



## IN-VIVO COUNTING

# 2270

### *Actinide (Uranium/Plutonium) Lung Counter*

The Model 2270 Lung Counter provides accurate and reliable measurements of uranium, plutonium and americium in the lungs.



## FEATURES

- Lung detector positioner mechanism with six degrees of freedom
- Lung positioner accommodates up to four detector crystals in two Mirion ACT-II™ cryostat packages
- Digital Signal Analyzers for high resolution signal processing
- Comfortable reclining chair for subject positioning
- Apex-InVivo™ software for system control and analysis
- Lung Counting option for automatic chest wall thickness correction
- Turnkey system delivered calibrated and ready to count

## SYSTEM OPTIONS

- Detector Anti-Compton shields to reduce subject generated background
- Automatic Liquid Nitrogen fill system
- 15 cm (6 in.) or 10 cm (4 in.) thick low background steel shield
- Select 2000, 2800, or 3800 mm<sup>2</sup> area low or broad energy detectors for high resolution lung counting

## DESCRIPTION

Accurate measurement of plutonium, uranium and americium are particularly challenging when the lungs in question also contain depositions of higher energy nuclides such as <sup>137</sup>Cs or <sup>60</sup>Co. For more than 20 years Mirion has designed and fabricated the systems and components to meet this challenge. Mirion is constantly surveying technological advances that improve system ergonomics and detection capability. The 2270 Lung Counter is one of the company's two resulting standard Lung Counting systems.

The Model 2270 Lung Counter provides accurate and reliable measurements of uranium, plutonium and americium in the lungs. The standard system design includes two Mirion ACT-II cryostat assemblies, a detector positioning mechanism that provides six degrees of freedom, digital spectrum analyzers, Apex-InVivo body counting software with the lung counting software option, and a comfortable subject positioning chair.

Each of the system's ACT-II Cryostats can accommodate two low or broad energy crystals with surface areas of 2000 mm<sup>2</sup>, 2800 mm<sup>2</sup>, or 3800 mm<sup>2</sup> each. Mirion will work with the user during the proposal process to recommend the optimal crystal size and type based on the customer's detection requirements and budget. Please refer to the Mirion low and broad energy germanium detector specification sheets for additional detailed information on detector performance and design.

## 2270 | ACTINIDE (URANIUM/PLUTONIUM) LUNG COUNTER

The 2270 Lung Counter also includes complete system integration, calibration, installation and training. The result is a complete turnkey system specifically tailored to the measurement and analysis of U/Pu lung burdens on a routine basis. System integration is completed at the factory. If one of the optional system shield assemblies is purchased then the calibration is also performed at the factory.

The installation and training are provided at the customer's site. If the customer elects to supply the shield or shielded room for the system, then the calibration will be provided at the customer's site after installation in the shield. The combination of hardware, software and services included in this system ensures that the system is ready for operation once the system has been installed at the customer's site.

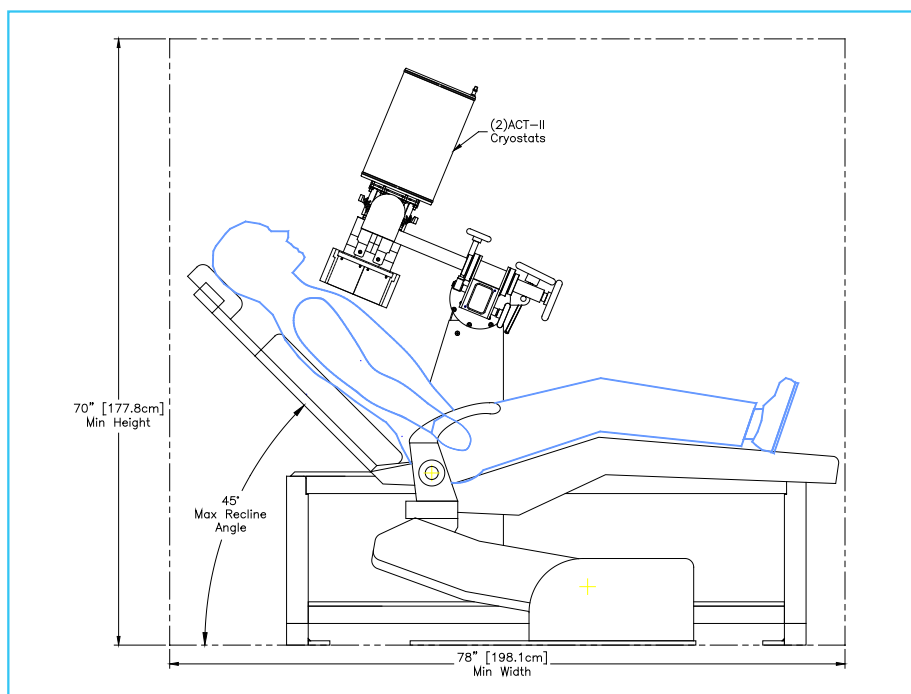
Mirion offers both a standard 10 and a 15 cm thick, low background steel shield as an option for the 2270 Lung Counter. These shields come with overlapping double entry/exit doors, internal lighting, an oxygen sensor, and a subject panic button, as well as shield penetrations for detector cables, liquid nitrogen fill lines, music system cables and closed circuit video cables. The customer must provide a shield or shielded room for use with the Model 2270 system which provides external environment shielding equivalent to that provide by the 10 cm thick shield room in order to achieve system detection performance similar to that defined in this specification sheet.

