COAXIAL GE
DETECTOR SYSTEM

1285

Instruction Manual

S/N 4861544

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COAXIAL GERMANIUM DETECTOR SYSTEM

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COAXIAL GERMANIUM DETECTOR SYSTEM

Section 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

A Ge detector system is a germanium diode having a P-I-N structure mounted in a cryostat consisting of a vacuum chamber thermally coupled to a liquid nitrogen (LN_2) heat sink. The detector output is available from the preamplifier which is directly mounted to the cryostat.

A typical Canberra detector system is illustrated below with key features identified:

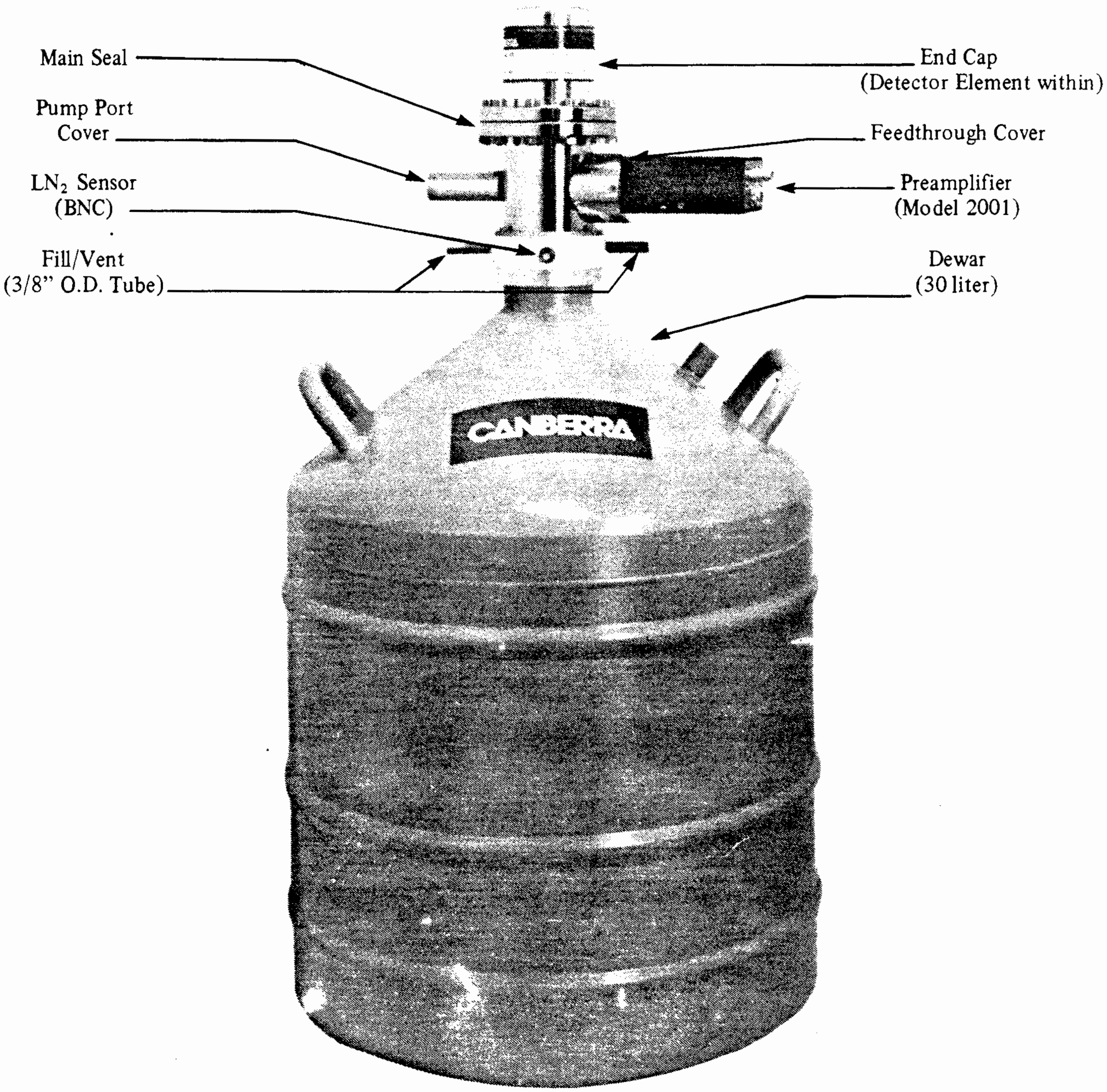


Figure 1-1.

1.2 DETECTOR ELEMENT

The "raw" material for Ge detectors is p-type Czochralski grown single crystal germanium having impurity concentrations in the order of 10^{10} atoms/cc. Coaxial detectors are fabricated with one of two basic geometries which are illustrated below:

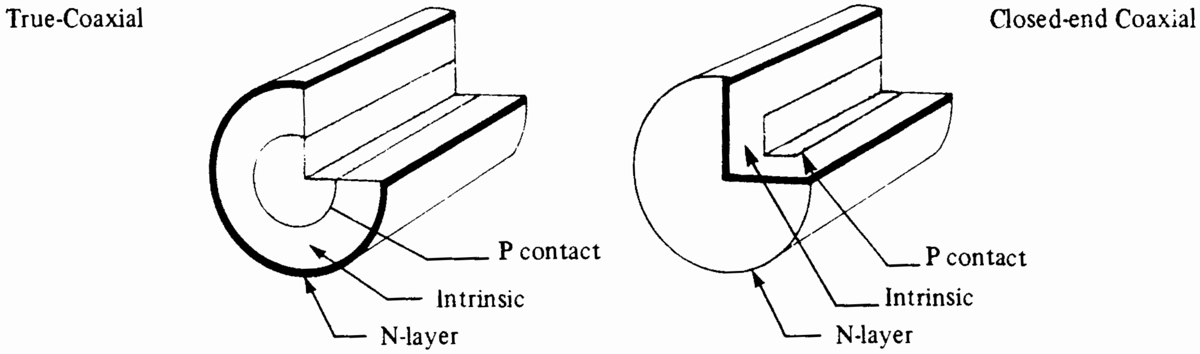


Figure 1-2.

