



WORK INSTRUCTION

Radon Testing RSK-W029

Work instructions are continually revised and improved. For the most recent version, please visit <http://www.salemkeizer.org/qam/qam-documents>

1.0 SCOPE:

- 1.1 The purpose of this Radon Testing Plan is to describe the procedures to be taken to test District owned and/or occupied buildings.

2.0 INSTRUCTION:

Scope

School districts in Oregon must test all buildings owned and/or occupied by district students and/or staff for radon, per Oregon Revised Statute (ORS) 332.166-167. All testing must be completed on or before January 1, 2021. Retesting of buildings is to occur every ten years, at a minimum. The statute also requires districts to submit test data to the Oregon Health Authority (OHA) and to share test results with the district's community.

As of January 2016, Salem Keizer Public Schools has completed radon testing for all district facilities.

This plan will define our radon testing protocols, which are based on the Environmental Protection Agency's (EPA) radon testing protocols.

Test kits or testing services must meet the current requirements of the national certifying organizations, National Radon Proficiency Program (NRPP, www.nrpp.info) or the National Radon Safety Board (NRSB, www.nrsb.org).

Initial Testing

Initial and follow-up testing, as needed, will use short term (2-5 day) passive test devices. Testing will occur between November 1 and March 31 in any given school year.

Testing will occur in all **frequently occupied spaces** in contact with the soil or located above a basement or a crawlspace and will occur simultaneously per school site. EPA studies indicate that radon levels on upper floors are not likely to exceed the levels found in ground-contact rooms. Testing rooms on the ground-contact floor or above unoccupied basements or crawlspaces is sufficient to determine if radon is a problem in a building. Areas such as restrooms, hallways, stairwells, elevator shafts, utility closets and storage closets do not need to be tested.

Testing Protocols

1. A Test Kit Placement Log (Appendix B) and a Test Kit Location Floor Plan will be prepared for each building in which radon measurements are made. The District will use the building's emergency/fire escape plan as a template. Test kit location will be accurately recorded on both a Log and Floor Plan. Testing practices must be done following the directions on the test kit.
2. The number of test kits used to measure radon (detectors) must be determined by counting the number of appropriate rooms. One detector kit is used for each room that is 2000 square feet or less. Additional test kits are needed for larger rooms.
3. Additional test kits will be provided to serve as quality assurance measures (duplicate, blank, and spike measurements). Quality assurance procedures will be conducted as described in the Quality Assurance Procedures below.

4. Test kits will be placed in all rooms in contact with the soil or located above a basement or crawlspace that are frequently occupied by students and/or district staff.
5. Testing will occur during the time that students and teachers are normally present (during weekdays).
6. All test kits placed in the building site (detectors, duplicates, and blanks) must be noted on the Device Placement Log and Floor Plan by their serial number.
7. Test kits should be placed:
 - a. Where they are least likely to be disturbed or covered up.
 - b. At least three feet from doors, windows to outside or ventilation ducts.
 - c. At least one foot from exterior walls.
 - d. At least 20 inches to six feet from floor.
 - e. About every 2,000 square feet for large spaces (e.g., a 3500 square foot gymnasium would require two test kits)

To prevent tampering, kits may be suspended from a wall or ceiling (using string and thumb-tack/tape.)

8. Test kits must **NOT** be placed:
 - a. Near drafts resulting from heating, ventilating vents, air conditioning vents, fans, doors and windows.
 - b. In direct sunlight.
 - c. In areas of high humidity such as bathrooms, kitchens, laundry rooms, etc.
 - d. Where they may be disturbed at any time during the test
9. Testing with short-term test kits must be conducted under closed conditions (closed windows/doors except for normal exit/entry).
 - a. Closed conditions: Short-term tests should be made under closed conditions in order to obtain more representative and reproducible results. Open windows and doors permit the movement of outdoor air into a room. When closed conditions in a room are not maintained during testing, the subsequent dilution of radon gas by outdoor air may produce a measurement result that falls below the action level in a room that actually has a potential for an elevated radon level. Buildings will only be tested for radon during periods when the HVAC system is operating as it does normally. No changes may be made to the HVAC operation during testing period.
 - b. All external doors should be closed except for normal use.
 - c. Closed conditions must be verified when placing and retrieving test kits.
10. Short-term test kits will be placed during colder months (November through March).

