

This is proposed draft of changes to NJ requirements for RRNC in New Schools
Send comments to Bill@wpb-radon.com 610 346-8004

N.J.A.C. 5:23-10
Radon Hazard Subcode
as of 2/8/2011

Note to editors: use ~~strike through~~ for deletions & underline for additions
use (..) for comments with your initials

5:23-10.1 Title, scope; intent

(a) This part of the regulations, adopted pursuant to the State Uniform Construction Code Act, P.L. 1975, c. 217, as amended and as supplemented by P.L. 1989, c.186 (N.J.S.A. 52:27D-119 et seq.), and entitled Radon Hazard Subcode, shall be known, and may be cited throughout the regulations as, N.J.A.C. 5:23-10 and, when referred to in this subchapter, may be cited as "this subchapter"

1. This subchapter is intended to complement rules adopted by the New Jersey Department of Environmental Protection at N.J.A.C. 7:28-27 which provide for certification of persons who sell radon or radon progeny devices, test for radon or radon progeny, or mitigate radon in buildings.

i. Copies of N.J.S.A. 26:2D-70 et seq. and N.J.A.C. 7:28-27 may be obtained from the New Jersey Department of Environmental Protection, Radon Section, Mail Code 25-01, PO Box 420, Trenton, NJ 08625-0420.

(b) This subchapter pertains to the construction of all buildings in Use Groups E and R, as defined in the building subcode, within recognized radon prone areas defined as Tier One by the New Jersey Department of Environmental Protection and shall control matters relating to construction techniques to minimize radon gas and radon progeny entry and facilitate any subsequent remediation that might prove necessary.

(c) This subchapter pertains to only those portions of Use Group E buildings that are in or below indoor occupied areas of the building.

(d) This subchapter seeks to protect and ensure public safety, health and welfare insofar as it is affected by radon entry into schools and residential buildings.

It is the purpose of this subchapter to establish standards and procedures to ensure that construction techniques that minimize radon entry and that facilitate any post-construction radon removal that is required shall be incorporated in the construction of all buildings in Use Groups E and R in tier one areas and are permitted to be incorporated elsewhere in New Jersey.

Radon is a colorless, odorless, tasteless, radioactive gas that occurs naturally in soil gas, underground water, and outdoor air. Prolonged exposure to elevated concentrations of radon and its progeny (that is, substances formed as a result of the radioactive decay of radon) has been associated with increases in the risk of lung cancer. An elevated concentration is defined as being at or above the guideline of 4 pCi/L or 0.02 WL average annual exposure.

Inasmuch as it is deemed to be more cost effective to build schools and residential buildings that resist radon entry than to remedy a radon problem after construction, design and construction techniques shall be employed, in tier one areas, to minimize pathways for soil gas to enter and features shall be incorporated during construction in tier one areas that will facilitate radon removal after completion of the structure if prevention techniques prove to be inadequate.

The installation of radon mitigation systems in existing portions of buildings shall not be subject to the construction technique requirements set forth in N.J.A.C. 5:23-10.4.

5:23-10.2 Definitions

The following words, terms and abbreviations, when used in this subchapter, shall have the following meanings unless the context clearly indicates otherwise.

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“AASHTO #57” means the American Association of State Highway and Transportation Officials grading system for stone that requires 90-100 percent of the stone to pass through a 1” sieve, 25-60 percent must pass through a 1/2” sieve and 0-10 percent must pass through a No. 4 sieve.

“Cracks” means openings in the slab or foundation that are 1/32” or greater.

“Drainage Matting” means an underslab material specifically made to create a void space to allow water or air to pass through it.

"Foundation pipe drain" means a drain placed in the gravel bed around the perimeter of a foundation that utilizes a perforated pipe. An "interior foundation pipe drain" is one placed around the internal perimeter of a foundation. An "exterior foundation pipe drain" is one placed around the external perimeter of a foundation.

"French drain" or "channel drain" means a path used to assist with water drainage which is installed in basements of some structures during initial construction, which consists of a gap (typically one-half to one and one-half inch in width) between the basement block wall and the concrete floor slab around the entire inside perimeter of the basement.

