

WORCESTER POLYTECHNIC INSTITUTE HEALTH PHYSICS PROCEDURE HP-5

SEALED SOURCE LEAK TESTS

1. PURPOSE:

To ensure the integrity of the sealed sources and to ensure that they are free from surface radioactive contamination.

2. FREQUENCY:

- 2.1. Sealed sources and detector cells containing licensed material that does not emit alpha particles shall be tested for leakage and/or contamination every 6 months (WPI Materials License 03-6802, Amendment-39, Condition 15.A., and 105CMR120.223(A)(2)).
- 2.2. Sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination every 3 months (WPI Materials License 03-6802, Amendment-39, Condition 15.B., and 105CMR120.223(A)(3)).
- 2.3. If a sealed source or detector cell is transferred to WPI without certification that a leak test has been made within 6 months prior to transfer, the source shall not be put into use until tested (WPI Materials License 03-6802, Amendment-39, Condition 15.C., and 105CMR120.223(A)(1)). WPI shall not acquire licensed material in a sealed source or device unless the source or device has been registered in accordance with 105CMR120.128(N) (WPI Materials License 03-6802, Amendment-39, Condition 17.).
- 2.4. Sealed sources and detector cells need not be leak tested if any of the following apply (WPI Materials License 03-6802, Amendment-39, Condition 15.D., and 105CMR120.223(B)):
 - 2.4.1. They contain only hydrogen-3.
 - 2.4.2. They contain only a radioactive gas.
 - 2.4.3. Their half-life is less than 30 days.
 - 2.4.4. They contain 100 microcuries or less of beta and/or gamma emitting material, or 10 microcuries or less of alpha emitting material.

- 2.4.5. They are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or for transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer.
- 2.5. No sealed source or detector cell shall be stored for more than 10 years without being tested for leakage and/or contamination (WPI Materials License 03-6802, Amendment-39, Condition 15.D.(v)).
3. MATERIALS, TOOLS, AND EQUIPMENT:
 - 3.1. Form(s): Sealed Source Tests (RHSC Report Form 8)
 - 3.2. Filter paper, or another appropriate material
 - 3.3. Optional: Alcohol, or another effective solvent
 - 3.4. Gas-flow proportional counter or equivalent detection equipment
4. PRECAUTIONS:
 - 4.1. Ensure that all appropriate health physics practices are followed throughout the procedure.
 - 4.2. Take all necessary precautions to avoid the spread of possible contamination.
 - 4.3. Utilize the concepts of time, distance, and shielding to maintain dose as low as reasonably achievable.
 - 4.3.1. Because the potential localized exposure is high when swiping the PuBe source or any of the 30 mCi (original activity) Cs-137 sealed sources, it is necessary to demonstrate that the combined swiping protocols for the year will not result in a skin extremity dose (the part of the body receiving the highest exposure) greater than 10% of the annual dose established in 10CFR 20.1201(a)(2)(ii) and 105CMR120.211(A)(2)(b) (50 rem shallow dose to the skin of any extremity, 10% of which is 5 rem). Otherwise direct extremity monitoring would be required. The assigned shallow-dose equivalent must be calculated as the dose averaged over the contiguous 10 square centimeters of skin receiving the highest exposure (10CFR20.1201(c) and proposed amendment to 105CMR120.211(C)).
 - 4.3.2. The following table denotes the estimated surface activities for WPI's four high-activity sources, assuming they act as point sources. Also assuming a one-minute swipe contact with each source performed twice per year, the

skin extremity exposure to the survey individual would be about 0.43 rem. This value is only 8.6% of the allowed 10% occupational annual exposure limit to the skin of the extremities (5 rem), and still allows minor exposures from WPI's remaining much smaller sources while remaining underneath the limit.

Source	Serial Number	Estimated Max Dose Rate at Surface*	Estimated Skin Extremity Exposure During a Minute Swipe	Estimated Skin Exposure Averaged Over 10 cm***	Number of Times the Source is Swiped Per Year	Estimated Yearly Exposure
Pu-Be	M-615	50 rem/hr**	0.83 rem	0.17 rem	2	0.34 rem
Cs-137	M-777	4.5 rem/hr	0.075 rem	0.015 rem	2	0.03 rem
Cs-137	CS-817	4.5 rem/hr	0.075 rem	0.015 rem	2	0.03 rem
Cs-137	6842-GS	4.5 rem/hr	0.075 rem	0.015 rem	2	0.03 rem
Total Estimated Annual Exposure =						0.43 rem

* Assuming a point source, with original non-decayed activity.