- a. Colder months: Because testing under closed conditions is important to obtain meaningful results from short-term tests, the District will schedule testing during the coldest months of the year. During these months, windows and exterior doors are more likely to be closed. In addition, the heating system is more likely to be operating. This usually results in the reduced intake of outside air. Moreover, studies of seasonal variations of radon measurements in buildings found that short-term measurements may more accurately reflect the average radon level in a room for the school year when taken during the winter heating season.
 - b. The District will check and document local weather forecasts prior to placing test kits.
11. The District will not conduct short-term measurements (2-5 days) during severe storms or period of high winds. The definition of severe storm by the National Weather Service is one that generates winds of 58 mph and/or $\frac{3}{4}$ inch diameter hail and may produce tornadoes.

Suggested testing timeline:

Monday morning – Place kits (detectors/duplicates/blanks) per Test Kit Placement Log created for the building. Record data, as needed, on Log.

Thursday morning – Pick up kits, record as needed, ship with (previously requested & received) spiked test kits to Radon Measurement Laboratory.

12. The District will not conduct initial measurements under the following conditions:
- a. During abnormal weather or barometric conditions (e.g., storms and high winds). If major weather or barometric changes are expected, it is recommended that the 2 to 5-day testing be postponed. EPA studies show that barometric changes affect indoor radon concentrations. For example, radon concentrations can increase with a sudden drop in barometric pressure associated with storms.
 - b. During structural changes to a school building, renovation of the building's envelope or replacement of the HVAC system.
13. After receiving the results of the initial testing, the District will prepare the report, send it to the Building Administrator to share with staff and community. All radon reports will be posted on the District website.

Quality Assurance Procedures

1. **Duplicates:** Duplicates provide an indication of the precision of the measurement. Duplicates are test kits that are placed in the same location alongside the kits used as detectors for the same measurement period. The number of duplicates should be 10 percent of the rooms to be tested at a school site. A minimum of one duplicate per building is needed. [Round up if a fraction. For example, a building has 55 rooms to be tested. Ten percent of those equals 5.5 test kits. Six kits will be used as duplicates.
2. **Blanks:** Blanks can be used to determine whether the manufacturing, shipping, storage or processing of the test kit has affected the accuracy of the measurements. They are called blanks because they are placed alongside opened detectors but then immediately resealed. As a result, blanks should have results at or close to 0.0 pCi/L. The number of blanks should be five percent of the rooms to be tested at a school site; round up if a fraction. A minimum of one blank per building is needed.
3. **Spikes:** Spikes evaluate how accurately the detectors supplied by a radon testing laboratory measure radon and the accuracy of that lab's kit processing. Spike testing involves exposing kits to known levels of radon in a certified performance test chamber. Currently, there are two chambers (Bowser-Morner Inc. and Radon

Measurement Lab) certified by AARST-NRPP (<http://aarst-nrpp.com/wp/test-chambers/>) to provide spiking services. Those spikes are returned to the District, which sends them (unidentified) to the radon testing laboratory. The number of spikes should be three percent of the rooms to be tested at a school site; round up if a fraction. A minimum of one spike per building is needed.

Developing a device placement and floor plan is recommended for each building to be tested. The serial numbers and locations for devices placed on the site (detector, duplicate and blanks) should be included in the device log. The District should retain the logs, but time and date data is copied to/sent along with the kits to the radon measurement laboratory.

Quality Assurance Procedures for the District's Radon Measurement Program

Please read this entire section before starting testing. Some steps are time dependent. All should be done as part of well-planned testing effort.