“Gravel Bed” means a bed of crushed rock, aggregate or gravel placed under a concrete slab that provides drainage and airflow under the slab. The words gravel, aggregate and crushed stone are used interchangeably throughout this subchapter.

“Gravel Bed Area” means the square foot ground contact area of a continuous gravel bed contained within the foundation walls, footers or other perimeter obstructions that surround the gravel bed and block airflow out of the gravel bed area. All gravel beds greater than 64 ft² must be directly connected with solid or perforated piping to radon vent piping.

“Perforated Piping” means rigid plastic piping at least 3” in diameter that is a minimum sewer and drain ASTM D-2729, with at least two 5/8” diameter holes in the pipe, every 5”. Each set of two holes are typically drilled 120 degrees apart from each other.

“Prefabricated Drainage Matting” means a prefabricated composite 3-dimensional low profile drainage and venting material that is wrapped with non-woven filter fabric with equivalent airflow properties of at least four inch PVC pipe and a compressive strength of at least 7500 psf. ???

"Picocurie per Liter (pCi/L)" means 2.2 disintegrations per minute of radioactive material per liter. It may be used as a measure of the concentration of radon gas in air. One picocurie is equivalent to 10⁻¹² Curies.

"Radon" means the radioactive noble gas radon-222.

"Radon Progeny" means the short-lived radionuclides formed as a result of the decay of radon-222, including polonium-218, lead-214, bismuth-214 and polonium-214.

“Radon Vent Pipe” means gas and water tight pipe and fittings at least 3” in diameter that is routed from the gravel bed connection to the outside that is used to vent radon from the soil to an approved location outside the building.

"Sub-Slab Collection Plenum Box" means concrete blocks that are laid on their side and placed in a pattern in a gravel bed to create a void space in the gravel. Radon vent piping is routed into the void space. The void space provides minimal flow restriction for air that is drawn out of the gravel bed using the radon vent piping that is routed into the void space. The words "collection box" or "collection plenum box" are used interchangeable throughout this sub-chapter.

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"Sump" means a ~~collection pit designed to collect water that is installed through a floor slab r, and from which such water is drained by means of a sump pump or drain to grade or to a drywell-~~ tank or pit that receives only liquid wastes, located below the elevation of a gravity discharge, that is emptied by pumping. (2009 National Standard Plumbing Code) AJK

"Sump pump" means a ~~pump used to move collected water out of the sump to an above grade discharge remote from the structure-~~ permanently installed mechanical device for removing clear water or liquid waste from a sump. (2009 National Standard Plumbing Code) AJK

"Vented gravel bed" means a sub-slab gravel bed that has the appropriate sized radon vent pipe connected to the gravel as specified in this subchapter.

"Working level (WL)" means that concentration of short-lived radon decay products that will result in 130,000 million electron volts of potential alpha-particle energy per liter of air. Working level is a measure of radon decay product concentration in air.

5:23-10.3 Enforcement

(a) The provisions of this subchapter shall be enforced by the enforcing agencies having responsibility for the enforcement of this chapter.

(b) Enforcement responsibility shall be divided among subcode officials in the following manner:

1. Plan review and inspection with regard to compliance with N.J.A.C. 5:23-10.4(b) and N.J.A.C.5:23-10.4(c) shall be the responsibility of the building subcode official, except that N.J.A.C. 5:23-10.4(b)14 shall be the responsibility of the electrical subcode official;
2. Enforcement responsibility for work other than which is required in N.J.A.C. 5:23-10.4(b) and N.J.A.C. 5:23-10.4(c) shall be as set forth in N.J.A.C. 5:23-3.4(a).

NOTE: This section is for New Construction of Residential Homes

5:23-10.4 Construction techniques

(a) Tier one radon hazard areas shall be identified in accordance with the county/municipal radon listing established by the Department of Environmental Protection. The current list of municipalities in tier one areas is set forth in Appendix 10-A of this subcode.