** As per External Audit, June 30, 2005.

*** A 10 cm skin exposure is difficult to calculate from a point source, but we conservatively estimate it to be 2-10 times less than the activity at the surface for directly contacted skin. For purposes of calculation, a value of 5 times less was used.

4.4. Perform an operability check on all instrumentation used. Ensure that the instrumentation has been calibrated in accordance with 105CMR120.225(B) and 10CFR20.1501(b), at intervals not to exceed 12 months (Ibid. CMR not CFR).

5. INSTRUCTIONS:

5.1. Verify each source's serial number.

5.2. Swipe each source:

5.2.1. In some cases, alcohol or another solvent may be used to moisten the swipe to facilitate extraction of the contaminating radioactive material from the surface, however swipe moistening is not required by CFR, CMR, or Regulatory Guide 8.21. Obtain the alcohol or another effective solvent if desired or necessary.

- 5.2.2. If desired, moisten a piece of filter paper, or other suitable material of high wet strength and absorbent capacity, with this solvent.
- 5.2.3. Wipe all external surfaces of the source thoroughly, keeping the swipe time underneath one minute as per step 4.3 when swiping the four main sources. Note: For sealed sources we swipe the entire external surface area, the area to be swiped in lab surveys is covered in HP-12.
- 5.3. Count each swipe using either a gas-flow proportional counting system or equivalent detection equipment. All tests for leakage and/or contamination shall be capable of detecting the presence of 5 nanocuries of radioactive material on the test sample (105CMR120.223(A)(5), and WPI Materials License 03-6802, Amendment-39, Condition 15.E.). Prior to counting the swipes:
 - 5.3.1. Ensure that the swipes are completely dry to prevent the shielding of alpha and beta radiation.
 - 5.3.2. Calibrate the equipment with alpha and beta calibrated sources.
 - 5.3.3. Take a background count.
- 5.4. Action:
 - 5.4.1. Action Levels for Sealed Sources: WPI's RHSC approved its own highly restrictive limits for removable surface contamination for sealed sources at its meeting of July 26, 2006. Action Level-1 is 2 pCi alpha per source, and 10 pCi beta per source. If Action Level-1 is exceeded, the RSO or ARSO will notify the PI owning the source, and will remonitor following cleanup. Action Level-2 is 10 pCi alpha per source, and 100 pCi beta per source. If Action Level-2 is exceeded, the RSO or ARSO will contact the PI owning the source, will remonitor following cleanup, and will notify the RHSC in writing of the incident and its outcome.
 - 5.4.2. If the measured activity is less than 0.005 microcuries, the DPH considers the source to be free from surface radioactive contamination (WPI Materials License 03-6802, Amendment-39, Condition 15.E., and 105CMR120.223(E)).
 - 5.4.3. If the measured activity is 0.005 microcuries or greater:
 - 5.4.3.1. For sources covered by WPI's Materials License, file a report with the Director of the Radiation Control Program, Schrafft Center, Suite 1M2A, 529 Main Street, Charlestown, MA 02129, within 5 days of the date that the leak test result is known. The

report shall specify the source or detector cell involved, the test result, and the corrective action taken (WPI Materials License 03-6802, Amendment-39, Condition 15.E., and 105CMR120.223(G)).

5.4.3.2. For the Pu-Be source (classified as Special Nuclear Material, not covered by WPI's Material's License) notify the NRC Operations Center at (301) 816-5100, and file a report with the NRC Document Control Desk, Washington DC, 20555-0001, within 5 days of the date that the leak test result is known. Note: The requirements to swipe the Pu-Be source are derived from the manufacturer's required registration of a specifically licensed item (10CFR32.210(c)).

5.4.3.3. Remove the source from service; repair, decontaminate, or dispose of it in accordance with 105CMR120.223(F) or NRC requirements for Special Nuclear Material.

5.4.4. All test results shall be kept for inspection by the DPH (105CMR120.223(D)).

6. RESTORATION: None

7. REFERENCES:

7.1. 105CMR120.223. Testing for Leakage or Contamination of Sealed Sources.

7.2. 105CMR120.225 and 10CFR20.1501. Surveys and Monitoring, General.

7.3. WPI Materials License 03-6802.

7.4. 105CMR120.128(N). Special Requirements for License to Manufacture, Import or Initially Distribute Sealed Sources or Devices Containing Sealed Sources to Persons Having a Specific License.

7.5. NRC Regulatory Guide 8.21 Health Physics Surveys, Section 1.4 Surface Contamination Surveys.