

RHSC - October 1993

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**WORCESTER POLYTECHNIC INSTITUTE
HEALTH PHYSICS PROCEDURE HP-22
CALIBRATION OF THE Ar-41 MONITOR**

1. PURPOSE:

To ensure that the Ar-41 monitor is within proper calibration.

2. FREQUENCY:

This procedure shall be performed semi-annually.

3. MATERIALS, TOOLS, AND EQUIPMENT:

3.1. Form(s):

3.1.1. Calibration of the Ar-41 Monitor

3.2. Allen wrench

3.3. Calibrated gamma radiation source (i.e.: Co-60, Cs-137, etc.)

3.4. Jewelers screwdriver

3.5. Meterstick

3.6. Gamma-Spectroscopy system (i.e., GeLi)

3.7. Graduated Hypodermic Syringe

3.8. Plastic vial or another appropriate container (approximate volume 20 mL)

3.9. Packing tape or another appropriate item

4. PRECAUTIONS:

4.1. Ensure that all health physics practices are followed throughout the survey.

4.2. Utilize the concepts of time, distance, and shielding to maintain exposure as low as reasonably achievable.

4.3. Implement all appropriate safety precautions when working with high voltages.

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5. INSTRUCTIONS:

- 5.1. Determine the operating voltage plateau of the Ar-41 monitor.
 - 5.1.1. Verify that all power switches are off and that the check source is retracted.
 - 5.1.2. Remove the three allen screws from the base plate of the geiger tube assembly on the shield chamber. Carefully remove the preamplifier and the geiger tube.
 - 5.1.3. Energize accessory power, turn the Log Ratemeter Power switch to HV, and turn the Log Ratemeter Function switch to HV.
 - 5.1.4. Record the initial high voltage reading as read on the ratemeter.
 - 5.1.5. Loosen the HV Adjust locknut and rotate it fully CCW.
 - 5.1.6. Place a gamma radiation source (i.e. Co-60) within one meter of the detector.
 - 5.1.7. Place the Function switch in the CPM position. Tune the HV Adjust potentiometer to each of the voltages listed on the form.

CAUTION: Do not adjust the voltage to the point of continuous discharge!

- 5.1.8. Record the count rate indicated on the ratemeter for each voltage setting. Allow sufficient time for the count rate to stabilize before recording the reading.
- 5.1.9. Construct a graph, plot count rate versus voltage.

- 5.1.11. Verify that 1050 VDC is within the operating plateau. If it is not, notify the Reactor Facility Director.
- 5.1.12. Set the HV Adjust to 1050 kVDC as indicated on the rate meter.
- 5.1.13. Record the final high voltage reading as read off of the local panel meter.
- 5.1.14. Turn off all power to the monitor.
- 5.1.15. Replace the geiger tube and the preamplifier assembly.
- 5.2. Calculate the calibration factor.
 - 5.2.1. Obtain a plastic vial and enclose the opening with tape.
 - 5.2.2. Lift one edge of the tape, insert the tube from the P-10 (10% methane 90% argon) gas tank, and fill the vial.
 - 5.2.3. Remove the gas tank tube from the vial, affix the edge of the tape, and seal any holes created.
 - 5.2.4. Secure the lid on the plastic vial.
 - 5.2.5. Irradiate the sample in the reactor core for ten minutes at one kilowatt.
 - 5.2.6. Withdraw a sample of activated P-10 gas from the plastic vial using the graduated hypodermic syringe. Record the volume extracted on the form.
 - 5.2.7. Determine the activity of the argon in the syringe using a gamma spectroscopy system. (The energy of argon is 1293.6 keV.)
 - 5.2.8. Create a closed loop for air circulation through the Ar-41 monitor.

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- 5.2.9. Inject the contents of the hypodermic syringe into the closed loop.
- 5.2.10. Pump the argon through the system until equilibrium is reached (maximum count rate).
- 5.2.11. Record the maximum count rate and calculate the calibration factor (cpm/ μ Ci/cc)
- 5.3. Perform a source check with the Cs-137 source. Record the reading.
- 5.4. Perform the Ar-41 Monitor Preoperational Check. Record all appropriate values.
- 5.5. Submit all results to the Reactor Facility Director for review.

6. RESTORATION:

None

7. REFERENCES:

- 7.1. Manufacturer's manual for the Argon-41 monitor
- 7.2. University of Massachusetts Lowell "Calibration of Stack Gas Monitor for Argon-41"