(b) The construction techniques set forth in this subsection shall be the minimum radon hazard protective features required to be incorporated into construction of buildings in Use Groups E and R in Tier One areas, and may be incorporated elsewhere, in order to minimize radon and radon progeny entry and facilitate any post-construction radon removal that may be required. Enumeration of these construction techniques is not intended to preclude voluntary use of additional or more extensive techniques. Full compliance with these construction techniques is not required for additions; however, those construction techniques that are feasible shall be incorporated.

1. A continuous vapor retarder not less than six-mil (0.006 inch; 0.152 mm) polyvinyl chloride or polyethylene with any seams overlapped not less than 12 inches (305 mm), or other -equivalent materials, shall be installed under the slab in basement and slab-on-grade construction and on the soil in crawl space construction.

2. Floors of basements and slab on grade construction shall be placed over a base course, not less than four inches (102 mm) in thickness, consisting of gravel or crushed stone containing not more than 10 percent material that passes through a No. 4 sieve.

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3. Basement slabs with interior foundation pipe drains installed shall have a solid three-inch minimum diameter vent pipe section installed in conjunction with this drainage system. and be connected to a radon vent pipe terminating at an approved location on the exterior of the building.
4. Slab on grade construction and basement slabs which do not have an interior foundation pipe drain shall have a minimum 3" pipe Tee fitting installed in the gravel bed for every 1,500 square feet, or portion thereof, of slab area. The Tee fitting shall be connected to a radon vent pipe. Radon vent pipes connected to Tee fittings installed in separate gravel beds can be joined into a single vent pipe that is routed through the roof if the total gravel bed area is less than 1500 square feet. If the total area of the gravel beds is between 1500 Square feet and 4000 square feet the riser pipe diameter shall have a minimum four inch pipe.
5. Basement slabs with French drains or channel drains shall not be allowed unless interior foundation pipe drains as described in this section are installed.
6. Joints in foundation walls and floors, including, without limitation, control joints between slab sections poured separately, and between foundation wall and floor (except for French drains or channel drains), as well as penetrations of the foundation walls and floor including, but not limited to, utility penetrations, shall be substantially sealed by utilizing a non-cracking polyurethane or similar caulk, or equivalent, in order to close off the soil gas entry routes. Any openings or penetrations of the floor over the crawl space shall be substantially sealed in order to close off the soil gas entry routes.
7. Untrapped floor drains shall be provided with removable stoppers which substantially close off the soil gas entry routes. Sump pits that includes piping that drains to grade or to a drywell shall have a mechanical trap or check valve in the piping.
8. A sump cover which substantially closes off the soil gas entry routes shall be provided for all sump installations. Section (b)3 is not required if foundation pipe drains terminate in a sump pit and a radon vent pipe is routed into the pit.
9. Any ductwork that is routed through a crawl space or beneath a slab shall be sealed with mastic systems or tape that meets the applicable requirements of UL 181A or UL 181B, or other equivalent sealants.
10. Sealant materials that substantially close off the soil gas entry routes shall be installed on any doors or other openings between basements and adjoining crawl spaces that are vented to the exterior.
11. The tops of foundation walls, including, without limitation, interior ledges, that are constructed of hollow masonry units shall be capped or the voids shall be completely filled.
12. The independent vent stack pipe provided in accordance with (b)3, 4 or 8 above shall be an adequately supported, gas tight, three-inch minimum diameter solid pipe, through any enclosed portions of the building. The pipe shall be routed in a manner that provides three feet of vertical pipe that is accessible for the installation of a future in-line vent pipe fan in a non-conditioned (not heated or cooled) space, including, without limitation, an attic space, but excluding a basement or crawl space, and installed in a configuration, and supported in a manner, that will ensure that rain water or condensate accumulation within the pipes will drain downward into the ground beneath the slab or vapor barrier. The vent stack pipe shall meet the following termination requirements:
 - i. Vent pipes shall terminate at least 12 inches above the roof, measured from the highest point where the vent intersects the roof. When a vent pipe extension terminates on an occupiable roof the vent pipe shall extend at least seven feet above the roof surface.
 - ii. No vent terminal shall be located directly beneath any door, window, or other ventilating opening of the building or of an adjacent building nor shall any such vent terminal be within 10 feet horizontally of such an opening unless it is at least two feet above the top of such opening.

