Creating healthy and safe homes for children through practical and proven steps.

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National Center for Healthy Housing

**Radon Resistant New Construction**
**for Educational Properties (Schools and Child Care Facilities – G99-12 – pages 729-738)**
**and Multifamily Residential Properties (Apartment Homes - G99-100 - pages 739-748)**

**We seek your support for G99-12 and G100-12 as modified by our public comments.** The National Center for Healthy Housing (NCHH) submitted proposals to amend the International Building Code (IBC) to require RRNC in multifamily residential buildings and schools located in Zone 1 areas, which are locations with high potential of radon. The IBC Committee declined to accept these proposals at its hearing in May, but indicated that the proposals would fit the code with a more simple presentation of the requirements and inclusion of the radon map. The proponents have revised the proposals in response to the feedback and submitted them in comments for consideration at ICC's final action hearings October 24-28 (exact date to be determined) in Portland OR. All members of the ICC who represent government agencies are eligible to vote at the final action hearings.

**Adding radon-resistant new construction (RRNC) provisions to construction codes will ensure that new housing and schools do not have dangerous levels of radon. Excluding radon from buildings prevents exposure and therefore lung cancer.** Builders can install features during new construction to create either a passive radon-resistance system or an active radon reduction system. An active system includes a fan, while a passive system would be upgraded with a fan if there's an elevated radon level. Radon-resistant new construction (RRNC) is much more cost effective than installing a radon reduction system after the building has been constructed. RRNC is consistent with energy-efficiency standards because tightening the building and sealing openings keep fuel costs down.

**Radon is the number-one cause of lung cancer among non-smokers**. Radon is responsible for about 21,000 lung cancer deaths in the U.S. every year. In 2005, the Surgeon General issued a national health advisory on radon. Studies show definitive evidence of the association between residential radon exposure and lung cancer, leaving no doubt about the risks that radon in the home presents to Americans or its association with lung cancer. Although lung cancer can be treated, the survival rate is one of the lowest for those with cancer. After diagnosis, only 11-15% of lung cancer victims live beyond five years.

> *"Radon poses an easily reducible health risk to populations all over the world, but has not up to now received widespread attention. Radon in our homes is the main source of exposure to ionizing radiation, and accounts for 50% of the public's exposure to naturally-occurring sources of radiation in many countries." - Dr. Michael Repacholi of WHO's Radiation and Environmental Health Unit.*

**Radon is a persistent public health risk** because it's an odorless, tasteless, and invisible gas produced by the decay of naturally occurring uranium in soil and water and a proven carcinogen. Radon is found in outdoor air and in the indoor air of buildings of all kinds. EPA recommends that homes be fixed if the radon level in the indoor air is 4 pCi/L (picoCuries per Liter) or more. The greatest radon exposure risk is in rooms that are below grade (e.g., basements) and in contact with the ground or immediately above such rooms.

**Frequently Asked Questions about Requiring Radon-Resistant Construction for Educational Properties (Schools and Child Care Facilities) and Multifamily Residential Properties (Apartment Homes) in the International Building Code**

**What Would Be Required of Builders of Multifamily Properties and Educational Buildings?**
The proposed approach is similar to New Jersey requirements for passive sub-slab or sub-membrane depressurization systems, which apply to new homes and schools located in Zone 1 areas. The requirements to reduce radon entry include putting a layer of gravel and a plastic liner under the foundation and sealing all openings with a non-cracking polyurethane caulk. If the foundation walls are made of cinder block or other hollow masonry, the builder must also either cap the tops of the foundation walls or completely fill the openings in the blocks. To make it easier for a certified radon mitigation company to install and activate a fan if it turns out that radon levels are high, the regulations also require pre-installing the piping and electrical connection for a radon mitigation fan. The fan will draw the radon out from beneath the slab and vent it through the pre-installed piping to the outside.

