

**APPENDIX F
RADON CONTROL METHODS**

(The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.)

SECTION AF101 SCOPE

REVISE AS FOLLOWS:

AF101.1 General. This appendix contains requirements for ~~new construction in jurisdictions where~~ radon control methods for any dwelling where installed are required. ~~The A Zone 1~~ requirement for radon control ~~Inclusion of this appendix by jurisdictions shall be determined by through use of locally available data or by determination of the Zone 1 radon designation in Figure AF104 or Table AF104 AF101 and Table AF101(1).~~ Where a state or local jurisdiction has published radon potential data, such data shall supersede Figure AF104 or Table AF104.

SECTION AF102 DEFINITIONS

AF102.1 General. For the purpose of these requirements, the terms used shall be defined as follows:

ADD NEW TEXT AS FOLLOWS:

ACTIVE SOIL DEPRESSURIZATION (ASD). A system using a fan-powered vent drawing air from beneath a slab or membrane designed to achieve lower air pressure under the sub-slab or sub-membrane relative to air pressure above the slab or membrane.

DELETE WITHOUT SUBSTITUTION:

~~DRAIN TILE LOOP.~~ ~~A continuous length of drain tile or perforated pipe extending around all or part of the internal or external perimeter of a *basement* or crawl space footing.~~

REVISE AS FOLLOWS:

~~RADON GAS.~~ ~~The element Rn-222, which is a A naturally occurring, chemically inert, radioactive, colorless, odorless, tasteless, cancer-causing gas that is not detectable by human senses. occurs naturally as a decay product of radium. As a gas, it can move readily through particles of soil and rock and can accumulate under the slabs and foundations of homes where it can easily enter into the living space through construction cracks and openings.~~

ADD NEW TEXT AS FOLLOWS:

RADON ROUGH-IN. The installation of all parts and materials of an ASD a submembrane or subslab depressurization system, that must be completed prior to the placement of concrete, prior to the closure of building cavities and prior to the installation of finish materials. Such parts and materials including gas permeable layers, soil gas retarders, plenums, membranes, piping, suction inlets, discharge outlets and wiring.

SOIL-GAS-RETARDER. A continuous membrane of 6-mil [0.15 mm] polyethylene or other equivalent material used to retard the flow of soil gases into a building.

REVISE AS FOLLOWS:

SUBMEMBRANE DEPRESSURIZATION SYSTEM. A An ASD system designed to achieve lower sub-membrane air pressure relative to crawl space air pressure by use of a fan powered vent drawing air from beneath the soil gas retarder membrane.

SUBSLAB DEPRESSURIZATION SYSTEM (Passive). A An ASD system designed to achieve lower subslab air pressure relative to indoor air pressure by use of a fan-powered vent pipe routed through the conditioned space of a building and connecting the subslab area with outdoor air, thereby relying on the convective flow of air upward in the vent to draw drawing air from beneath the floor slab.

**SECTION AF103
REQUIREMENTS**

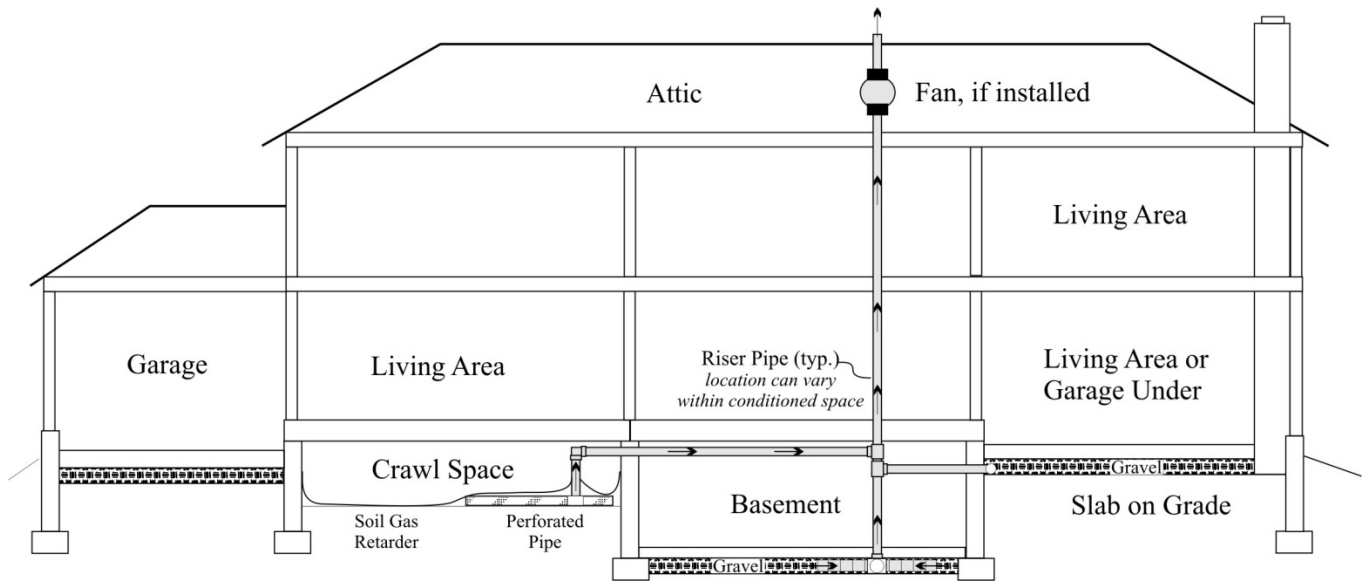
AF103.1 General. The following construction techniques are intended to resist radon entry and prepare the building for post-construction radon mitigation, if necessary (see Figure AF102). These techniques are required in areas where designated by the *jurisdiction*. AF103 is required in areas where designated by the jurisdiction and is intended to reduce radon entry and prepare the building for post-construction radon mitigation.

