

Ludlum 177-4 Calibration Worksheet

Location: Radiation Protection Calibration Facility at Site 38
Effective: February-2019 through July-2019

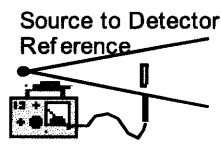
Serial# 32 Name DAW Date 5-30-19
 Temperature AMB °F Humidity AMB % TPS# 6 DVM# 12 Detector# 32
 Last Known Location AP-30 North

1. **Source Wipe:** As per RPIT source wipe procedure, wipe and record source# 137(-2.2)-196

2. **Power Up:** Plug instrument into AC receptacle and turn power switch on. The power lamp must light.

3. **As Found Performance Check:**

In the LLCF, expose the detector to the following exposure rates. Record meter readings. Calculate net count by subtracting background from each reading. Ex. If background=40 CPM and the as-found 0.05 mR/hr meter reading is 200 CPM then the net as-found reading is 160 CPM. (200-40=160) The net reading must be compared to the tolerance to determine if the instrument is in specification or out. The final readings and adjustments for both pulser and detector calibrations will be recorded later. All calibration adjustments are located on the back side of the instrument and are well labeled.



As Found/Detector Calibration								
Range	Source	Distance	Exposure Rate	CPM Meter Reading				Tolerance
				As-Found		Final		
X1	N/A	135.2	Background	30	Net	SAME	Net	N/A
X1	137-2.4-2	135.2	0.05 mR/hr	200	170			134 - 201
X10	137-3.4-3	147.9	0.5 mR/hr	1650	N/A			1330 - 2006
X100	137-4.5-1	139.5	5.0 mR/hr	15.5K	N/A			14.8K - 18.1K
X1	Check	Contact	N/A	150	N/A		N/A	N/A

If any of the above As-Found readings are out of tolerance the PCN system must be invoked. The detector probe check tolerance was determined by the tube manufacture. They state the tube as 3350 CPM/mR/hr ±20% using 137Cs.

4. **Overload Test:** Expose the instrument to a 20 mR/hr field using the 137-4.5-1 at a distance of 69.9 cm. Meter must not drop below full scale.

Remove the instrument from the 20 mR/hr field. Meter must return to background in <2 minutes.

5. **Physical Inspection:** Move instrument to a technician bench and physically inspect the outside and inside of the Ludlum 177-4 for damage, loose or broken connections, etc. and repair any problems found.

6. **Clean Instrument:** Clean the entire outside of the instrument using a mild cleaner and paper towels "KayDry". Remove all extraneous tape, calibration labels, etc., from the instrument.

7. **Electronic Checks:** Using the following forms, record the information as required following the procedures in a - i.
- a. With the power switch in the off position, mechanically zero the meter. The zero adjustment screw is located on the front of the meter. Adjust if needed. Record results.
 - b. Turn power switch to the on position. Using a DVM measure and record the 5 volt power supply at pin 2 of LM340T/LM7805. Pin 2 is the pin closest to the top of the board.
 - c. Disconnect the detector. Using a DVM and high voltage probe measure and record the high voltage of the instrument.
 - d. Depress the HV test switch. Observe and record the HV meter reading.
 - e. Set the range switch to X10. Depress the CAL switch. Observe and record the meter reading.
 - f. Set the range switch to X100. Connect the detector cable to the GM output of a TPS.. Set frequency to 10K with a divide by of 25. Turn TPS power on and set to GM. Push and hold in the reset button. Meter must go to zero.
 Release reset button, unlock alarm set, and adjust pot fully counter clockwise. Turn alarm control on.
 Slowly turn alarm set pot clockwise until alarm sounds. Alarm lamp must light. Record as-found alarm set point. Adjust R51 for proper alarm set point if needed. Record final setting.
 Push in the reset button. Alarm must turn off until alarm point is reached again.
 Turn alarm control off and set TPS frequency to 100K divide by 1.
 Alarm must not turn on. Meter must stay above full scale.
 Rotate volume control. Volume must increase as control is turned CW and decrease as it is turned CCW.