**How Will These Proposals Help Reduce Radon in Schools and Multifamily Properties?**
The IBC covers the new construction of buildings with many different uses and occupancies: business, educational, factory and industrial, institutional, mercantile, residential, storage, and utility and miscellaneous. Communities using the IBC apply it to all of these types of buildings, except that those who have adopted the International Residential Code (IRC) would apply IRC to one- and two-family residential structures. These IBC code change proposals focus on all new educational buildings (including schools and child care facilities) and multifamily residential buildings.

**Why Isn't There a Proposal for Single-Family Homes?**
Consideration of changes to the International Residential Code (IRC), the code that affects one- and two-family dwellings, will not occur until 2013. Proponents will propose adding RRNC to the IRC in 2013.

**How Can I Obtain More Information?**
Contact Jane Malone, jmalone@nchh.org, 202-280-1982.

| **Risk of Lung Cancer from Radon and Comparisons to Other Causes of Death** | | |
|---|---|---|
| **Radon Level** | ***Of 1,000 non-smokers who are exposed to this level of radon over a lifetime, …** | ****The risk of cancer from this level of radon exposure equals...** |
| **20 pCi/L** | 36 people could get lung cancer | 35 times the risk of drowning |
| **10 pCi/L** | 18 people could get lung cancer | 20 times the risk of dying in a home fire |
| **8 pCi/L** | 15 people could get lung cancer | 4 times the risk of dying in a fall |
| **4 pCi/L** | 7 people could get lung cancer | the risk of dying in a car crash |
| **2 pCi/L** | 4 people could get lung cancer | the risk of dying from poison |
| **1.3 pCi/L** | 2 people could get lung cancer | (Average indoor radon level) |
| **0.4 pCi/L** | [unknown] | (Average outdoor radon level) |

* Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).
** Comparison data based on the 1999-2001 National Center for Injury Prevention and Control Reports from CDC.

# G100-12

## 425 (New), Chapter 35

## ***Proposed Change as Submitted***

**Proponent:** Jane Malone, National Center for Healthy Housing (jmalone@nchh.org)

**Add new text as follows:**

**SECTION 425**
**RADON REDUCING CONSTRUCTION FEATURES FOR**
**GROUP R-2 OCCUPANCIES.**

**425.1. General.** Group R-2 Occupancies shall comply with the provisions of this section if the building is located in an area of High (Zone 1) Radon Potential as determined by Figure AF101 of Appendix F of the *International Residential Code*.

**Exception.** Buildings complying with Chapter 2 of EPA 625-R-92-016.

**425.2. Radon Reducing Construction Features.** Buildings shall be equipped with radon reducing features in accordance with Sections 425.2.1 through 425.2.12.

**425.2.1 Vapor Barrier.** A continuous vapor barrier meeting ASTM E1745 Class A, B or C, with any seams overlapped not less than 12 inches (305 mm) and sealed, shall be installed under the slab in basement and slab-on-grade construction and on the soil in crawl space construction.

**425.2.2 Base Course.** Floors of basements and slab on grade construction shall be placed over a stone base course, not less than 4 inches (102 mm) in thickness. The stone base course shall have a void ratio of not less than 35 percent, or Size Number 4, 5 or 6 shall be used and shall meet the specifications of ASTM C33.