ADD NEW TEXT AS FOLLOWS:

AF103.2 ASD System Radon Rough-in. A rough-in is required for all ~~foundations and combination~~ foundation types, including crawlspace, basement, slab on grade, and slab on grade garage located below a living area as shown in Figure AF103.2. ~~The rough-in shall be installed prior to pouring of concrete slabs, closure of building cavities, and installation of finish materials.~~

ADD NEW FIGURE AS FOLLOWS:

**FIGURE AF103.2
FOUNDATION TYPES**



REVISE AS FOLLOWS:

~~AF103.6 AF103.3~~ **Passive Subslab depressurization system rough-in.** In *basement* or slab-on-grade buildings, the following components of a passive subslab depressurization system shall be installed during construction in accordance with Sections AF103.3.1 through AF103.3 and AF103.5 through AF103.6.58-9.

~~AF103.2 AF103.3.1~~ **Subfloor preparation. Gas permeable layer.** ~~To facilitate future installation of an ASD system, a~~ gas-permeable layer shall be constructed. ~~A layer of gas-permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of the living spaces of the building, to facilitate future installation of a subslab depressurization system, if needed.~~

The gas-permeable layer shall ~~be designed to allow the lateral flow of soil gases and~~ consist of one of the following:

1. A uniform layer of clean aggregate, not less than 4 inches [102 mm] ~~thick in depth, shall be placed over the soil.~~ The aggregate shall ~~have a void ratio of not less than 35 percent or a Size Number 4, 5, 56, or 6 as classified by ASTM C33~~ consist of material that will pass through a 2-inch (51 mm) sieve and be retained by a 1/4-inch (6.4 mm) sieve.
2. A uniform layer of ~~native or fill sand (native or fill),~~ a minimum of 4 inches [102 mm] ~~thick in depth,~~ overlain by a layer or strips of geotextile drainage matting ~~or loop of perforated pipe.~~ The geotextile

drainage matting shall have a cross-sectional area of at least 12 square inches [774 sq mm]. The geotextile matting shall be placed no closer than 12 inches [305 mm] to the foundation wall around the interior of the foundation perimeter designed to allow the lateral flow of soil gases.

3. A loop of 4 inch [102 mm] nominal or larger size perforated pipe placed in a trench along the perimeter of the foundation, with the trench backfilled with clean aggregate having a void ratio of not less than 35 percent or a Size Number 4, 5, 56, or 6 as classified by ASTM C33 such that the pipe is surrounded by a minimum of 4 inches [102mm] of aggregate on all sides. The pipe shall be placed no closer than 12 inches [305 mm] to the foundation wall around the interior of the foundation perimeter.
4. Other materials, systems or floor designs with demonstrated capability ~~for~~ to allow the lateral flow of soil gases from depressurization across the entire sub-floor area.