The n-type contact is formed by diffusing lithium into the surface at elevated temperatures. The surface barrier (p+) contact is applied to the axial hole by evaporation of an appropriate metal. When reverse bias is applied to the detector free carriers are swept from the bulk leaving a depleted region of active detector volume between the contacts. The electric field strength across this depletion region must be sufficient to collect the election-hole pairs resulting from photon interactions.

1.3 CRYOSTAT

1.3.1 GENERAL DESCRIPTION

A cryostat consists of a vacuum chamber which houses the detector element plus a dewar (double wall vacuum-insulated vessel) for the liquid nitrogen cryogen. In some cases, the detector chamber and dewar are permanently connected. These are called "integral" cryostats. "Dipstick" cryostats have a detector vacuum chamber with a dipstick-like cold finger which is inserted into the neck of a dewar.

The detector element is held in place by a holder, which is electrically isolated but thermally connected to a copper cold finger. The cold finger transfers heat from the detector assembly to the liquid nitrogen reservoir. The detector holder is held in place by an anti-microphonic stabilizer. The detector holder as well as the outer vacuum jacket or "end-cap" are made as thin as possible to avoid attenuation of low energy gamma rays. The holder is generally made of aluminum and is typically 0.5 to 1mm thick. The end-cap is also generally made of aluminum. It is typically 1.5mm thick on the sides, and 0.5mm thick at the entrance window. The detector element face is located typically 5mm from the end-cap so caution should be used to avoid pushing the end-cap in against the detector assembly.

Standard Canberra cryostats are illustrated below:

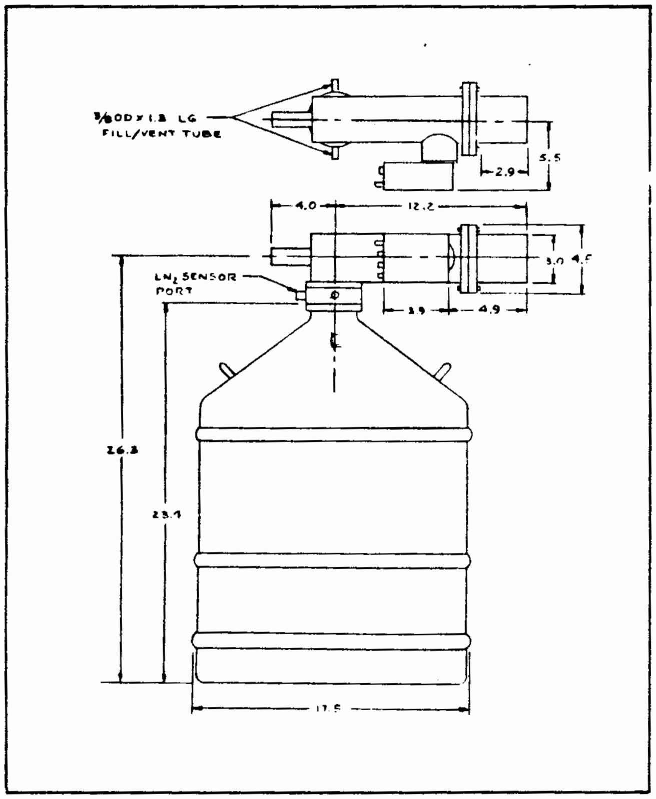


Figure 1-3. 7600

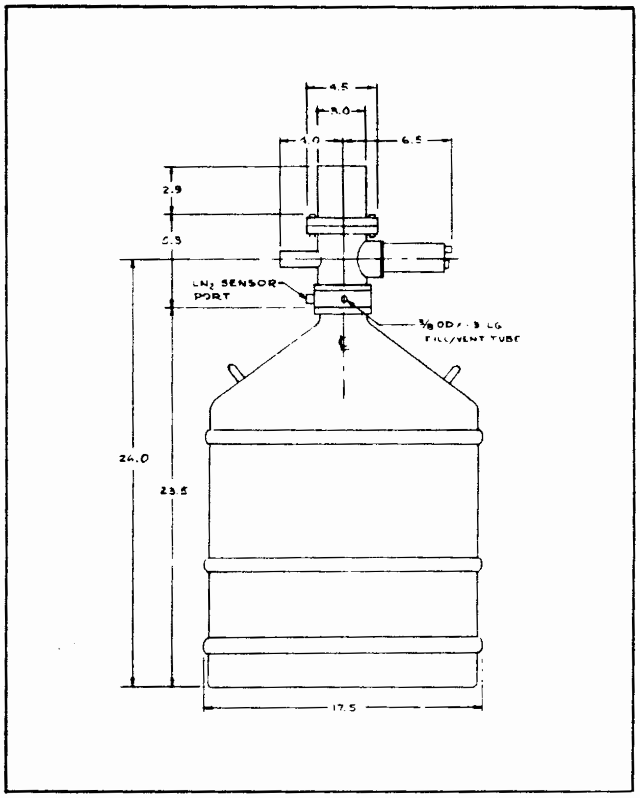


Figure 1-4. 7500

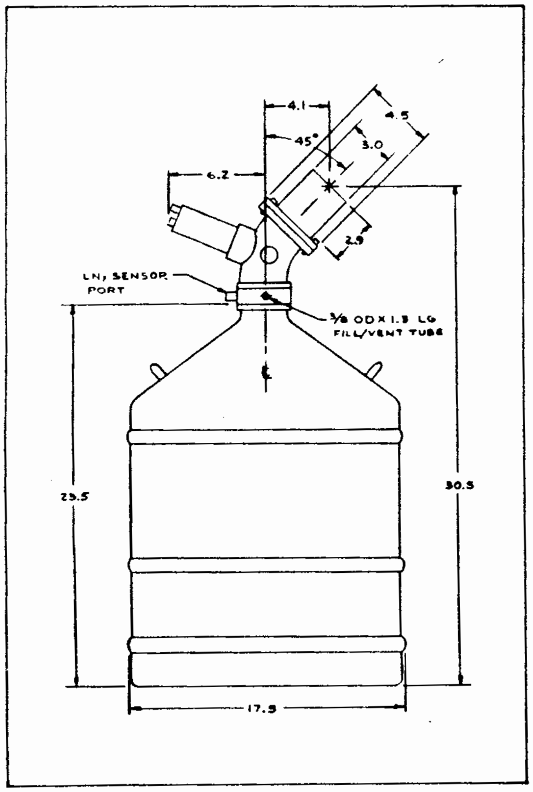


Figure 1-5. 7550

Canberra cryostats are designed from the ground up with quality and long-term reliability in mind. The detector chamber walls are made from stainless steel components which are joined by TIG (Tungsten Inert Gas) welding. The copper cold-finger is brazed (not soldered) to the stainless steel tailstock. The standard end-cap material is of type 1100 aluminum and is a deep-drawn shape having low porosity. Cryostats are vacuum baked at high temperatures to reduce out-gassing and are leak checked at least two times by helium mass spectrometer leak detectors before the final seal is made.