		As-Found	Final	Adjust	Observe	Tolerance
a.	Mech. Zero	0	SAME	meter	meter	0
b.	+5 volts	4.9	↓	N/A	DVM	4.5 - 5.5
c.	High Voltage	900	↓	R45	DVM	890 - 910
d.	HV Meter	900	↓	R13	meter	0.85K - 0.95K
e.	CAL Switch	1800	↓	N/A	meter	1.62K - 1.98K
f.	Alarm set point	230	↓	R51	Alarm Set Pot	190 - 290

*when measuring the HV use a 1000 megohm high voltage probe and a DVM with an input impedance of 10^7 ohms.

- g. Set frequency of TPS to 10 and divide by to 2. Set volume control to mid position, response to fast and the range switch to the X1 position. Audible clicks must be heard. ✓
- h. Push and hold the reset button on the TPS. Observe the rate at which the meter drops. Release reset push button. Change response switch to slow. Push and hold the reset button on the TPS. Observe the rate at which the meter drops. It must be slower then the fast position. ✓
- i. Using the table below set TPS as needed and record Ludlum 177-4 meter readings.

As Found/Pulsar Calibration							
Range	Input Frequency (CPM)	TPS Setting		CPM Meter Reading		Adjust	Tolerance
		Freq.	Divide by	As-Found	Final		
X1	150	10	4	150	* SAME	X1	135 - 165
X1	60	10	10	60	↓		54 - 66
X1	240	100	25	235	↓		216 - 264
X10	1.5K	100	4	1.5K	*	X10	1.35K - 1.65K
X10	600	100	10	600	↓		540 - 660
X10	2.4K	1K	25	2350	↓		2.16K - 2.64K
X100	15K	1K	4	15K	*	X100	13.5K - 16.5K
X100	6K	1K	10	6K	↓		5.4K - 6.6K
X100	24K	10K	25	23.5K	↓		21.6K - 26.4K

If any of the above As-Found readings are out of tolerance the PCN system must be invoked. The * above indicates the calibration set point. This instrument is calibrated to true pulse repetition rates, and will read the true count rate from the detector.

8. Calibration:

Reattach probe to instrument.

- a. Were all tolerances to this point for both radiation and electronic checks within the specifications stated? Select one. Yes. Go to step 8.b. No. Go to step 8.d.
- b. Were any adjustments made? Select one. Yes. Go to step 8.d. No. Go to step 8.c.
- c. To indicate no adjustments were made, write the word *same* under the final column in each table. Go to step 9.
- d. Using the form in step 3, complete the information needed under the column final. Make adjustments as needed.

9. Check Source Measurement:

- a. Set function switch to x1 and record background reading. 30 CPM (Background must be <100)
- b. Place the detector in the instruments check source holder. Record the reading. 150 CPM
- c. Subtract reading 9.a. from reading 9.b. and record. 120
- d. Subtract 20% from the reading in 9.c. and record. 100 CPM (If needed, round up measurement for ease of reading)
- e. Add 20% to the reading in 9.c. and record. 140 CPM (If needed, round down measurement for ease of reading)
- f. Remove old CHECK SOURCE READS label and attach a new one to the side of the instrument. Record measurements in 9.d. and 9.e. on the label.

10. DPM Calculation:

Using the DPM calculation computer program, determine the detector's gamma efficiency and DPM/CPM ratio using the final CPM reading from form 3.c line 3 (0.5mR/hr line). Record information in the spaces provided. Attach a label to the detector containing the following information: Efficiency, DPM/CPM, technician's name, calibration date, instrument and serial number.
 gamma efficiency .4 % 252 DPM/CPM

11. Label Change:

Place new calibration labels on the instrument. Record the information needed in the spaces provided. This instrument is due for calibration every year. ✓

12. Comments:

Attach any comments to this page.

Reviewed By: [Signature] Date: 7-11-19

Sources and instruments used for this calibration are traceable to National Institute of Standards and Technology

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