AF103.3 AF103.3.2 Soil gas retarder. A minimum 6-mil (.006 in; 0.15 mm) [or 3-mil (.003 in; 0.075 mm) cross-laminated] polyethylene or equivalent flexible sheeting material shall be placed on top of the gas permeable layer prior to casting the slab or placing the floor assembly ~~to serve as a soil gas retarder by bridging any cracks that develop in the slab or floor assembly, and to prevent concrete from entering the void spaces in the aggregate base material.~~ The sheeting shall cover the entire floor area with separate sections of sheeting lapped not less than 12 inches (305 mm). Openings in the sheeting caused by pipe, wire and other penetrations shall be sealed. The sheeting shall fit closely around any pipe, wire or other penetrations of the material. All Punctures or tears in the material shall be sealed or covered with additional sheeting. ~~Where under slab insulation is installed, it shall be placed on top of the sheeting.~~

ADD NEW TEXT AS FOLLOWS:

AF103.3.3 Vent pipe connector. ~~A 3-inch nominal [76 mm] or larger size ABS, PVC or equivalent gas-tight pipe shall be embedded vertically into the gas permeable layer before the slab is cast. A 4 inch (102 mm) nominal diameter tee fitting or equivalent method shall be used to secure the vent pipe opening within the gas permeable layer. Not less than 5-4 feet [1524-1219 mm] of perforated pipe or geotextile matting shall be connected to each of the two horizontal openings of the tee fitting or the two horizontal openings shall be connected to the interior drain tile system.~~

~~Alternatively, the 3-inch nominal [76 mm] size pipe shall connect through a sealed sump cover, where the sump communicates directly with the sub-slab aggregate or communicates with it through a drainage system, shall secure the vent pipe opening. A flexible rubber coupling connector shall be provided at the sump cover connection to facilitate servicing the sump.~~

REVISE TEXT AS FOLLOWS:

AF103.5 AF103.4 Passive Sub-membrane depressurization system rough-in. In buildings with crawl space foundation, the components of a sub-membrane depressurization system shall be installed during construction in accordance with Sections AF103.4.1 through AF103.4.3AF103.6.5.

Exceptions:

1. Buildings in which an *approved* mechanical crawl space ventilation system is installed.
2. Where the soil gas retarder will be covered with concrete, the requirements of 103.3.2 shall apply.

~~**AF103.5.1 AF103.4.1 Ventilation.** Crawl spaces shall be provided with vents to the exterior of the building. The minimum net area of ventilation openings shall comply with Section R408.1. **Exception:** Outdoor ventilation is not required for conditioned crawl spaces.~~

AF103.5.2 AF103.4.2-1 Soil-gas-membrane retarder. The soil in crawl spaces shall be covered with a continuous layer of soil gas-membrane complying with ASTM E1745 Class A, B or C 6-mil (0.15 mm) polyethylene soil-gas-retarder. The membrane ground cover shall be lapped not less than 12-6 inches [152 305 mm] at joints and shall extend upwards 4-6 inches [152 305 mm] and be sealed to all foundation walls enclosing the crawl space area. Seams shall be sealed with polyurethane caulk complying with ASTM C920 class 25 or higher, or taped or equivalent method, installed in accordance with the manufacturer's recommendations.

AF103.5.3 AF103.4.3.2 Vent pipe connector. A 4-inch (102-mm) nominal diameter tee fitting shall be installed beneath the soil gas membrane with not less than 10 feet of perforated pipe connected to each of the two horizontal openings of such fitting or the two horizontal openings of the tee fitting shall connect to the interior drain tile system. The branch opening of the tee fitting shall be connected to the vent pipe in accordance with Section AF103.5. A plumbing tee or other approved connection shall be inserted horizontally beneath the sheeting and connected to a 3- or 4-inch-diameter (76 or 102 mm) fitting with a vertical vent pipe installed through the sheeting. The vent pipe shall be extended up through the building floors, and terminate at least 12 inches (305 mm) above the roof in a location at least 10 feet (3048 mm) away from any window or other opening into the conditioned spaces of the building that is less than 2 feet (610 mm) below the exhaust point, and 10 feet (3048 mm) from any window or other opening in adjoining or adjacent buildings.

AF103.6.4 AF103.5 Vent pipe. A minimum 3 inch [76 mm] diameter nominal size or larger ABS, PVC or equivalent gas-tight pipe shall be extended from the tee fitting up through the building floors and in accordance with Sections AF103.5.1 through AF103.5.8. Materials used shall comply with P3002.1. embedded vertically into the subslab aggregate or other permeable material before the slab is cast. A “T” fitting or equivalent method shall be used to ensure that the pipe opening remains within the subslab permeable material. Alternatively, the 3-inch (76 mm) pipe shall be inserted directly into an interior perimeter drain tile loop or through a sealed sump cover where the sump is exposed to the subslab aggregate or connected to it through a drainage system.

AF103.5.1 Vent pipe termination. The vent pipe shall terminate vertically upward extend up through the building floors, and terminate at least not less than 12 inches [305 mm] above the surface of the roof in a location at least not less than 10 feet [3048 mm] away from any window, air intake, or other opening into the conditioned spaces of the building that is less than 2 feet [610 mm] below the exhaust point and. The vent pipe shall terminate not less than 10 feet [3048 mm] from any window or other opening in adjoining or adjacent buildings.