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iii. No vent terminal shall be closer than 10 feet horizontally from any lot line. Where this 10 foot horizontal distance is not possible due to lot width, the vent terminal shall be placed as remote from the lot line as practicable.

13. Radon vent pipes shall be identifiable and clearly labeled at intervals of not more than 25 feet in concealed locations, not more than 50 feet in exposed locations and not less than once in any room or space.

14. Electrical junction boxes shall be installed within 6 feet of the provided area, such as an accessible attic space, where a future in-line vent pipe fan and system failure alarms may be installed.

15. In combination basement/crawl space or slab-on-grade/crawl space buildings a three-inch minimum solid vent pipe shall be provided between the areas and interconnected into the independent vent stack to permit use of a single in-line vent pipe fan if activation of the system is desired.

16. In order to reduce stack effect, air passages that penetrate the conditioned envelope of the building, such as attic access openings, or other openings installed in top-floor ceilings, shall be closed, gasketed or otherwise sealed with materials approved for such applications.

NOTE: This section is for New Construction of Schools

(c) The construction techniques set forth in this subsection shall be the minimum radon hazard protective features required to be incorporated into construction of buildings in Use Group E in Tier One areas, and may be incorporated elsewhere, in order to minimize radon and radon progeny entry and facilitate any post-construction radon removal that may be required. Enumeration of these construction techniques is not intended to preclude voluntary use of additional or more extensive techniques. Full compliance with these construction techniques is not required for additions; however, those construction techniques that are feasible shall be incorporated.

1. Any foundation wall in contact with a gravel bed shall have all foundation voids at the concrete slab elevation filled solid with mortar. If the interior slab is below the exterior grade, the masonry exterior foundation walls shall have, at an elevation above grade or at the exterior grade, all voids in one complete horizontal course filled solid with mortar. Any other openings into the exterior foundation wall below this filled course shall be sealed.

2. Any hollow core foundation walls that are in contact with a gravel bed on one side of the foundation shall have the below slab surface of the foundation wall on the gravel bed side and any foundation utility penetrations sealed with an appropriate sealer.

3. A gravel bed at least six inches in height no smaller grade size than AASHTO #57 shall be placed under all occupied areas of the building. Gravel bed height shall be maintained under any areas requiring a thicker slab.

4. A concrete slab shall cover all gravel beds and be at least 4 inches thick. The concrete slab shall be cast tight to the foundation wall. Control joints cast into concrete slabs shall use materials ½ inch or less in thickness to facilitate later sealing.

5. A minimum continuous 10 mil thick (0.010 inch; 0.254 mm) vapor retarder or equivalent shall be between all sections of the concrete slab and the gravel bed. Any seams in the barrier shall be overlapped at least 12 inches. Openings around the vapor barrier for utility piping or foundation supports shall be sealed using materials and methods specified by the sealant manufacturer.