Vacuum maintenance is accomplished through the use of molecular sieves located in the tailstock of the cryostat. The amount of sieve material is adequate to maintain vacuum for more than 10 years under normal use. In integral cryostats, the sieve is located on the walls of the inner flask of the dewar.

1.3.3 VACUUM SEALS

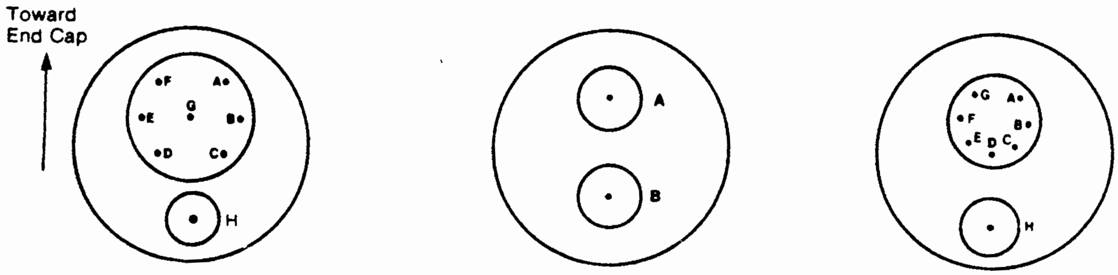
Canberra dipstick cryostats have one main seal where the end-cap joins the cryostat body. In the typical cryostat this is an ultra high vacuum bakeable metal seal made by deformation of the end-cap material between annular pinch ridges in the fixed and floating flanges. This type of seal is impervious to solvents, and to temperature extremes and is not permeable to some of the gases that plague conventional "O"-ring seals. Since no organic materials are used in maintaining vacuum, aging effects are negligible.

A second seal is required for cryostat evacuation. The typical Canberra cryostat utilizes a metal evacuating port which is sealed by cold welding with a pinch-off tool after the cryostat is evacuated and leak tested on a helium mass - spectrometer leak detector.

Integral cryostats have seals providing vacuum isolation and mechanical connection between the dewar and the detector chamber. These seals may be of metal or of viton depending on the dewar manufacturer.

1.3.4 ELECTRICAL FEEDTHROUGHS

Electrical contact to the detector element is made through ceramic electrical feedthroughs. The following illustration shows the pin functions. See the preamplifier schematic for more information.



2001 Room Temp FET
G - Signal
H - Bias

2001C Cool FET
A - FET Drain
B - Ground
C - FET Protection
D - Test Input
E - FET Heater
F - Feedback
G - Not Used
H - Bias

D.C. Coupled
A - Signal
B - Bias

D.C. Coupled
A - Signal
H - Bias

2001C Cool FET
A - FET Drain
B - Ground
C - FET Protection
D - N/C
E - Test Input
F - N/C
G - Feedback
H - Bias

Figure 1-6.

1.3.5 FILL AND VENT COLLAR

Canberra dipstick cryostats are equipped with a fill and vent collar which enables them to be filled without moving the detector chamber. The modern version of this collar is made of silicone rubber which forms a gas-tight seal between the dewar and detector chamber. The collar is fitted with two identical, thin wall, 3/8 inch diameter, stainless steel tubes, either of which may be used for filling from a storage dewar at medium pressure (6 - 12 psig). The unused tube serves as a vent for N_2 gas that is evaporated during the filling operation. This tube can be fitted with a hose to direct the gas away from the sensitive preamplifier and electrical feedthrough areas.

The collar is also equipped with a port for an LN_2 level sensor such as that used with a Model 1786 LN_2 Alarm.

Transfer of LN_2 from a dewar to a cryostat by means of a low pressure withdrawal device is illustrated below:

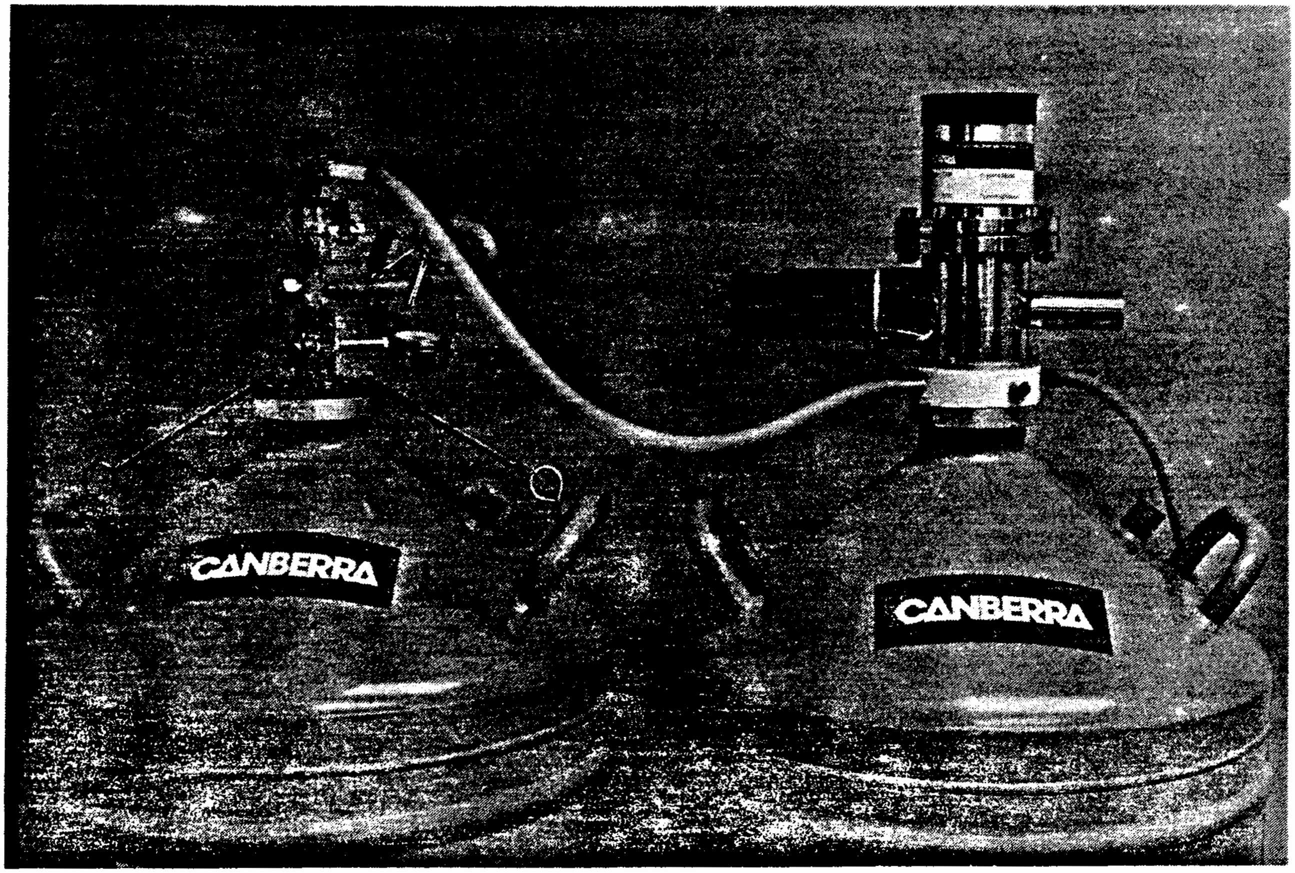


Figure 1-7.

To remove the dipstick from the dewar either of two procedures can be used:

1. Remove the three screws holding the aluminum ring to the dewar neck and lift the dipstick-collar assembly upward.
2. Lift the dipstick slightly with a twisting motion. Squirt a small amount of methyl alcohol around the exposed dipstick and move the dipstick around to lubricate the rubber. The dipstick can then be lifted vertically with a twisting motion without damaging the collar.

Section 2

UNPACKING AND SHIPPING

2.1 UNPACKING

Remove the cryostat from the box by lifting it vertically by the dewar handles. If the detector has been transported in a cold environment, allow it two hours to come to room temperature before proceeding. This will prevent undue moisture accumulation on sensitive parts of the system. Remove the cord holding the dipstick to the dewar and/or holding the plastic bag to the detector chamber. Remove the plastic bag covering the detector chamber and inspect the entire detector system for mechanical damage. If there is evidence of shipping damage contact the carrier, file a claim for damages, and notify Canberra of the nature and extent of the damage. Check for excessive moisture accumulation which could be indicative of internal damage.

Dipstick cryostats are shipped with removable shock absorbers which should be removed after the cryostat has been inspected for damage. Vertical dipstick cryostats have a plastic foam donut between the detector chamber and collar. Slit the tape holding this donut together and remove it. The detector chamber can then be lowered into its normal position. (This collar may not be found on detectors which by necessity have to be packed in short boxes due to transport facilities). Horizontal dipstick cryostats have a plastic foam pillow which cradles the horizontal detector chamber to prevent bending of the dipstick during shipment. This pillow is secured to the dewar neck by means of nylon cord or tape and can be removed by cutting same.

2.2 PACKING FOR RE-SHIPMENT

Keep all of the packing materials with the original shipping container in case the detector should be shipped to the factory for service or elsewhere for use. We cannot be responsible for shipping damage incurred after initial delivery of the detector or if a detector is returned for in-warranty service with improper packing.

Detectors properly prepared for shipment are shown below:

Figure 2-1.

Figure 2-2.

Section 3

TEST PROCEDURE

3.1 INTRODUCTION

The salient specifications of Ge detectors are few in number, and detectors are not complex instruments, so it is possible to verify the performance of a detector with relative ease – provided that the proper equipment is available and correct procedures are used. The equipment used in conjunction with a Ge detector must be of the right type and in good working order to ensure good system performance. Likewise, the procedures must reflect the standards of the manufacturer or there will be unexplained differences in performance between tests in the factory and in the field.

3.2 EQUIPMENT REQUIRED

Ge Detector, Cryostat, and Preamplifier
NIM Bin and Power Supply – C.I. Model 1400, 2000 or Equivalent
Amplifier – C.I. Model 1413, 2010 or Equivalent
MCA – with 8192 ADC Range, 4096 Memory, and Digital Output Device
Detector Bias Supply – C.I. Model 3105, 3005 or Equivalent
Co^{60} source – NBS Calibrated Point Standard or Equivalent
V.O.M. – Simpson 260 or Similar
Oscilloscope – 50 MHz Band width, 5mV/div.

3.3 SET-UP PROCEDURE

Connect the equipment as shown in Figure 3-1 below:

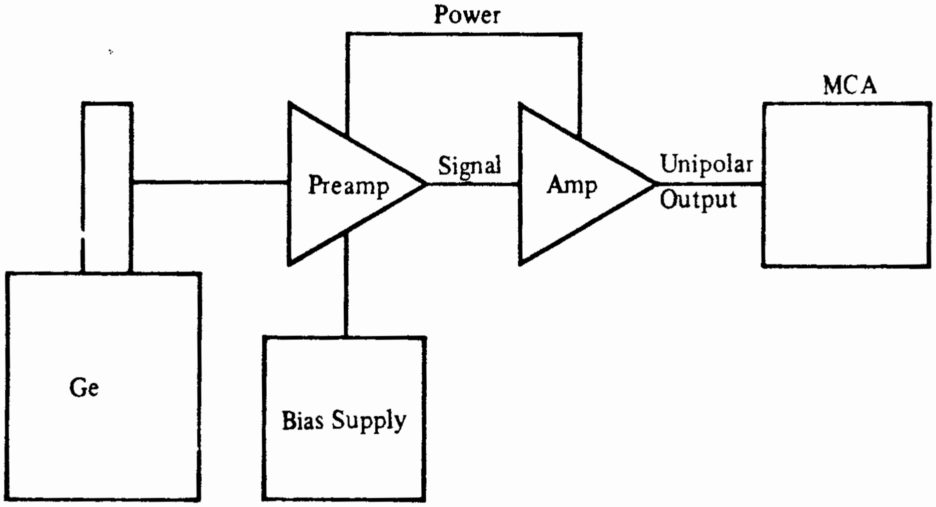


Figure 3-1.