**425.2.3 Solid Vent Pipe**. Solid vent pipe shall be installed as follows:

1. Basement slabs with interior foundation pipe drains installed shall have solid 6 inch (153 mm) minimum diameter vent pipe sections installed in conjunction with this drainage system. One independent vent stack pipe shall be installed for every contiguous 15,000 square feet (1392 sq. m), or portion thereof, of slab area, terminating at an approved location, as prescribed in 425.2.9, on the exterior of the building. Basement slabs with French drains or channel drains shall not be allowed unless interior foundation pipe drains as described in this section are installed.
2. Basement slabs which do not have an interior foundation pipe drain, and slab on grade construction (excluding non-habitable spaces such as garages), shall be provided with one 6 inch (153 mm) minimum diameter solid vent pipe section with a "T" pipe fitting or equivalent for every contiguous 15,000 square feet (1392 sq. m), or portion thereof, of slab area, with this vent pipe section to be installed into the sub-slab aggregate. Each of the horizontal openings of the "T" pipe fitting shall be connected to a minimum of 10 feet (3 m) of 6 inch (153 mm) diameter perforated pipe or equivalent area soil gas collection plenum and placed in the sub-slab aggregate. The vertical portion of the "T" pipe fitting shall be connected to an independent solid vent stack pipe terminating at an approved location, as prescribed in 425.2.9, on the exterior of the building. Where more than one vent pipe section is provided, interconnection of these sections into a single independent vent stack is permitted for coverage up to a total area of 15,000 square feet (1392 sq. m) to permit use of a single in-line vent pipe fan if activation of the system is desired.
3. Crawl spaces shall be provided with one 6 inch (153 mm) minimum diameter solid vent pipe section with a "T" pipe fitting or equivalent for every contiguous 15,000 square feet (1392 sq. m), or portion thereof, of crawl space area. Each of the horizontal openings of the "T" pipe fitting shall

be connected to a minimum of 10 feet (3 m) of 6 inch (153 mm) diameter perforated pipe or equivalent area soil gas collection plenum and installed upon the soil. The vertical portion of the "T" pipe fitting shall be connected to an independent solid vent pipe terminating at an approved location on the exterior of the building.

4. In combination basement/crawl space or slab-on-grade/crawl space buildings, a 6 inch (153 mm) minimum diameter solid vent pipe may be provided between the areas and interconnected into the independent vent stack, for coverage up to a total area of 15,000 square feet (1392 sq. m) to permit use of a single in-line vent pipe fan if activation of the system is desired. Slabs areas divided by internal footings may be joined with piping into a single independent vent stack for coverage up to a total area of 15,000 square feet (1392 sq. m).

**425.2.4 Joint and Penetration Sealing**. 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 all other openings and penetrations of the foundation walls and floor including, but not limited to, utility penetrations, shall be substantially sealed by utilizing a caulk complying with ASTM C920 class 25 or greater, in order to close off the soil gas entry routes. Prior to sealing, backer rods shall be used to fill gaps greater than one inch. 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.

**425.2.5 Floor drains.** Floor drains shall substantially close off the soil gas entry routes with a water-seal trap or other mechanical means.

**425.2.6 Sump Cover**. A sump cover which substantially closes off the soil gas entry routes shall be provided for all sump installations. Sump covers shall not be used as a vent pipe location.

**425.2.7 Sealing**. The following measures shall be provided:

1. No ductwork for supply or return air shall be routed through a crawl space or beneath a slab. Where ductwork passes through or beneath a slab, all openings and joints shall be seamless or properly taped or sealed water-tight.
2. 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.
3. 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.
4. The vapor barrier in a crawlspace shall turn up onto the foundation walls not less than 12 inches (153 mm) and shall be sealed to the wall with a caulk complying with ASTM C920 class 25 or higher or equivalent method.

**425.2.8 Vent Stack Installation**. The independent vent stack pipe provided in accordance with this section shall be an adequately supported, gas tight, 6 inch (153 mm) minimum diameter solid pipe, through any enclosed portions of the building. The pipe shall be routed in a manner that makes it accessible for the installation of a future in-line vent pipe fan in a non-conditioned (not heated or cooled) space 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.

**425.2.9 Vent Stack Termination**. The vent stack pipe shall meet the following termination requirements:

1. Vent pipes shall terminate at least 24 inches (610 mm) 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 10 feet (3 m) above the roof surface.

   **Exception:** Buildings more than three stories in height shall be allowed to extend vent pipe terminals through a wall provided that the termination is at least 20 feet (6 m) above grade and is effectively screened.

2. No vent terminal shall be located directly beneath any door, window, or other ventilating opening into the conditioned space of the building or of an adjacent building nor shall any such vent terminal be within 25 feet (7620 mm) horizontally of such an opening unless it is at least 2 feet (610 mm) above the top of such opening.
3. No vent terminal shall be closer than 25 feet (7620 mm) horizontally from any lot line.

