



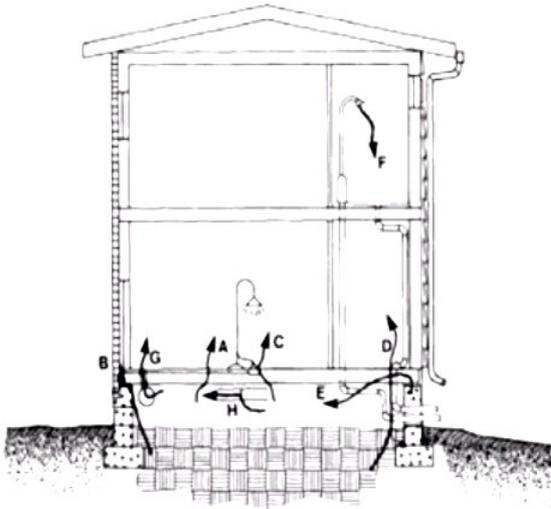
Section AF103 is broken down into several subsections, but can be categorized into two main construction categories; slab-on-grade or slab-below-grade (basements) and crawl space construction. Slab-on grade and slab-below-grade construction includes concrete slabs as-well-as any other floor system with direct contact to the ground.

Section AF103.2 specifically deals with sub-grade preparation for slabs. When a sub-slab depressurization system is to be used, it is necessary to correctly prepare the base prior to the installation of a soil-gas-retarder. The use of aggregate, or sand overlaid with drainage matting, or any other approved gas-permeable material or system is required beneath all concrete slabs or similar floor systems in direct contact with the ground. The layer of material must be located so that it protects all interior floor areas of the building. Where aggregate or sand are used, they must be placed in a uniform layer at least 4 inches thick. The sand must also be overlaid with a drainage matting material that will assist in causing the soil gases to travel in a lateral direction.

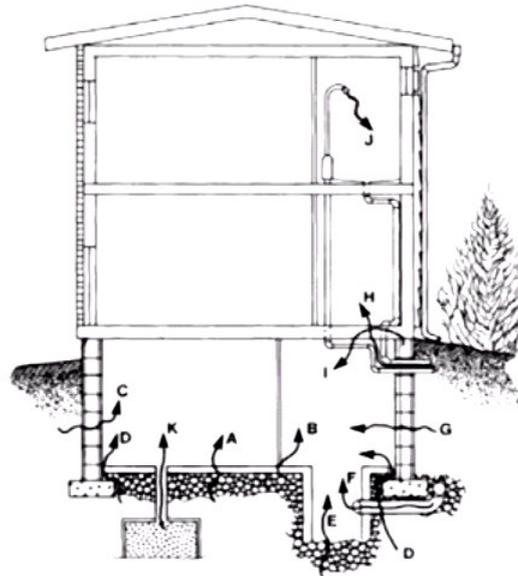
Section AF103.3 deals with the soil-gas-retarder materials. An acceptable sheeting material must be installed on top of the gas-permeable base layer. The material is to be a minimum 6-mil polyethylene membrane or any other flexible sheeting that provides equivalent protection. The soil-gas-retarder resists the vertical flow of radon gas into the slab or other type of floor assembly. Therefore, the membrane must cover the entire floor area of the building with joints adequately lapped and penetrations tightly sealed. Any tears, rips, or punctures are to be adequately repaired with additional sheeting material.

Section AF103.4 (and ensuing subsections) identifies the various points at which radon may enter the building and specifies the appropriate methods for sealing or otherwise protecting the potential entry routes. This section applies to both a slab or crawl space.

## Ways that Radon can enter the home.



- A. Cracks in subflooring and flooring
- B. Spaces behind stud walls and brick veneer walls that rest on uncapped hollow-block foundation
- C. Electrical penetrations
- D. Loose-fitting pipe penetrations
- E. Open tops of block walls
- F. Water (from some wells)
- G. Heating duct register penetrations
- H. Cold-air return ducts in crawl space