6. All utility pipes placed in the gravel bed shall have at least 2" of combined gravel height above or below the pipe.

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7. All gravel bed areas shall be directly connected to radon vent piping routed to an approved location above the roof. Radon vent piping shall not terminate in a sump.
8. Radon vent piping shall be routed through the conditioned space of the building
9. Crawl spaces that have corrugated steel decking supporting the concrete slab above the crawl space shall be constructed in a manner to seal any openings between the gravel bed and the crawl space. Thickening the slab at the outer edge of the corrugated decking to cover the openings is an acceptable method for sealing the possible openings between the gravel bed and the crawl space.
10. Plastic radon vent piping and fittings installed above the slab shall be schedule 40 or greater. All plastic fittings and piping shall be made of the same material. Piping and fittings installed above the concrete slab shall be joined together in an airtight and watertight manner as specified by the manufacturer's installation instructions.
11. Radon vent piping can be gas and watertight metal piping and fittings if necessary to comply with code requirements. Metal piping and fittings shall be joined together in an airtight and watertight manner as specified by the manufacturer's installation instructions.
12. Gravel bed areas less than 1,500 square feet shall be connected to 3" or larger radon vent piping. The radon vent piping shall be connected to a 3" or larger Tee fitting embedded in the gravel bed with at least 1 foot of 3 inch or larger perforated piping for every 50 square feet (ft²) of gravel bed area. Perforated piping installed in the gravel bed shall be attached to both ends of the Tee fitting and laid in the gravel bed with the holes facing down. Pre-fabricated drainage matting providing at least equivalent airflow and connection to the gravel bed as the perforated piping can be substituted if the drainage mat connection to the radon vent piping is also at least equivalent to a 3 inch Tee fitting connection.
13. Gravel bed areas between 1,500 and 4000 square feet shall be connected to 4" or larger radon vent piping. The radon vent piping shall be connected to a 4" or larger Tee fitting embedded in the gravel bed with at least 1 foot of 4 inch perforated piping for every 50 square feet of gravel bed area. Perforated piping installed in the gravel bed shall be attached to both ends of the Tee fitting and laid in the gravel bed with the holes facing down. Prefabricated drainage mat providing at least equivalent airflow and connection to the gravel bed as the perforated piping can be substituted for the perforated piping if the drainage mat connection to the radon vent piping is also at least equivalent to a 4 inch Tee fitting connection.

A collection box in the gravel bed can be substituted for the perforated piping or prefabricated drainage mat. The collection box shall be constructed by turning at least four open core 16 inch by 8 inch by 8 inch cement blocks on their side in a square so as to create an open plenum that is at least 14 inches by 14 inches by 8 inches high. A six-inch or greater space shall be maintained between the cement blocks in the sub-slab plenum. Solid radon vent piping 4" or larger shall be routed from inside this plenum to an approved exhaust location. See Figures 1 and 2 below.

The collection box shall be covered with appropriate metal decking or pressure treated plywood or other equivalent durable covering that adequately supports the concrete slab.

14. Gravel bed areas between 4,000 and 15,000 square feet (ft²) shall be connected to 6" or larger radon vent piping. The radon vent piping shall be connected to a 6" or larger Tee fitting embedded in the gravel bed. The six-inch Tee fitting embedded in the gravel bed shall be connected to two additional six-inch Tee fittings. Four, four inch perforated pipes shall be attached to these Tee fittings and connected to one foot of 4 inch perforated piping for every 50 square feet of gravel bed area. The perforated piping shall be placed in the gravel bed with the holes facing down. See Figure 2 3 below.

Prefabricated drainage mat providing at least equivalent airflow and connection to the gravel bed as the

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perforated piping can be substituted for the perforated piping if the drainage mat connection to the Tee fittings is at least equivalent to a 4" Tee fitting connection.

A collection box in the gravel bed can be substituted for the perforated piping or drainage mat. The collection box shall be constructed by turning at least six open core 16 inch by 8 inch by 8 inch cement blocks on their side in a square so as to create an open plenum that is at least 32 inches by 32 inches by 8 inches high. An eight-inch or greater space shall be maintained between the cement blocks. Solid radon vent piping 6" or larger will be routed from inside this plenum to an approved exhaust location. See Figure 3.4 below.

The collection box shall be covered with appropriate metal decking or pressure treated plywood or other equivalent durable covering to adequately support the concrete slab.

15. Any collection box set in the gravel bed shall be located so that it is no more than half the distance from the center of the gravel bed to any outer edge.

16. If the length of any gravel bed is more than 10 times the width of the gravel bed, then a perforated pipe with the holes facing down shall be placed in the gravel bed in place of a collection box. The perforated pipe shall be at least the length of the long length of the gravel bed minus the width of the gravel bed.

17. Radon vent pipes connected to separate gravel beds can be joined into a single vent pipe that is routed through the roof if the piping is sized for the total gravel bed area the pipe or pipes are venting.