AF103.7 AF103.5.2 Vent pipe drainage. ~~Components of the radon~~The vent pipe ~~system~~ shall be installed to provide ~~positive condensate~~ drainage to the ground beneath the slab or ~~soil-gas-retarder membrane.~~ The pipe shall not be trapped and shall have a minimum slope of one-eighth inch per foot (1 percent slope).

ADD NEW TEXT AS FOLLOWS:

~~**AF103.5.3 Vent pipe installation.** Components of the radon vent pipe system shall be installed in accordance with Section 512 of the International Mechanical Code.~~

REVISE TEXT AS FOLLOWS:

AF103.9 AF103.5.4.3 Vent pipe identification. All exposed and visible interior vent pipes shall be identified with not less than one *label* on each floor and in crawlspaces and accessible *attics*. The *label* shall read: "Radon Vent Reduction System."

AF103.10 AF103.5.5.4 Combination foundations. ~~Combination basement / and crawl space and or combination slab-on-grade / and crawl space~~Where more than one type of foundation is present, all foundation areas shall have separate radon vent pipes installed in each type of foundation area. ~~Each radon~~ Vent pipes shall connect to a single vent that terminates above the roof or shall be connected to a single vent that each individual vent pipe shall terminates separately above the roof.

AF103.6.2 AF103.5.6.5 Multiple vent pipes Separate foundation areas. In buildings *dwelling*s where interior footings or other barriers separate foundation the areas, of subslab aggregate or other gas-permeable material, each area shall be fitted with an individual vent pipe, or a pipe loop or equivalent method shall connect such areas below the slab. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.

AF103.8 AF103.5.7.6 Provisions for radon fan. To facilitate possible installation of a radon fan, the following shall be provided:

AF103.5.6.1 Vent pipe accessibility. ~~The r~~Radon vent pipes shall be accessible for future fan installation through provided with accessible in an attic or other area outside the habitable space for the purpose of installing a ASD fan. ~~The pipe shall be centered in an unobstructed cylindrical space having a vertical height of not less~~

than 48 inches [122 cm] and a diameter of not less than 21 inches [53 cm] in the location where a fan would be installed.

Exception: The radon vent pipe need not be accessible in an attic space Where an approved electrical supply is ~~provided~~ installed on the roof for future use.

ADD NEW TEXT AS FOLLOWS:

~~**AF103.5.8 Provision for ASD fan.** A cylindrical space having a vertical height of not less than 48 inches [122 cm] and a diameter of not less than 21 inches [53 cm] shall be provided in the location where an ASD fan would be installed. The ASD pipe shall be centered in this space. The space provided for the ASD fan shall be located in accordance with Section AF103.6.~~

AF103.5.6.2 ASD-Radon fan location. ASD Fans shall be ~~installed~~ located outdoors, in attics or in garages that are not beneath conditioned spaces. ~~ASD fans-Fans~~ shall not be installed below ground, in conditioned spaces, in occupiable spaces of a building or in any basement, crawlspace or other interior location that is directly beneath a conditioned or occupiable space of a building. ~~ASD fans-Fans~~ shall not be installed in any location where pipe positively pressured by the fan would be located inside conditioned or occupiable space.

REVISE TEXT AS FOLLOWS:

~~**AF103.12 AF103.75.6.3 Power source.** To provide for future installation of a ~~radon-ASD fan~~ active submembrane or subslab depressurization system, an electrical circuit ~~terminated~~ that terminates in an approved junction box shall be installed during construction in the attic or other anticipated location of a ~~ASD vent-pipe fans~~. An electrical supply shall also be accessible in anticipated locations of system failure alarms.~~

~~**AF103.4 AF103.68- Entry routes.** Potential radon entry routes shall be closed in accordance with Sections AF103.86.1 through AF103.6.58.9 AF103.4.1 through AF103.4.10.~~

~~**AF103.4.4 AF103.68.1 Floor openings.** Openings around bathtubs, showers, water closets, pipes, wires and other objects that penetrate concrete slabs or floor assemblies shall be sealed in a permanent manner filled with a polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.~~

Exception: Sealing is not required for floors above conditioned spaces.