**425.2.10 Labeling.** Radon vent pipes shall be identifiable and clearly labeled as a radon reduction system at intervals of at least every 10 feet (7620 mm) and at least once in every room or space. The radon reduction system label of any section of vent pipe above the roof shall caution against placement of air intake valves within 10 feet (7620 mm) of the vent pipe discharge.

**425.2.11 Electrical Connection for Fan**. A dedicated electrical branch circuit terminating in an electrical box shall be installed proximate to each vent stack where a future in-line vent pipe fan and system failure alarms may be installed.

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

**Add new standard to Chapter 35 as follows:**

**ASTM**
ASTM E 1745-11 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

**US EPA** Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

**EPA 625-R-92-016-1994** Radon Prevention in the Design and Construction of Schools and Other Large Buildings.

**Reason:** The purpose of this requirement is to protect occupants from deadly exposure to radon gas in the multifamily residential environment. This proposed change will reduce radon exposure risk for occupants of multifamily residential buildings that are constructed in known areas[1] of high radon potential.

In the current ICC family of codes, provision for radon control, commonly known as radon-resistant new construction, is contained only in the optional Appendix F for the International Residential Code. We intend to propose changes to the IRC in 2013 to require radon resistant new construction in the next code change cycle.

Epidemiological studies confirm that radon increases the risk of lung cancer in the general population. Radon is the second leading cause of lung cancer – second only to smoking – and more significant than secondhand smoke. In the US alone, 21,000 lung cancer deaths each year are caused by radon exposure. [2] The World Health Organization estimates that between 3% and 14% of all lung cancer cases worldwide are caused by radon exposure. [3] The Surgeon General of the United States issued a Health Advisory in 2005 warning Americans about the health risk from exposure to radon in indoor air. Dr. Richard Carmona, the Nation's Chief Physician, urged Americans find out how much radon they might be breathing. Dr. Carmona also stressed the need to remedy the problem as soon as possible when the radon level is 4 pCi/L or more.

Radon is a colorless and odorless gas that is a decay product of uranium and occurs naturally in soil and rock. The main source of high-level radon pollution in buildings is surrounding uranium-containing soil such as granite, shale, phosphate and pitchblende. Radon enters a building through cracks in walls, basement floors, foundations and other openings. There is no known threshold concentration below which radon exposure presents no risk. Even low concentrations of radon can result in a small increase in the risk of lung cancer. EPA recommends that all homes and schools be tested for radon. EPA recommends mitigation if radon is above 4 pCi/L (equivalent to EPA Radon Zone 1) and consideration of mitigation if radon is 2-4 pCi/L (equivalent to Zone 2). [4] In 2009, the World Health Organization released a report indicating that 100 Bq/$m^3$or 2.7 pCi/L should be the reference level for radon.[5]

This proposal consists of the subchapter 10 "Radon Hazard Sub-code of the New Jersey Uniform Construction Code" – which applies to all residential and educational uses – combined with revisions consistent with provisions that were accepted for the IGCC 2012. These provisions improve upon the New Jersey standard by improving the cost-efficiency and effectiveness of this existing radon standard.

[1] "Zone Maps," US EPA, http://www.epa.gov/radon/zonemap.html
[2] "Health Risks," US EPA, http://www.epa.gov/radon/healthrisks.html
[3] "Radon and Cancer," World Health Organization, http://www.who.int/mediacentre/factsheets/fs291/en/index.html

[4] "Health Risks," US EPA, http://www.epa.gov/radon/healthrisks.html
[5] "WHO Handbook on Radon," http://www.who.int/entity/ionizing_radiation/env/9789241547673/en/index.html

**Referenced Standards - New**
ASTM E 1745 (attached)

**Referenced Standards – Existing**
ASTM C 33
ASTM C 920

**Cost Impact:** This code change will increase the cost of construction. This change will also save lives.

**Analysis:** A review of the standard proposed for inclusion in the code, ASTM E 1745 and EPA 625-R-92-016 with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2012.

