Voltage supply from the counting electronics can be ‘daisy chained’ through multiple junction boxes, with input and output connectors provided on each junction box. Similarly, the signal outputs can be ‘daisy chained’ together with an “OR’ing” circuit to provide a single TTL input to the counting electronics. For single channel information, the ANTECH N2000 can accommodate up to 19 channels, allowing for 19 Slab Counters to be connected to a single counting electronics module, with the N2000-2 accommodating 4 channels.

Shipping

Each Passive Neutron Slab Counter can optionally be provided with a bespoke Pelican style shipping case for storage and transportation. The shock and vibration resistant foam liner will provide protection for the ^{3}He tubes and the system electronics within the junction box.

Specification

		N2004	N2006
Neutron Detectors		Four (4) ^{3}He detector tubes, 25.4 mm diameter x 1000 mm length, 4 atm pressure [1 in x 39.4 in]	Six (6) ^{3}He detector tubes, 25.4 mm diameter x 1000 mm length, 4 atm pressure [1 in x 39.4 in]
Detection Efficiency[1]		~1 - 1.8%	~2 - 2.5%
Die-Away Time		45 - 50 µs	
High Voltage		1600 - 1850 Vdc Plateau Region	
Dimensions (H x W x D)		1193 mm x 400 mm x 176 mm [47 in x 15.75 in x 6.9 in]	1193 mm x 505 mm x 176 mm [47 in x 19.9 in x 6.9 in]
Weight[2]		57 kg [125.7 lbs]	72 kg [158.7 lbs]
Interfaces	**Low Voltage**	Threaded Neill-Concelman (TNC)	
	High Voltage	Safe High Voltage (SHV)	
	Signal Output	Bayonet Neill-Concelman (BNC)	
Operating Voltage (V)		5 Vdc provided by counting electronics	
Power Requirement (VA)		5 VA	
Temperature	**Operating**	5 - 40°C	
	Storage	0 - 40°C	
Humidity	**Operating**	<95% RH	
	Storage	<95% RH	
Compliance		CE Complies with Directive 2014/30/EU	

1 Efficiency quoted as a single Slab Counter unit. Values not warranted.
2 Weight of the Passive Neutron Slab Counter only.