Use the same electrical circuit for all AC power to the system to avoid ground loops. The Bias Supply and Amplifier should be located on opposite ends of the NIM Bin, if possible, to minimize cross talk between them. Use the amplifier rear panel output (Unipolar) if the cable between Amplifier and MCA is more than 3 feet. The front panel output may be used with long cables only if the cable is terminated at the MCA with a 93-ohm load. Otherwise, it may oscillate. This is particularly true of the 1413 amplifier.

Instrument Settings – These settings should be used unless otherwise noted on test data supplied with the detector.

Amplifier:

Input:	Positive
Output:	Positive
D.C. Restorer:	Low, Asym.
Shaping T.C.:	4μsec
Coarse Gain:	30
Fine Gain:	0.5

MCA:

Input:	Positive, D.C. Coupled
ADC Range:	8192
Memory Size:	2048
Digital Offset:	6144

3.4 APPLYING THE BIAS VOLTAGE

Observe the amplifier output with the oscilloscope. The noise should be several hundred millivolts p.p. with no detector bias applied. (Use the cable that normally goes to the MCA rather than an oscilloscope probe).

Monitor the test point on the rear panel of the preamplifier with the voltmeter. It should read approximately minus (-) 0.5 volts D.C. Do not confuse the test input (BNC) with the test point.

Increase bias to 100 volts. The noise at the amplifier output should decrease somewhat, and the voltmeter should momentarily go more negative before returning to its initial reading.

Increase the bias now to 500 volts. The noise should be further reduced and the voltmeter should respond exactly as before.

Increase the bias in 500 volt steps to the recommended value, observing the behavior of the amplifier signal and voltmeter after each increment. The noise should remain constant after the depletion voltage is reached. The voltage at the test point should correspond to that given on the test data sheet in the rear pocket of this manual.

3.5 FINE TUNING AMPLIFIER

Introduce the Co^{60} source to the detector while observing the voltmeter. Move the source close enough to the detector to cause about 0.1 volt change in the test point voltage.

Adjust the amplifier coarse and fine gains to give approximately 5 volt amplitude pulses.

With the D.C. restorer off, adjust the Amplifier Pole/Zero control.

The photographs below illustrate the desired pulse shape.

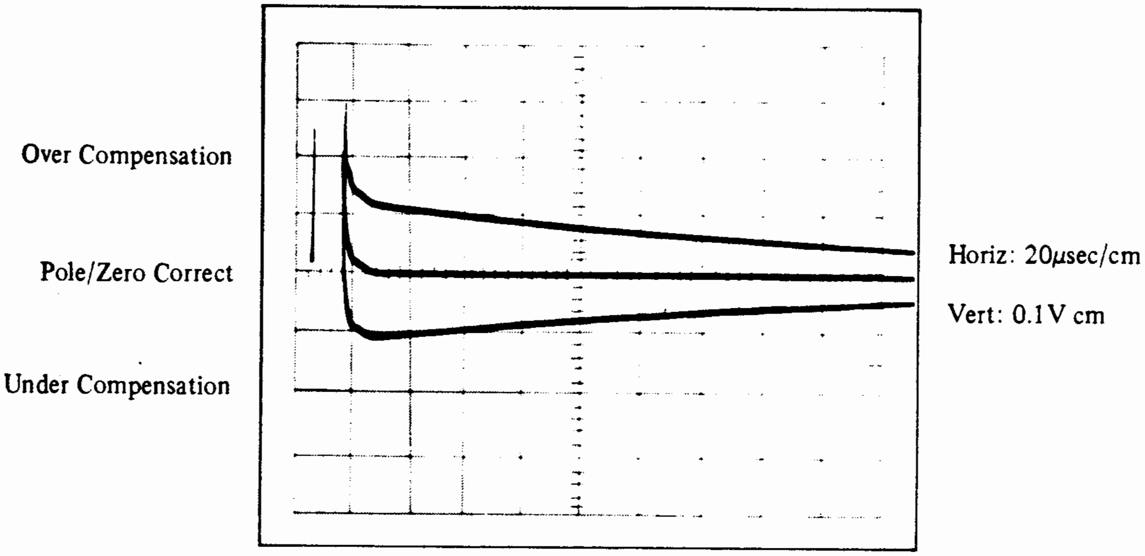


Figure 3-2. Pole/Zero Compensation.

3.6 ACCUMULATING SPECTRUM

With the D.C. restorer in Low, connect the Amplifier output to the ADC input and start a collect cycle on the MCA. Adjust the amplifier gain so that the 1.33MeV peak is within the last 20 channels or so of the memory.

Accumulate approximately 2000 counts in the peak channel of the 1.33MeV peak under quiet conditions. Do not move about or make noise during the accumulation of data.

A typical spectrum with key regions intensified is shown below:

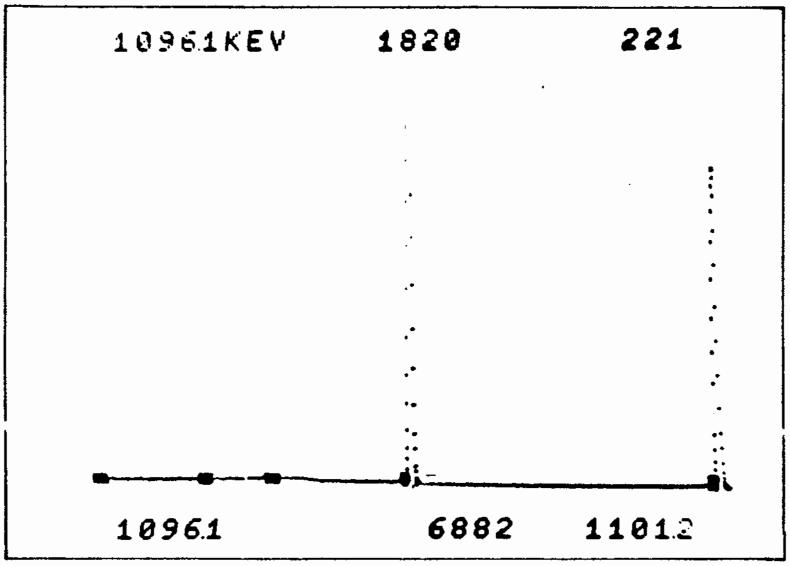


Figure 3-3. Co^{60} Spectrum with Compton Plateau, Compton Edge and Peak Regions intensified.