1. As discussed above, calculate how many detector kits are needed. This number equals the number of regular rooms that are to be measured, plus those kits required for larger rooms (2,000 square feet or larger). Larger rooms need one test kit per 2,000 square feet or portion thereof, so a 3,500 square-foot gymnasium needs two detector kits.
2. In addition to those detectors, kits for quality assurance (QA) purposes should be purchased in the following proportions: duplicate kits (a number equal to 10 percent of the rooms to be tested at a building site); blank kits (5 percent of the rooms to be tested at a building site); and spike kits (3 percent of the rooms to be tested at a building site). Note: Each building to be tested should have, in place, a minimum of one duplicate, one blank and one spike.
 1. Important: Test kit percentages for QA are based on the number of rooms to be tested, not the number of detector kits to be used.
3. After determining the number of test kits (detectors, blanks, duplicates and spikes) needed for initial measurement of building site(s), kits should be purchased from one manufacturer (and be from one lot). It is most cost effective to purchase in bulk.
4. Once the kits are received, staff should randomly draw the kits needed for spiking (the 3 percent) from the boxes. The serial numbers of the kits should be recorded, noted as the kits being reserved for spike testing and set aside.
5. Spiking Process
 1. For radon measurements of a single building site:
 1. Approximately two weeks before testing is to start, contact a certified performance test chamber to discuss spiking services (<http://aarst-nrpp.com/wp/test-chambers/>). Inquire about and understand the chamber's schedule for spiking the kits and express mailing them back to the sender. The testing timeline may depend on that schedule.
 2. Send kits to the certified performance test chamber for spiking. The chamber should return those spiked kits via overnight delivery to the team so that their arrival coincides with the end of the building's measurement period. Spikes can then be included in the same container as the detectors, blanks and duplicate kits (but not identified as spikes) and shipped overnight back to the radon measurement laboratory.
 2. For radon measurements of multiple building sites:

1. Approximately a month before testing is to begin, contact a certified performance test chamber (<http://aarst-nrpp.com/wp/testchambers/>) to discuss the chamber's spiking schedule and arrange ongoing spiking services for the duration of the testing project.
 2. With spiking service arrangements in place, mail the kits designated for spiking (the 3 percent) to the chamber. Now there is a bank of kits at the chamber waiting to be spiked. At the District's request, the chamber will spike the requested number of banked kits with a known amount of radon (spiked), and express mail them to the District along with documentation on that known level.
 3. The District will know in advance the date that the devices (detectors, blanks and duplicates) deployed at a particular building site are to be picked up. The District should contact the chamber with which it has banked test kits for spiking and request that a specific number of spiked test kits be sent back to the District, so their arrival coincides with the end of that building's measurement period. Spikes can then be included in the same container as the detectors, blanks and duplicate kits (but not identified as spikes) and shipped overnight back to the radon measurement laboratory.
6. The District will receive results for all the test kits analyzed in two to four weeks.

Follow-up Measurements

Follow-up testing (in rooms with initial short-term measurement of 4.0 pCi/L or higher) will start within one month after receiving the initial test results. Follow-up testing must be made in the same location in a room. Follow-up testing using short-term methods will be done in the same conditions as the initial measurement.

Reporting Results

ORS 332.166-167 requires that school districts make all test results available: to the District's School Board; the Oregon Health Authority (to post on its website), and readily available to parents, guardians, students, school employees, school volunteers, administrators and community representatives at the school office, district office or on a website for the school or school district.

Radon Mitigation

The District will take action to reduce the radon level in those rooms where the results are 4.0 pCi/L or more.