**425 (NEW) #2-G-MALONE**

## ***Public Hearing Results***

For staff analysis of the content of ASTM E1745-11 and US EPA 625-R-92-016-1994 relative to CP#28, Section 3.6, please visit: http://www.iccsafe.org:8888/cs/codes/Documents/2012-13cycle/Proposed-A/00a_updates.pdf

**Committee Action: Disapproved**

**Committee Reason:** This proposal was disapproved based upon the action taken in G99-12.

**Assembly Action: None**

## ***Individual Consideration Agenda***

**This item is on the agenda for individual consideration because a public comment was submitted.**

*Public Comment:*

**Jane Malone, National Center for Healthy Housing requests Approval as Modified by this Public Comment.**

**Replace proposal asfollows:**

**SECTION 425**
**RADON REDUCING CONSTRUCTION FEATURES FOR GROUP R-2 OCCUPANCIES.**

**425.1 General.** Buildings containing Group R-2 Occupancies shall comply with the provisions of this section where the building is located in a Zone 1 radon potential area as determined by Figure 425.1 and Table 425.1.

> **Exception:** Where approved, radon zone designations or maps adopted by a state agency shall supersede Figure 425.1 and Table 425.1.

**425.2 Radon reducing construction features.** Buildings, including garages below occupiable space, shall be equipped with radon reducing features in accordance with Sections 425.2.1 through 425.2.6.

**425.2.1 Gravel.** A layer of clean aggregate that meets the specifications of Size Number 4, 5, 56, or 6 of ASTM C33 shall be installed below the foundation slab. The depth of gravel shall be not less than the diameter of the pipe provided in accordance with Section 425.2.3.

**425.2.2 Vapor retarder.** A continuous vapor retarder of Class A, B or C complying with ASTM E1745 shall be installed under the slab in basement, crawl space slab, and slab-on-grade construction, and over the soil in crawl space construction. Seams of the vapor retarder shall be overlapped not less than 12 inches (305 mm). Seams shall be sealed with a caulk of not less than Class 25 complying with ASTM C920, or by tape specified by the vapor retarder manufacturer's instructions. The vapor retarder in a crawl space shall turn up onto the foundation walls not less than 12 inches (153 mm) and shall be continuously sealed to the wall with a caulk of not less than Class 25 complying with ASTM C920. Openings or penetrations in the retarder shall be sealed.

**425.2.3 Vent stack pipe.** A solid, rigid, gas tight, non-perforated, ABS or PVC vent stack pipe shall be installed in a continuous vertical stack, from the tee pipe fitting for each suction point in accordance with Section 425.2.3.6 within the interior of the building, to the termination point installed in accordance with Section 425.2.6. The vent stack pipe shall be without dips or sags and shall slope upward toward the vent or chimney at least 1/8 inch per foot (21 mm per 305 mm).

**425.2.3.1 Pipe dimensions.** Vent stack pipe shall be not less than 4 inches (102 mm) nominal inside diameter. Pipe wall thickness shall be Schedule 40.

**425.2.3.2 Pipe joints.** The joint surfaces for ABS or PVC pipe shall be prepared with a primer and solvent welded in accordance with the pipe manufacturer's instructions.

**425.2.3.3 Pipe support.** Above ground piping shall be supported by the structure of the building in accordance with the International Plumbing Code.

**425.2.3.4 Coverage area.** Where 4-inch (102 mm) nominal inside diameter pipe is used, not less than one independent vent stack shall be installed for vent coverage for each 5,000 square feet (464 $m^2$) area of slab or crawlspace. Where 6-inch (152 mm) nominal inside diameter pipe is used, not less than one independent vent stack shall be installed for each 15,000 square feet (1,392 $m^2$) area of slab or crawlspace.