3.7 RESOLUTION CALCULATION

Determine the peak centroids of the 1.1732 and the 1.3325MeV peaks by expanding each region individually and placing the cursor by eye at the center channel of each peak, noting the channel number of each.

The conversion factor is then:

$$\text{Conversion Factor} = \frac{1.3325 - 1.1732}{\text{Channel Separation}} = \frac{159.2\text{KeV}}{\text{Channels}}$$

Using the setting for the ADC previously described, the conversion factor should be in the range of 0.16KeV/channel. If it is not, then something is set up improperly.

Print out the 1.33MeV peak and determine the number of channels FWHM and FWTM (Full Width at Half Maximum, and Full Width at Tenth Maximum). Do a linear interpolation between channels to obtain accurate results.

1.33 MeV Peak

```
20010
000199  000267  000389  000526  000688  000886  001131  001371  001642  001868
001958  002002  001929  001877  001699  001441  001231  000906  000734  000536
000348  000233  000146  000094  000059  000024  000020  000009  000009  20300
```

$$\text{Half Maximum} = \frac{2002}{2} = 1001$$

$$\text{FWHM} = \frac{1131 - 1001}{1131 - 886} + 10 + \frac{1231 - 1001}{1231 - 906} = \frac{130}{245} + 10 + \frac{230}{325} = 11.23 \text{ channels}$$

FWHM (KeV) = 11.23 x 0.163 KeV/ch = 1.83

$$\text{Tenth Maximum} = \frac{2002}{10} = 200$$

$$\text{FWTM} = \frac{267 - 200}{267 - 199} + 20 + \frac{233 - 200}{233 - 146} = \frac{67}{68} + 20 + \frac{33}{87} = 21.36 \text{ channels}$$

FWTM (KeV) = 21.36 x 0.163 KeV/ch = 3.48

3.8 PEAK/COMPTON CALCULATION

Unless otherwise noted on the test data, we publish the average of the Peak-to-Compton Edge and Peak-to-Compton Plateau values. In the calculation, approximately 30 channels of each region are integrated and the average count per channel is determined. This number is divided into the number of counts in the peak (1.33 MeV) channel to give that specific ratio.

$$\text{Peak/Compton (Plateau)} = \frac{\text{Highest Channel Count in 1.33 MeV Peak}}{\text{Average Count/Channel in Plateau}}$$

$$\text{Peak/Compton (Edge)} = \frac{\text{Highest Channel Count in 1.33 MeV Peak}}{\text{Average Count/Channel in Edge}}$$

$$\text{Peak/Compton} \quad \frac{\text{Peak/Compton (Edge)} + \text{Peak/Compton (Plateau)}}{2}$$

The energy ranges used for Compton Plateau and Compton Edge are approximately 1060 KeV and 1096 KeV respectively.

3.9 EFFICIENCY MEASUREMENT

The efficiency measurement is done with the simplest, most straightforward MCA settings so as to minimize the ADC dead time (and attendant questions of live time correction) and effort required to integrate the peaks (if the MCA does not have such arithmetic capability). For these reasons, we use the 1024-channel range and memory size and no digital offset for this measurement.

Start accumulation and adjust amplifier fine gain controls so that the 1.33 MeV peak is somewhere in the upper half of the display.

Accumulating Data:

Instruments Settings:

Amplifier:

Input: Positive
Output: Positive
D.C. Restorer: Low, Asym.
Shaping T.C.: 4μsec
Coarse Gain: 10
Fine Gain: 0.9

MCA:

Input: Positive, D.C. Coupled
ADC Range: 1024
Memory Size: 1024
Digital Offset: 0
Clock: Live Time

Positioning Source:

Place the source 25cm away from the detector face. The detector face is typically 5mm from the inside of the end cap, and the overall end cap thickness is about 1.5mm, typically, at the edge. The distance from the center of the source to the outside face of the end cap should be 24.35cm, in most cases. Check the Detector Test Specifications for detector-to-window distance. The source should be on the end cap axis and no extraneous materials should be between the source and the detector. Appropriate allowances should be made for sources of substantial thickness.

When the 1.33 peak is storing in the desired region, stop collect, reset and start collect again, this time with a preset live time of 1000 seconds.

When collection is complete, integrate a symmetrical region about the 1.33 MeV peak about 10 channels wide.

The Relative Efficiency is then obtained by the following formula:

$$\text{Relative Efficiency} = \frac{N}{T} \times \frac{1}{Rs} \times \frac{1}{1.2 \times 10^{-3}} \times 100\%$$

Where:

N = Number of counts in 1.33 MeV peak
T = Time of collection (seconds)
Rs = Gamma-Ray emission rate from source (Gamma rays/sec)

The factor 1.2×10^{-3} is the recognized absolute efficiency of a 3" x 3" NaI(TI) detector at a detector-to-source distance of 25cm.

Background Correction:

In conditions where background is high and might contribute to an error in the efficiency measurement a second spectrum should be accumulated in the absence of the calibrated source. The integral of background in the same region of interest about 1.33 MeV should be subtracted from the former integral before calculating the relative efficiency.

3.10 SOURCE CALIBRATION

NBS sources are calibrated in terms of nuclear transformations per second (NT/S) and for Co^{60}, there is one 1.33 MeV photon emitted per nuclear transformation

The source emission rate must be corrected for decay at least monthly, because the half life of Co^{60} of 5.26 years implies a rate decrease of approximately 1.1% per month. Use the following formula to correct for source decay:

$$N = N_o e^{-(.693)\frac{t}{T}}$$

Where:

N = present rate of emission
N_o = original rate of emission
t = elapsed time
T = half-life (5.26 years for Co^{60})

Source Calibration using 3" x 3" NaI(TI) Detector

If no NBS or other suitable calibrated source is available, a 3" x 3" detector may be used for direct side-by-side comparisons of Ge detector efficiency.

If this approach is used, it is best to integrate the upper half of the 1.33 MeV peak and multiply by two to determine peak intensity for the NaI(TI) detector. This reduces the influence of the 1.17 MeV gamma rays on the 1.33 MeV peak.

Section 4.

