ANTECH

Large Sample Tritium and Plutonium Isothermal Calorimeter

CD285-1540

Introduction

The ANTECH CD285-1540 Calorimeter is a high performance system designed to measure the quantity of heat produced by tritium or plutonium in containers using the principle of the isothermal or power difference mode of operation. The calorimeter is designed to measure the quantity of tritium by determining the thermal power of the sample (W). It can also be used to measure plutonium or uranium samples. It consists of a large volume single measurement chamber (thermal element) instrumentation enclosure and workstation mounted on a steel chassis fitted with castors. The thermal element contains the measurement chamber into which a canister containing the sample to be measured is placed. The measurement chamber is surrounded by layers of thermal insulation to reduce the effects of ambient temperature variation on the measurement.

Four variants of the Calorimeter are available:

1. Model CD285-1540-5 for measuring individual canisters of up to 12.6cm (4.96") diameter x 25.0cm (9.84") high, including lifting fixtures.
2. Model CD285-1540-7 for measuring cylindrical canisters of up to 17.38cm (6.84") diameter x 61.39cm (24.17") high, including lifting fixtures
3. Model CD285-1540-10 for measuring cylindrical canisters of up to 25.27cm (9.95") diameter x 77.47cm (30.5") high, including lifting fixtures.
4. Model CD285-1540-12 for measuring cylindrical canisters of up to 30.4cm (12") diameter x 38.1cm (15") high, including lifting fixtures.

Principle of Operation

The calorimeter operates on the isothermal (or power replacement) principle. It regulates the temperature of the three concentric cylinders which are surrounded by high performance insulation. This is in order to provide a stable environment around the measurement chamber, so that the sample being measured is isolated from the effect of fluctuations in the ambient temperature of the laboratory. An array of heat-flow sensors, installed between the outer surface of the inner cylinder and the inner surface of the middle cylinder, measure the heat-flowing from the inner cylinder to the middle cylinder. These sensors replace the traditional use of a nickel sense coil which is a resistive temperature sensor previously used to measure the temperature of the inner cylinder. The use of heat-flow sensors improves the accuracy of control of the inner cylinder. The sensors are wired in series and the heat-flux passing across them generates a voltage (the Seebeck effect) which is accurately measured and used to precisely control the temperature of the inner cylinder.

Particular attention has been paid to system performance through the design and selection of hardware for the thermal element, the insulation surrounding it and the measurement instrumentation. This is to meet the stability, sensitivity and minimum detectable activity requirements for the system.

The system control and analysis computer, high precision digital voltmeters and precision controlled power sources (also known as Precision Power Supplies) are housed in the instrumentation enclosure.

MasterCal™ user software operates under the latest Microsoft Windows platform and the instrument may be monitored and controlled over a network. The software includes data acquisition and data analysis functions. Measurement data is archived and may be re-analysed off-line.

Features

- Large measurement chamber with a choice of four standard chamber sizes (other chamber sizes available on request)
- True Isothermal 'air bath' absolute measurements
- Automatic software algorithms for equilibrium sample power prediction and measurement end point determination
- Automatic plutonium, americium and other radio decay correction for isotopic ratios

- Highly efficient thermal insulation providing an excellent isolation from changes in ambient temperature
- Twin RAID Drives for computer system back-up
- Networkable
- Configurable measurement chamber operating temperature and cylinder control parameters
- Custom designs available for different volume measurement chambers and detection sensitivities

Benefits

- Absolute measurement of sample thermal power
- User friendly Windows based interface software
- Elimination of requirement for water as a heat sink thereby reducing a potential criticality hazard
- Transportable trolley mounted system
- Optimisation of measurement range to suit operational requirements
- Suitable for measurement of large Pu or Tritium samples
- Thermopile heat flow sensors provided enhanced measurement control sensitivity, hence improved detection efficiency and limit of detection
- Remote monitoring of measurement progress (where networking is permitted)
- Measurements approved for use by the IAEA and WIPP

Specification

Attribute	**Model**			
	CD285-1540-5	**CD285-1540-7**	**CD285-1540-10**	**CD285-1540-12**
System				
External dimensions (H x W x D) mm (inches)	1858 (73.14") x 1270 (50") x 824 (32.44")	1858 (73.14") x 1300 (51.2") x 824 (32.44")	1858 (73.14") x 1404 (55.27") x 824 (32.44")	1858 (73.14") x 1404 (55.27") x 824 (32.44")
Sample Chamber (D x H) mm (inches)	126 (4.96") x 250 (9.84")	174.1 (6.85") x 634 (25")	252.7 (9.95") x 774.7 (30.5")	304.6 (12") x 381 (15")
Weight (exc. canisters) kg (lb)	498 kg (1095 lb)	606 kg (1333 lb)	741 kg (1630 lb)	655 kg (1440 lb)
Electrical				
Power supply	110-240Vac, 50/60Hz (specified at purchase)			
Power consumption	700W (typical), 1000W (max)			
Environmental				
Operating temperature	19 to 26°C (optimum), 32°C (max)			
Humidity	5 to 90% (non-condensing)			
Electrical Enclosure	IP54			
Compliance Safety	Low Voltage Directive 2014/35/EU; NFPA 70, UL-61010-1:2012 Ed 3+R:21Nov2018; CSA C22.2#61010-1-12.			
Electromagnetic Compatability	EMC 2014/30/EU			
Performance				
Measurement range (W)	0.005 to 12.5 (extendable)			
Measurement time (mins)	Typical <400mins (<720min for higher powers greater than 5W)			
Precision (typical)	<8% at 0.01W; <0.04% at 5W, <0.03% at 10W			
Accuracy (typical)	<9% at 0.01W; <0.06% at 5W; <0.04% at 10W			