~~**AF103.4.2 AF103.86.2 Concrete joints.** Control joints, isolation joints, construction joints and other joints in concrete slabs or and between slabs and foundation walls shall be sealed with a caulk or sealant. Gaps and joints shall be cleared of loose material and filled with polyurethane caulk complying with ASTM C920 class 25 or higher or equivalent method or other elastomeric sealant applied installed in accordance with the manufacturer's recommendations.~~

~~**AF103.4.3 AF103.8.3 Foundation and condensate drains.** Foundation and HVAC condensate drains routed below the soil gas retarder area shall be isolated through a plumbing trap shall be trapped or routed through non-perforated pipe to daylight outdoors.~~

~~**AF103.4.4 AF103.6.3 8.4 Sumps.** Sump pits open to soil or serving as the termination point for subslab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid. Sumps used as the suction point in a sub-slab depressurization system shall have a lid designed to accommodate the vent pipe. Sumps used as a floor drain shall have a lid equipped with a trapped inlet.~~

~~**AF103.4.5 AF103.6.48.5 Foundation walls.** Hollow block masonry foundation walls shall be constructed with either a continuous course of solid masonry, one course of masonry grouted solid, or a solid concrete beam at or above finished grade ground surface to prevent passage of air from the interior of the wall into the living space. Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall be sealed. Joints, cracks and other openings around penetrations of both exterior and interior surfaces of masonry block and wood foundation walls below the ground surface shall be filled with polyurethane caulk complying with ASTM C920 class 25 or higher, or equivalent method applied installed in accordance with the manufacturer's recommendations sealant. Penetrations of concrete walls shall be filled sealed.~~

~~**AF103.4.6 AF103.8.6 Dampproofing.** The exterior surfaces of foundation walls below grade portions of concrete and masonry block walls below the ground surface shall be dampproofed in accordance with Section R406.~~

~~**AF103.4.7 AF103.8.7 Air-handling units.** Air-handling units in crawl spaces shall be sealed to prevent air from~~

~~being drawn into the unit.~~

~~**Exception:** Units with gasketed seams or units that are otherwise sealed by the manufacturer to prevent leakage.~~

~~**AF103.4.9 AF103.8.8 Crawl space floors.** Openings around penetrations through floors above crawl spaces shall be caulked or otherwise filled to prevent air leakage.~~

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~~**Exception:** Air sealing is not required for floors above conditioned crawl spaces complying with Section R408.3.2.2.~~

~~**AF103.4.10 AF103.6.5 8.9 Crawl space access.** Access doors and other openings or penetrations between basements and adjoining crawl spaces shall be closed, gasketed or otherwise filled to prevent air leakage.~~

~~**Exception:** Air sealing is not required for conditioned crawl spaces conforming to Section R408.3.2.2.~~

**TABLE AF101-~~AF104~~(1)
HIGH RADON-POTENTIAL (ZONE 1) COUNTIES^a**

(No changes to table or footnotes. Same as 2012 IRC table and footnotes.)

**FIGURE AF101-~~AF104~~
EPA MAP OF RADON ZONES**

(No changes to figure. Same as 2012 IRC figure.)

a. pCi/L standard for picocuries per liter of radon gas. The U.S. Environmental Protection Agency (EPA) recommends that homes that measure 4 pCi/L and greater be mitigated.

The EPA and the U.S. Geological Survey have evaluated the radon potential in the United States and have developed a map of radon zones designed to assist *building officials* in deciding whether radon-resistant features are applicable in new construction.

The map assigns each of the 3,141 counties in the United States to one of three zones based on radon potential. Each zone designation reflects the average short-term radon measurement that can be expected to be measured in a building without the implementation of radon-control methods. The radon zone designation of highest priority is Zone 1. Table AF101-~~AF104~~ lists the Zone 1 counties illustrated on the map. More detailed information can be obtained from state-specific booklets (EPA-402-R-93-021 through 070) available through State Radon Offices or from EPA Regional Offices.

DELETE WITHOUT SUBSTITUTION:

**FIGURE AF102
RADON-RESISTANT CONSTRUCTION DETAILS FOR FOUR FOUNDATION TYPES**

(Figure to be deleted.)

~~**AF103.4.8 Ducts.** Ductwork passing through or beneath a slab shall be of seamless material unless the air-handling system is designed to maintain continuous positive pressure within such ducting. Joints in such ductwork shall be sealed to prevent air leakage.~~

~~Ductwork located in crawl spaces shall have all seams and joints sealed by closure systems in accordance with Section M1601.4.1.~~

~~**AF103.11 Building depressurization.** Joints in air ducts and plenums in unconditioned spaces shall meet the requirements of Section M1601. Thermal envelope air infiltration requirements shall comply with the energy conservation provisions in Chapter 11. Fireblocking shall meet the requirements contained in Section R302.11.~~