TEMPERATURE CYCLING

4.1 GENERAL

The Coaxial Ge detector is capable of withstanding repeated and prolonged periods of room temperature storage. Before being shipped, every detector is subjected to a minimum of 5 temperature cycles to ensure stability. While it is only reasonable to assume that a detector will last longer if it is kept cold at all times, with certain precautions no serious compromise in life time will result from temperature cycling. These precautions are given below.

4.2 BIAS OFF DURING WARM-UP

A detector should not be allowed to warm up with Bias applied. When a detector warms up, the molecular sieve outgasses and pressure within the cryostat rises. If electrical discharge occurs as a result of this increased pressure, the sensitive detector surfaces can be damaged. The Model 1786 Liquid Nitrogen Monitor can be used to disable the Bias supply when the LN_2 drops below a satisfactory level.

4.3 COMPLETE WARM-UP

It takes several hours for a detector to warm up completely and several hours to cool down thoroughly. When a warm-up cycle is begun, the detector should be allowed to warm up fully before being cooled down again. Otherwise some of the residual gases that are absorbed by the detector surfaces may be frozen there. If the detector warms up completely, the molecular sieve will tend to pump the system clean when the detector is recooled. If a detector is inadvertently cooled after partial warm-up, a full warm-up cycle will likely restore any lost performance.

The time required to completely warm-up a cold detector depends on the type of cryostat and on the conditions. Here are some guidelines for the various types:

Dipstick - Withdraw the detector assembly from the Dewar and keep it out for 24 hours. Keep it vertically upright during this time.

Integral - Empty the LN_2 and turn the cryostat on its side with the neck plug removed for 48 hours. Be sure to dry out the Dewar thoroughly before replacing the LN_2

Portable (MAC) - Force the LN_2 out and allow the unit to warm up for 48 hours. See the MAC instructions (supplement to this manual).

Section 5

TROUBLESHOOTING

5.1 GENERAL

There are a very limited number of Ge detector failure modes, the most common being preamplifier failure and cryostat vacuum loss. The number of things which can contribute to loss of resolution are almost limitless, however, and this is where careful diagnosis is more important.

The most important indication of the condition of a Ge detector itself, exclusive of preamplifier and other electronics problems, is reverse leakage current. With modern D.C. coupled detectors, the first stage of the preamplifier can be used as an electrometer to measure the leakage current of a detector. A schematic representation of the circuit is given below:

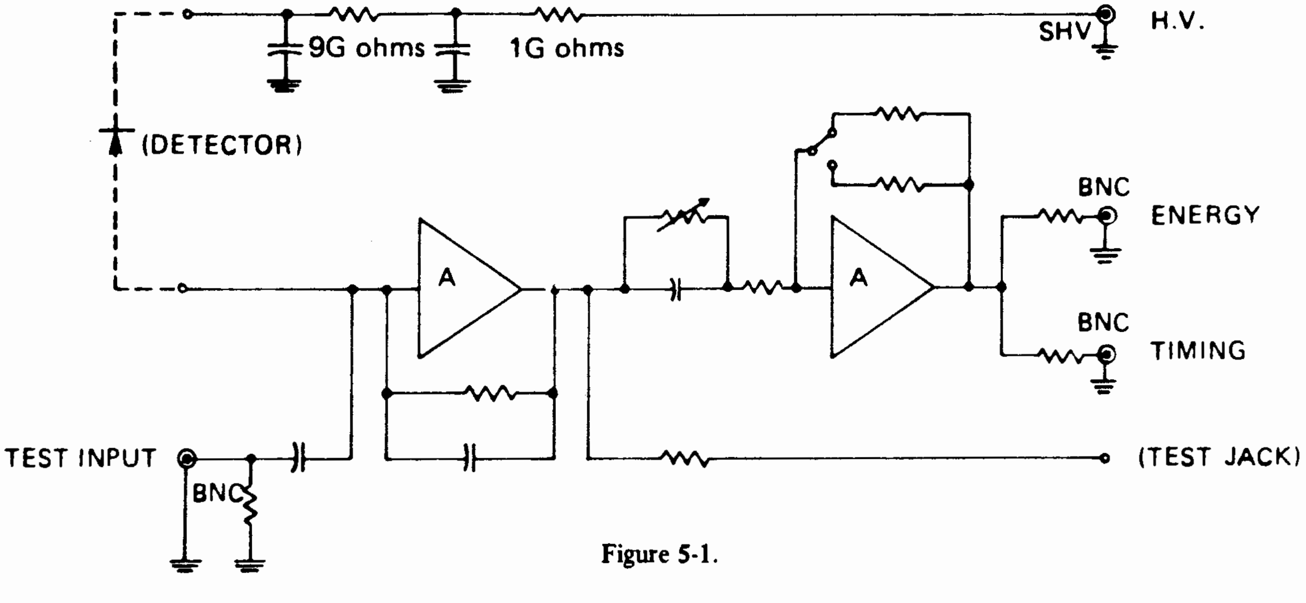


Figure 5-1.

The voltage at the test point (rear panel on 2001) has a d.c. offset of about -0.5 volts. In addition, detector leakage current will cause the test point voltage to shift in a negative direction. The transfer function is determined by the feedback resistance. For the 2001, which has a feedback resistance of 2 x 10^9 ohms, the test point voltage changes by approximately 2 volts per nanoampere of leakage current. Radiation detected by the Ge also results in detector current so measurements of leakage current must be done with no radioactive sources present.

The diagnosis of detector problems require that the leakage current or so-called V-I characteristics can be determined. The following troubleshooting guides make reference to this procedure for a variety of problems.

Symptom	Check
No Output	Measure the 2001 rear panel test point voltage; it should correspond to test data sheet. See section 3.4 under test procedure.