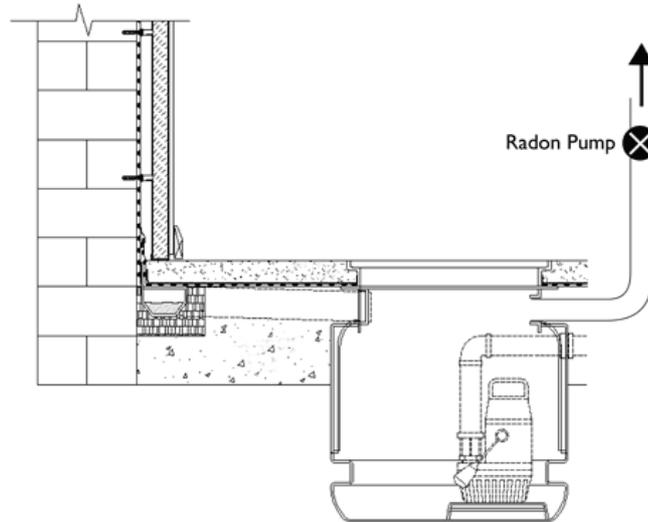
- A. Cracks in concrete slabs
- B. Cold joint between two concrete pours
- C. Pores and cracks in concrete blocks
- D. Floor-to-wall crack or French drain
- E. Exposed soil, as in a sump
- F. Weeping (drain) tile, if drained to open sump
- G. Mortar joints
- H. Loose fitting pipe penetrations
- I. Open tops of block walls
- J. Water (from some wells)
- K. Untrapped floor drain to a dry well or septic system

It is typical for a floor slab or other type of floor assembly to be penetrated by plumbing, mechanical and electrical components. Polyurethane caulk or an equivalent sealant material must be installed at all penetrations created by the passage of piping, vents, conduit, cable, or other items penetrating the floor. The sealant is to be installed in accordance with the recommendations of the caulking manufacturer.

Where joints occur within a concrete slab floor or at the point where the floor intersects the foundation walls, they must be filled with an appropriate caulk or sealant material. All loose material must be removed prior to installation of the sealant material. Polyurethane caulk or any other type of elastomeric sealant will allow for slight movement of the penetrating items without reducing the integrity of the seal.

Condensate drains that pass through the floor system are to be run to the exterior using non perforated pipe or must be provided with an approved trap.

A gasketed or sealed lid must be provided on any sump pit that serves as the end point for a sub-slab or exterior drain tile loop system. Such a lid is also required if the sump pit is open to the soil. The sump lid must be designed to accommodate the vent pipe where the sump is used as the suction point in a sub-slab decompression system. Where used as a floor drain, the sump pit lid is to be equipped with a trapped inlet.



Where ductwork passes through or is installed beneath a concrete floor slab, the ducts must be free of seams that may allow air and gas to enter the duct system. Seams are only permitted where it can be demonstrated that the air-handling equipment will maintain continuous positive pressure within the ducting. In such situations, the seams must be sealed to eliminate any air leakage. All duct work must be performance tested in accordance with ODOE duct testing standards. Ductwork passing through a crawl space must have seams and joints sealed by one of the methods prescribed in Section M1601.3.1. This will allow the use of fibrous glass and seamed metal ducts and field fabricated ductwork. Again, all duct work must be performance tested in accordance with ODOE duct testing standards.

In addition to above penetrations, crawlspace access under Section R408.3, under-floor mechanical equipment access per Section M1305.1.4, or any other access point from the habitable space into the crawl space, such as doors or panels must be closed and gasketed to create an airtight separation.

It's important to remember, the requirements for sealing of all penetrations as addressed in Section AF103.4 is mandatory, and are in addition to **any** of the following specific requirements found in Sections AF103.5 and AF103.6.

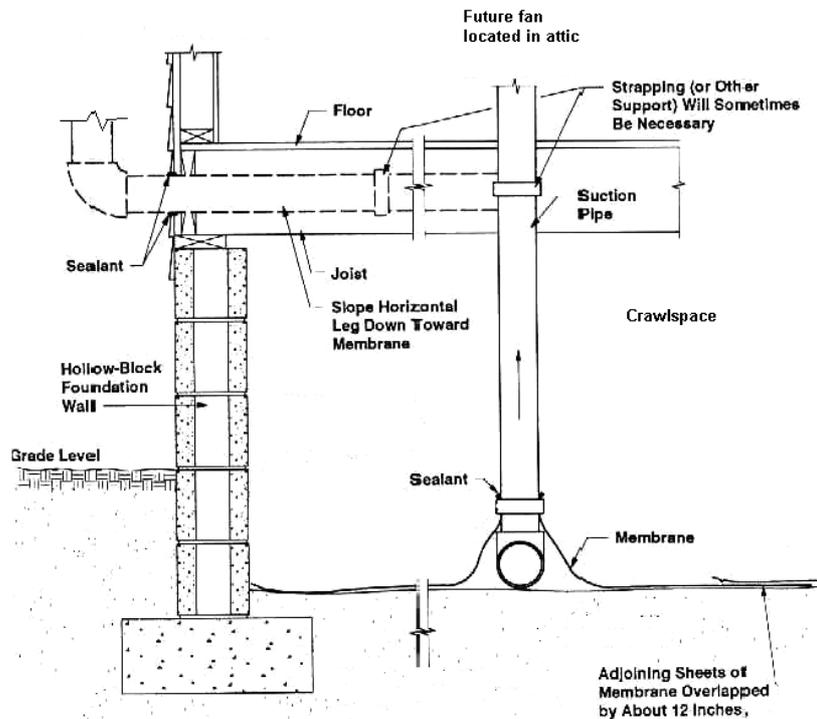
**Section AF103.5 specifically addresses crawl spaces, and provides three ways to accommodate radon mitigation.**

