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## CALIBRATION PROCEDURES

<b>MODEL:</b> 26	<b>DIAL:</b> none	<b>DETECTOR:</b> pancake GM
Revision 1		
Revised by: <i>Kimberly Gray</i>		Date: <i>8 March '12</i>
Approved by: <i>Richard Smith</i>		Date: <i>8/2/12</i>
Q/A Approval: <i>Larry Hillis</i>		Date: <i>8/1/12</i>

### Equipment Required:

or Bq (30,000 dpm) and 5 cm (2 in.) in size.

- All instruments used in calibrating the Model 26 must be calibrated by standards traceable to the National Institute of Standards and Technology and must have a current calibration label attached.
- A Ludlum Model 500 pulser or equivalent is required. If the Pulser does not have a high-voltage readout, use a high-impedance voltmeter with at least 1000 Megohm meter input resistance to measure the detector voltage.
- A <sup>137</sup>Cs gamma range with beta shield, capable of producing 2 mR/hr to 20 mR/hr (20 μSv/h to 200 μSv/h).
- NIST-traceable sources consisting of a <sup>99</sup>Tc (or equivalent) beta source and a <sup>239</sup>Pu (or equivalent) alpha source, both approximately 500 dps

### Initial Calibration Procedures

- If any calibration procedure cannot be completed satisfactorily, the instrument should be tagged and removed for proper disposition.
- Set the instrument to read in either cpm or cps, typically cpm for domestic orders and cps for international orders. Enter the setup mode by turning the unit ON and pressing the MODE button three times when the unit displays 0.0. Verify that the other internal settings are set to default:
  - Response Time : (0 for automatic or a number from 1 to 60 seconds) default = 0, Fast

- Count Rate Alarm Point : (0-1999, and units of c/s, kc/s, cpm, and kcpm; 0 disables the alarm), default = 0
  - Scaler Alarm Point : (0-1999 counts or 0-1999 k counts), default = 0
  - Scaler Time: (0-19:99 minutes: seconds, 0 disables this mode), default = 60 seconds (1:00)
  - Mode Disable: (disables MAX and scaler modes), default = 0
- Turn off the Model 26.
  - Disassemble cover from the Model 26 and remove GM tube.
  - Turn the Model 26 on.
  - Connect the Model 26 to the pulser or a certified high-impedance voltmeter (at the point just before the detector ballast resistor). Confirm a HV reading of 900 Vdc  $\pm$  50 Vdc.
  - Connect the Model 26 to the pulser if a high-impedance voltmeter was used in the previous step.
  - Rotate the pulser MULTIPLIER switch to the 100 position.
  - Rotate the Model 500 Pulse Polarity switch to the -NEG position, the AMPLITUDE control to the 5V position, and the LO-HI control to maximum clockwise position.
  - Adjust the pulser MULTIPLIER, COARSE and FINE controls to 800 (480 if in cps).
- To determine the Model 26 input sensitivity, decrease the AMPLITUDE LO-HI control on the pulser until the Model 26 display is approximately 75% of full-scale deflection (60 kcpm instead of 80 kcpm or, if in cps, 600 cps instead of 800 cps). This should be the knee of the input sensitivity plateau or slightly above the area where a small decrease in the AMPLITUDE LO-HI control causes the Model 26 reading to fall rapidly. The Model 26 input sensitivity is the voltage indicated at this point on the pulser meter and should be 700  $\pm$ 150 mV.
  - Adjust the pulser AMPLITUDE LO-HI control to 1.5 V and maintain this level for all subsequent calibration procedures.
  - Use the COARSE and FINE controls to adjust the pulser. Confirm and record the following readings:
- CPM DISPLAY:
- 80.0 kcpm = 80.0  $\pm$  4 kcpm
  - 20.0 kcpm = 20.0  $\pm$  1 cpm
  - 8.0 kcpm = 8.0  $\pm$  0.4 kcpm
  - 2.0 kcpm = 2.0  $\pm$  0.1 kcpm
  - 800 cpm = 800  $\pm$  40 cpm
  - 200 cpm = 200  $\pm$  10 cpm
- OR CPS DISPLAY:
- 120 kcpm (2 kcps) = 1.99  $\pm$ 0.1 kcps
  - 48 (800 cps) kcpm = 800  $\pm$  40 cps
  - 12 (200 cps) kcpm = 200  $\pm$ 10 cps
  - 4.8 (80 cps) kcpm = 80  $\pm$ 4 cps
  - 1.2 (20 cps) kcpm = 20  $\pm$ 1 cps
  - 480 cpm (800 cps) = 8  $\pm$ 1 cps
  - 120 cpm (2 cps) = 2  $\pm$  1 cps
- Turn off the Model 26.

- Install tube and reassemble.
- Turn on the Model 26.
- Press the Model 26 ON/ACK switch and verify that the click audio works and can be silenced (acknowledged).

### Cs-137 Gamma Range

- Disconnect the pulser and reconnect the pancake GM tube. Verify that the background count rate is approximately 30-60 cpm (or 0.5-1.0 cps), and record it.
- Place the Model 26 detector in the  $^{137}\text{Cs}$  radiation field (using the plastic enclosure seam as the center line and facing the detector screen towards the radiation source) at the 20 mR/hr radiation level mark (or 200  $\mu\text{Sv/h}$  if in cps mode).
- Expose the source.
- Record the meter reading on the Model 26.
- Repeat the above steps for 10, 5, and 2 mR/hr (or if in cps mode, 100, 50, and 20  $\mu\text{Sv/h}$ ).
- Divide the count rate received for 2 mR/hr by 2, and record this as the count rate per mR/hr. Verify that this count rate is 3300 cpm/mR/hr  $\pm 10\%$  (2970-3630) cpm/mR/hr). Or if in cps mode, verify that the count rate at 20  $\mu\text{Sv/h}$  is 5.17 cps/ $\mu\text{Sv/h}$   $\pm 10\%$  (4.65-5.69 cps/ $\mu\text{Sv/h}$ ).

### Alpha and beta sensitivities

**Note:** Verify that the scaler count mode is set to 60 seconds (1:00).

- Record net readings from NIST-traceable alpha and beta sources (typically  $^{239}\text{Pu}$  and  $^{99}\text{Tc}$ ), and calculate  $4\pi$  efficiencies. Verify that values meet the specifications for this instrument. Put the instrument into SCALER mode and record a scaler count. Record the efficiency as a net  $4\pi$  percentage (received counts/emitted particles  $\times 100\%$ ).