1. Ventilation for the areas with radon levels above 4.0 pCi/L will be evaluated. If deficiencies are identified in the ventilation, those will be remedied, and the spaces will be retested.
2. If the ventilation is functioning as designed, the District will consult with a radon mitigation specialist that has been certified by the National Radon Proficiency Program (NRPP) or the National Radon Safety Board (NRSB). That list is located at: <http://1.usa.gov/1nSvisi>

Radon can be controlled through:

- HVAC systems. Adjustments to the heating, ventilation and air conditioning systems serving a room may reduce radon levels to below EPA's action level guideline of 4 pCi/L.
- Seal entry routes. Seals are installed at major entry routes to minimize radon entry.
- Soil depressurization. A suction fan is used to produce a low-pressure field in soil under the building slab. This low-pressure field prevents radon entry by ventilating the gas outside before it is drawn into the building.
- Building pressurization. Indoor/soil pressure relationships are controlled to prevent radon entry. More outdoor air is supplied than exhausted so the building has a slightly positive pressurize compared to both

the exterior of the building and the sub-soil area.

- Zone-specific ventilation. A building's crawlspaces, tunnels, conduits, vaults, etc. may be used to design a system that reduces its elevated radon.

Retesting

1. Buildings with radon mitigation systems will be tested annually to ensure that the radon mitigation measures are working.
2. If major renovations to the structure of a school building or major alterations to a school's HVAC system are planned, the building will be tested before initiating the renovation. If elevated radon is present, radon-resistant techniques can be included as part of the renovation.
3. If major renovations to a building or to a building's HVAC system take place, test the building after work is complete.
4. Oregon law requires retesting all school buildings every 10 years. The same testing protocols must be followed as the initial testing.

GLOSSARY

Action Level: The designated measurements at or above which consumers should take action to reduce radon levels. EPA's Action Level is set at 4.0 pCi/L.

Blanks: Measurements made by analyzing unexposed (closed) detectors that accompanied exposed detectors to the field. School districts use blanks to assess if any change in analysis is caused by anything outside the immediate room conditions being tested. Background levels may be due to leakage of radon into the detector, detector response to gamma radiation or other causes.

Carcinogen: A dangerous substance that is directly involved in the contraction of cancer.

Closed-building condition: Keep all windows and doors closed except for normal entry and exit. Do not operate fans or other machines that bring in air from outside. Fans that are part of an existing radon-reduction system or small exhaust fans operating for only short periods of time may run during the test. HVAC systems run in normal operation.

Duplicates: Duplicate measurements provide a check on the precision of the measurement result and allow the user to make an estimate of the relative precision. Large precision errors may be caused by detector manufacture or improper data transcription or handling by suppliers, laboratories or technicians performing placements. Precision error can be an important component of the overall error. The precision of duplicate measurements are monitored and recorded as quality records.

PicoCuries per liter (pCi/L): A unit of measurement. It specifies the decay in seconds within a volume of one liter of air.

Radon: Radon is a colorless, odorless, radioactive gas. It forms naturally from the decay (breaking down) of radioactive elements, such as uranium, which are found in different amounts in soil and rock throughout the world. Radon gas in the soil and rock can move into the air and into underground water and surface water. It is the second leading cause of lung cancer.



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Short-term test: A radon testing kit that is designed for a short testing period anywhere from a two- to 90-day period.

Spikes: Measurements used to assess the accuracy of a lab analysis and/or how accurately detectors supplied by a laboratory (i.e., test kit manufacturer) measure radon. Spikes are test kits that have been exposed to a known concentration of radon in a chamber approved by the National Radon Proficiency Program (NRPP) or National Radon Safety Board (NRSB). The process for completing this aspect of a radon measurement effort's quality assurance/quality control plan is laid out in the "Radon Test Placement Protocol Checklist" in Appendix A.

3.0 APPLICABILITY:

3.1 Risk Management Personnel

4.0 REVISION HISTORY:

Date	Revision Ref.	Description
8/16/16		Approved by department

5.0 APPROVAL AUTHORITY:

5.1 Director of Safety and Risk Mgmt. Services

Approval on file

Signature

Date