18. All concrete slabs shall be allowed to cure for at least 14 days before any crack or joint sealing is done. Interior walls shall not be installed over unsealed control joints or cracks. All cracks, control joints or other openings through any concrete slab including the intersection between the concrete slab and any foundation wall shall be sealed utilizing a non-cracking polyurethane caulk, membrane sealant, or equivalent sealing.

19. Any cracks or openings through the concrete slab under unit ventilators or in the foundation wall behind unit ventilators shall be sealed before the unit ventilator is installed.

20. Floor drains, which allow soil gas to enter the building, shall be provided with removable stoppers or a radon gas resistant drain.

21. All sump installations that could allow soil gas to pass into an occupiable space shall have a removable sump cover which substantially closes off the soil gas entry routes.

22. Openings or penetrations of the floor above any crawl space shall be substantially sealed in order to close off the soil gas entry routes.

23. Any entrance to a crawl space from an occupiable space shall include an airtight door. Other openings between any crawl space and occupiable space shall be substantially sealed.

24. All above slab plastic radon vent piping shall be adequately supported at least every 6 feet of horizontal run and 10 feet of vertical run or as specified by the manufacturers installation instructions. The pipe shall be routed in a manner that makes it accessible for the installation of a future in-line vent pipe fan above a flat roof or in a non-conditioned (not heated or cooled) space that has no occupiable space above it. All radon vent piping shall be installed in a configuration and supported in a manner, that will ensure that rain water or condensate accumulation within the pipes will drain downward into the ground beneath the concrete slab and vapor barrier. The radon vent piping shall meet the following termination requirements:

i. Radon vent piping shall terminate in a vertical orientation at least 12 inches above the roof, measured from the highest point where the vent intersects the roof. When radon vent piping terminates on an occupiable roof, the vent pipe shall extend at least eight feet above the occupied surface.

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ii. No radon vent piping shall terminate directly beneath any door, window, or other opening of the building or of an adjacent building nor shall any such vent terminal be within 10 feet horizontally of such an opening unless it is at least two feet above the top of such opening.

iii. No radon vent piping shall be closer than 10 feet horizontally from any lot line. Where this 10 foot horizontal distance is not possible due to lot width, the vent terminal shall be placed as remote from the lot line as practicable.

iiii. No radon vent piping shall be closer than 20 feet from a mechanical outdoor air intake.

25. Radon vent piping shall be identifiable and clearly labeled at intervals of not more than 10 feet in concealed locations, not more than 20 feet in exposed locations and not less than once in any room or space.

26. Each radon vent piping run shall have an electrical junction box installed within 6 feet of the area where a future in-line vent pipe fan could be installed.

27. Each gravel bed area greater than 64 square feet (ft²) requires a least one test location(s) through the slab to determine the amount of negative pressure generated by the test fan. The test hole shall be located in an area that is most distant to the sub slab plenum collection box or radon vent piping. The test holes can be drilled through the slab or test holes can be tubing placed in the slab during the slab construction. Tubing placed in the slab must be protected against damage until the pressure test is completed.

A test fan shall be temporarily attached to the radon vent piping no sooner than 14 days after completion of the concrete slab. The test fan shall be rated at no more than 500 cfm at one inch of static pressure for six-inch piping or a maximum of 250 cfm at one inch of static pressure for four-inch piping or 150 cfm at one inch of static pressure for three-inch piping. A digital differential pressure gauge capable of measuring a pressure difference of 0.001 inches of water column shall be used to measure the pressure difference between the test hole and the room. The test holes shall be sealed with poly-urethane caulking or cement after the testing is complete.

Each test hole shall have a negative pressure change induced by the fan that is at least 4.0 pascals (0.016 inches of water column) in strength prior to building being enclosed or 2.0 pascals after the building is enclosed and heated. Only a NJ certified mitigation business who is listed with the state as certified to do school mitigation can do the sub-slab pressure readings. The mitigation business shall provide the General Contractor with the results of this testing. If this sub-slab negative pressure is not induced, additional sealing or additional radon vent piping connected to the gravel bed area shall be installed and additional pressure readings made by the mitigation business to ensure the previously defined pressure is achieved.