Mirion can also option a set of detector anti-Compton shields, an automatic liquid nitrogen filling system, a music system and a closed circuit television system for use with the 2270 Lung Counter. Mirion highly recommends the use of the anti-Compton shields around the germanium detectors. These lead shields significantly reduce spectral background due to bremsstrahlung interactions from the naturally occurring 40K within the subject. This background reduction can be used to improve detection capability and lower counting time.

The 2270 Lung Counting system is designed to make routine radiation protection monitoring for actinides in the lungs fast, reliable and accurate. The chair and detector positioning mechanism are designed to allow optimal positioning of the detectors over the lungs to increase operational efficiency and lower detection limits.

The subject or patient is seated in a semi-reclining position in the chair for routine counts. The chair geometry minimizes the chest wall thickness, which improves detection limits, and is more comfortable for the patient than a fully reclining position. The detector positioning mechanism slides on a rail assembly on the side of the chair. This allows the detectors to be moved out of the way making it easy for the patient to enter and exit the chair.

The chair can be positioned to a nearly fully reclining position. The combination of the sliding detector positioner mechanism and the reclining chair allows the system to be used to count individual organs such as the liver or thyroid. Such counting geometries that may be of interest in research operations and accident scenarios.



## SYSTEM OPERATION

The subject is seated in the chair. The detector arrays are adjusted to be in uniform contact with the subject's upper chest. All controls are convenient to the operator so this is a quick task. The shield door is then closed and the count started. Then the operator fills in a brief screen about that count (name, ID number, reason for count, etc.). The rest is completely automatic. When the count is done, the spectrum is stored, analyzed, the results displayed and/or printed, and any appropriate warning messages are generated to the operator.

Then the program and counter are ready for the next person.

## SPECIFICATIONS

### Power

- Specify: 110/220 V ac, 50 or 60 Hz
- Requirements: Vary depending upon computer and electronics

### Environmental

- Temperature: Stable to within  $\pm 5$  °C
- Humidity: Non condensing
- Background Radiation: Normal background assumed
- General: Clean, dust free area

### Performance

- Energy range: 10-2000 keV
- Typical count time: 30 minutes
- Typical Lower Limit of Detection (LLD): 4-6 Bq (0.1 – 0.15 nCi) for <sup>235</sup>U with a four detector 2800 mm<sup>2</sup> LEGe array

Actual system detection limits may vary according to final system configuration and environmental background at the individual customer's facility.

### SHIELDS (Optional)

#### 10 cm (4 in.) Thick Low Background Steel Shield

- Inside dimensions: 218 x 208 x 122 cm (86 x 82 x 48 in.) W x H x D
- Weight: 17500 kg (38500 lb)
- Floor space required:
  - Doors closed: 277 x 150 cm (109 x 59 in.)
  - Doors open: 292 x 264 cm (115 x 104 in.)
- Height WITH BASE: 244 cm (96 in.)
- Floor load: 690 kPa (100 psi)

#### 15 cm (6 in.) Thick Low Background Steel Shield

- Inside dimensions: 218 x 208 x 122 cm (86 x 82 x 48 in.) W x H x D
- Weight: 27750 kg (61000 lb)
- Floor space required:
  - Doors closed: 292 x 160 cm (115 x 63 in.)
  - Doors open: 312 x 274 cm (123 x 108 in.)
- Height WITH BASE: 254 cm (100 in.)
- Floor load: 690 kPa (100 psi)