The first method is found in the exception under AF103.5. This method allows for a mechanically ventilated crawlspace system as described in Section R408.2, Exception 2. This exception does not require any further mitigation other than the sealing requirements found in AF103.4, as discussed above.

**R408.2, Exception 2;**

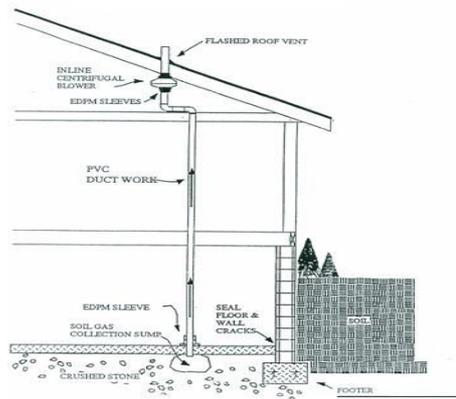
2. Ventilation openings are not required in the foundation when a continuously operated mechanical ventilation system is installed. The system shall be designed to have the capacity to exhaust a minimum of 1.0 CFM (0.5 L/s) for each 50 square feet (4.6 L/s) of under-floor area. The ground surface shall be covered with an approved ground cover material.

The second method is described in Section AF103.5.1 and is called a "Passive sub-membrane depressurization system". This system requires foundation ventilation, installation of a soil-gas-retarder, **and** a vent stack. The vent stack is not required to be fan assisted, but is required to be accessible for later installation of a fan. This method also requires the installation of an electrical supply for that future fan, and must be pre-wired for a "system failure" alarm (See Section AF103.12).



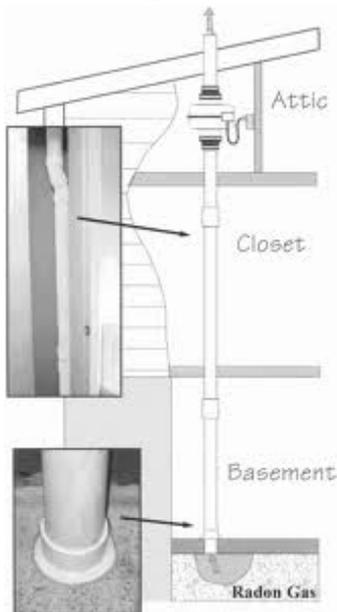
The third method requires foundation ventilation per R408.1 ( $1/150$  with no further reductions.), foundation ventilation openings per R408.2 (Operable louvers, dampers, or other means to temporarily close-off vent openings are not allowed.), the testing of building tightness with a blower door test, **and** the installation of a whole-house ventilation system. A mechanical exhaust, supply, or combination system providing building ventilation rates per Chapter 11, Table N1101.1(3) or ASHRAE 62.2 will meet this requirement. Obviously the blower door test will need to be performed prior to final approval and after all other aspects of the house construction are completed.