Test Point Voltage out of range regardless of detector bias.	Check preamp power supply voltages at the preamp.
	Check input FET (Q1) junctions with ohmmeter with power and high voltage off. Gate-Drain and Gate-Source junctions should have silicon diode forward-reverse characteristics. Otherwise FET is bad.
	Substitute another preamplifier if possible.
Test Point Voltage increases gradually with detector bias.	Remove the preamp and dry the cryostat electrical feed-through with a heat gun. Use enough heat to make the wax coating flow slightly. After cooling down, re-assemble and re-check the V-I characteristics.
Test Point Voltage increases non-linearly before recommended bias is reached.	Try operating detector at a lower bias voltage.
	Detector may have been subjected to an incomplete warming cycle. Warm up thoroughly and re-cool.
Test Point Voltage not stable (moves several volts both pos. and neg.).	Preamp feedback resistor may be open (R2).
Test Point Voltage Erratic.	Check for voltage breakdown in Preamp H.V. network, in the bias supply and in the H.V. cable.
Poor Resolution.	Check test point voltage for proper behavior with applied detector bias. (See section 3.4).
	Check for periodic signals on amplifier output with d.c. restorer off.
50 - 60 HZ Noise	Check for possible ground loops. Make sure that all components in the system are powered from the same circuit.
Microphonic Noise	Isolate the dewar from the floor with some insulating material such as rubberized hair.
	Rotate the cryostat collar so that the bottom of the dipstick does not rest against the recess at the bottom of the dewar. By moving the end cap from iside-to-side you can sense when the dipstick is centered in the recess in the dewar.
High Frequency Noise	H.V. bias supplies typically use 5KHZ to 20KHZ converter frequency. Change bias supplies if the converter frequency is observed on the amplifier output.
	Operate the detector in a sound insulating chamber or room if at all possible.

Poor Resolution	Consider the response of the ADC to the amplifier pulse shaping time constants. Older ADC's do not respond well to long rise time pulses. Use a linear gate such as the Canberra Model 1454 to solve this problem.
	Check for interference from other equipment. Printing terminals, computers, etc. can cause interference that will hurt detector resolution. Turn off such equipment in turn to find the offending unit.
	Operate the MCA in live display. Dynamic display can introduce noise signals into the preamplifierrs.
Peak Tailing	Check Amplifier Pole/Zero setting.
	Consider the possibility of radiation damage to the detector. This results in tailing on the low energy side of the peaks and is progressively worse with increasing peak energy.
	Check H.V. cables and circuits. Detector may not be getting rated bias.
	Dry electrical feedthrough. Leakage current to chassis may drain H.V.
Moisture Accumulation	Bad cryostat vacuum. Measure the weight loss over a 24 hour period. LN_2 weighs 1.78 lbs./liter. If LN_2 consumption exceeds 2 liters/day on an ordinary cryostat, the end is probably close at hand. If warm-up occurs, when the LN_2 is replenished the cryostat will remain cold and the loss rate will be fairly high until the molecular sieve has time to pump the cryostat down again. This may take a couple of days.

5.2 PREAMPLIFIER EXCHANGE

A faulty preamplifier may be replaced in the field if care is taken in handling it. Before working on any preamplifier, turn off the detector bias supply and allow the preamplifier to discharge fully (about 5 minutes) before proceeding.

Disconnect all cables and inspect the preamplifier to determine whether it is 1. D.C. coupled, with room temperature FET, or 2. D.C. coupled with cooled FET. This determination may be made using the following guidelines:

1. D.C. coupled with room temperature FET
    - detector requires positive bias.
    - maximum of three wires connect preamplifier to detector electrical feedthrough(s).

2. D.C. coupled with cooled FET
    - detector requires positive bias.
    - minimum of four wires connect preamplifier to electrical feedthrough(s).

5.2.1 CLEANING ELECTRICAL FEEDTHROUGH

If the electrical feedthrough pins are corroded, clean them with very fine emery cloth, taking care to blow away any dust that results. Wash the feedthrough with methyl alcohol if it is dirty. Dry with a hot air gun. If the feedthrough is coated with black wax, use enough hear to make the wax flow slightly.

5.2.2 INSTALLING MODEL 2001 (D.C. coupled, Room Temperature FET preamplifier)

Observe the way in which the original preamplifier is connected to the detector and install the new preamplifier exactly the same, or, determine the feedthrough connections for detector anode and cathode by using a simple ohmmeter. The detector has a few hundred ohms forward resistance and infinite reverse resistance. Typical electrical feedthrough arrangements are shown in Figure 1-3 (Section 1.3.4).

The detector conducts current when forward biased by the ohmmeter. The proper preamplifier connections are illustrated below:

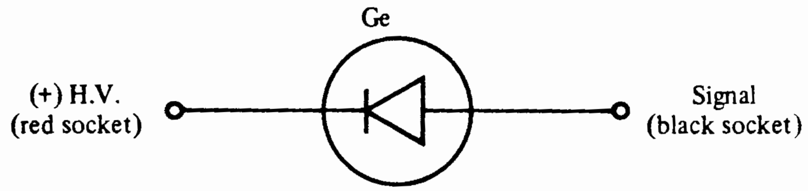


Figure 5-2.

(Remember that some ohmmeters put out the opposite polarity test voltage than indicated by the leads).

If a third connection is used on such detectors, it is a chassis ground and should go between the preamplifier's ground plane and the pin which is grounded to the cryostat. (Check with ohmmeter).

5.2.3 INSTALLING MODEL 2001C (D.C. coupled, cooled FET preamplifier)

The preamplifier has a pigtail connector assembly which carries all low voltage signals and a separate H.V. lead socket which connects to the H.V. feedthrough. The pigtail connector assembly will fit only one way. See the 2001C Schematic for more information.

Section 6
Detector Specifications and Performance Data

6.1 SPECIFICATIONS

Serial Number 4861544

The purchase specifications and therefore the warranted performance of this detector are as follows:

Rel. Efficiency - 30 %

Resolution - 1.8 keV (FWHM) @ 1.33 MeV

- ____ keV (FWTM)

- ____ keV (FWHM) @ ____

- ____ keV (FWTM)

Peak/Compton - ____ :1

Cryostat Description or Drw. No. if special 7905-7.5 SLS

6.2 PHYSICAL/PERFORMANCE DATA

Actual performance of this detector when tested is given below.

Geometry Closed Ended Coaxial

Diameter 54.2 mm

Length 63 mm

Active area facing window 23.2 cm^2

Distance from window 5 mm

Electrical Characteristics

Depletion Voltage (+) 4000 V dc.

Recommended Bias Voltage (+) 4500 V dc.

Leakage Current at Recommended Bias 0.01 Na.

Preamplifier Test Point Voltage at Recommended Bias (-) 2.50 V dc.

Capacitance at Recommended Bias 23 pf.

Resolution and Efficiency-with Amp Time Constant of 4 microseconds.

Isotope	Co^{57}	Co^{60}			
Energy (keV)	122	1332			
FWHM (keV)	0.85	1.77			
FWTM (keV)	1.60	3.48			
Peak/Compton		62.8:1			
Efficiency (%)		33.4%			