SUB - SLAB SUCTION

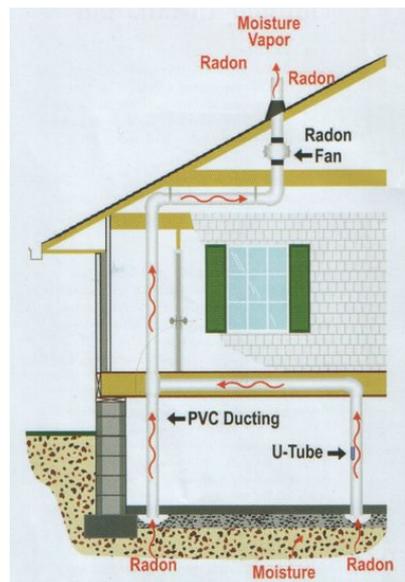


**Section AF103.6 specifically addresses basements and slab-on-grade construction.**

This section provides one basic method of radon mitigation, by use of a vent stack system. As with the vent stack described above (AF103.5.1.3), the minimum requirement is a "Passive sub-membrane depressurization system". Section AF103.6.1 describes in detail several options including inserting a vent pipe into the sub-slab aggregate materials by use of a "T" fitting or equal embedded in the aggregate, or the use of an interior perimeter drain tile loop or through a sump. This section also addresses the use of multiple vents (Sub-section AF103.6.2) when interior footings or other barriers separate the sub-slab aggregate. When multiple venting is required, the vent pipes may terminate individually above the roof or may be connected to a single vent stack.



Single Stack



Double Stack

**The remaining sections are generic in nature and apply to both slab and crawl-space construction.**

(Section AF103.7) When a "Passive sub-membrane depressurization system" is used, whether for a slab or crawl-space, the ground beneath the floor slab or soil-gas-retarder shall be properly prepared to provide positive drainage to the stack location.

(Section AF103.8) To accommodate the future installation of a fan, access to the radon vent stack-pipe must be provided through the attic or other non-habitable space. If an approved rooftop electrical supply is provided, the access from the building's interior is not necessary.

(Section AF103.9) Radon venting systems must be adequately identified to reduce the potential for improper use or modification. The identification is required for every floor level and in all accessible attics where the radon vents are exposed and visible. At a minimum, the identification label must state: "**Radon Reduction System.**"

(Section AF103.10) When dealing with a structure that combines a basement with a crawl space, or a slab-on grade with a crawl space, separate radon mitigation shall be provided for each individual type of foundation system. Again if vent piping is used, it must extend above the roof, either as an individual vent or as a single vent termination connected to multiple vents.

(Section AF103.11) When other provisions of the code are applicable to the installation of a radon reduction system, they are only applicable to the extent prescribed by the code. Specific references are made in this appendix to Section M1601 for joints in air ducts and plenums in unconditioned spaces, Section R602.8 for fire stopping in concealed spaces and Chapter 11 for whole house ventilation systems.

(Section AF103.12) Although this appendix only requires a venting system to be a "Passive depressurization system", it is possible a conversion to an active system may occur some time in the future. In anticipation of such an occurrence this appendix requires an electrical circuit be provided to an approved electrical box. The box should be located in the attic or other location that will provide access to the vent pipe. An active system will also require a "system failure" alarm, so in anticipation of this alarm an additional electrical supply must be provided at the anticipated future "system failure" alarm location. Examples of system failure warning devices are: *a liquid gauge, a sound alarm, a light indicator, and a dial (needle display) gauge.* The warning device *must* be placed where it can be seen or heard easily. The location and type of "system failure" alarm should be determined by the contractor (and/or home owner) and should be identified on house plans at the time of submittal for plan review.

**Additional questions?**  
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## Examples of System Failure Warning Devices

### Dynamometer



### Checkpoint Audible Radon System Alarm



An audible alarm is desirable when the U-tube manometer is installed in a hard to view location. The Checkpoint alarm will sound when the pressure drops in the vent pipe due to an obstruction or fan failure.

## Example of a Home Radon Testing Device



### Features

- HS71512 110V - 60 Hz
  - Numeric LED display range of .1 to 999.9 shows the level of radon gas in pCi/L.
  - Short-term reading displays the average radon gas levels over the past 48 hours.
  - Long-term reading displays the average radon gas levels since powered-up or last reset with a maximum reading time of 5 years.
  - Upon initial power-up, short-term and long-term readings will display after the first 48 hours.
  - Audible alarm sounds if the long-term average reaches 4 pCi/L or greater or the short-term average stays above 4 pCi/L for 30 consecutive days.
  - Samples air continuously with the display updated every hour.
  - Conducts a failsafe self-test every 24 hours with an error code displayed if there is a failure.
  - Menu button controls 4 functions.
  - Switch between the short-term and long-term display, indicated by a green LED illuminated next to the S or L .
  - Conduct a manual test of the detector.
- Mute or reactivate the audible alarm if the detector is in an alarm state.
  - Clear and reset the memory of the detector to begin new readings.
  - 10-foot power cord allows user to locate detector away from walls, windows and doors.
  - Evaluated by the US EPA and meets performance criteria to accurately and precisely measure radon.
  - One year warranty.