**425.2.3.5 Interconnected coverage areas.** Where a 4-inch (102 mm) nominal inside diameter solid piping located above the slab ~~that~~ interconnects the pipes from separate areas in combination basement and crawl space buildings, separate areas in combination slab-on-grade and crawl space buildings, or separate areas under slabs divided by internal footings, the coverage area shall not be greater than 5,000 square feet (464 $m^2$). Where a 4-inch (102 mm) nominal inside diameter perforated piping interconnects areas separated by interior footings in a pipe loop located along the perimeter of the foundation under the slab, the coverage area shall not be greater than 5,000 square feet (464 $m^2$). Where 6-inch (152 mm) nominal inside diameter pipe is used, the piping shall serve a total coverage area not greater than 15,000 square feet (1,392 $m^2$).

**425.2.3.6 Suction point.** A suction point consisting of a tee pipe fitting or saddle fitting shall be installed o connect horizontal piping below the structure and an independent solid vent stack in accordance with sections 425.3.6.1 through 425.3.6.3.

**425.2.3.6.1. Suction points in basement slabs, crawl space slabs and slab on grade foundations**. For basement slab, crawl space slab and slab on grade foundations, a tee pipe fitting or saddle fitting shall be installed in the sub-slab aggregate for each coverage area. Each of the horizontal openings of the tee pipe fitting or saddle fitting shall be connected to not less than 10 feet (?? mm) of perforated pipe having not less than 1 square inch (645 $mm^2$) of opening for each lineal foot of pipe. The perforated pipe shall be covered by the sub-slab aggregate. The vertical portion of the tee pipe fitting or saddle fitting shall be connected to an independent solid vent stack.

**425.2.3.6.2 Suction points in crawl spaces with soil floors.** Crawl spaces with soil floors shall be provided with a tee pipe fitting or saddle fitting for each coverage area. Each of the horizontal openings of the tee pipe fitting or saddle fitting shall be connected to not less than 10 feet (3048 mm) of perforated pipe having not less than 1 square inch (645 $mm^2$) of opening for each lineal foot of pipe. The perforated pipe shall be installed on top of the soil. The vertical portion of the tee pipe fitting or saddle fitting shall be connected to an independent solid vent stack.

**425.2.3.6.3 Sump cover.** A sump cover shall not be used as a suction point location**.**

**425.2.3.7 Vent stack termination**. The independent vent stack pipe shall discharge outside of the building and be installed in accordance with Sections 426.2.3.7.1 and 425.2.3.7.2.

**425.2.3.7.1 Rooftop termination.** Vent stack pipes shall terminate at least not less than 2 feet (610 mm) above the roof surface, measured from the highest point where the pipe intersects the roof surface. Where a vent stack pipe terminates on an occupiable roof, the pipe shall extend at least not less than 10 feet (3048 mm) above the roof surface.

> **Exception:** In a building more than three stories in height, the vent stack pipe shall not be required to terminate above the roof surface provided that it terminates through an exterior wall at a point at least not less than 20 feet (6096 mm) above grade and at least not less than 10 feet (3048 mm) in any direction from any operable window, door, or other gravity intake opening into the building.

**425.2.3.7.2 Clearance from other buildings and lots.** Vent terminals shall not be closer than 25 feet (7620 mm), measured horizontally, from any adjacent building or lot line.

**425.2.4. Sealing**. Openings and penetrations shall be sealed in accordance with Sections 425.2.4.1 through 452.2.4.5.

**425.2.4.1 Foundation walls and floors.** Joints, openings and penetrations in foundation walls and floors, that are in contact with the soil shall be sealed by a caulk of not less than Class 25 complying with ASTM C920. Prior to sealing, backer rods shall be used to fill openings greater than ½ inch (12.7 mm) in width.

**425.2.4.1.1 Hollow masonry unit walls.** The top course of hollow block masonry foundation walls shall be made of solid masonry units or the top course shall be fully grouted. The top course under the full width of door and window openings shall be made of solid masonry units or the hollow masonry units shall be fully grouted. Where a brick veneer or other masonry ledge is installed, the course immediately below the ledge shall be made of solid masonry units or the top course shall be fully grouted. Other penetrations through walls shall be sealed.

**425.2.4.2 Floor drains.** Floor drains and condensate drains shall not be open to the soil.

**425.2.4.3 Sump cover**. A solid sump cover, equipped with a seal or gasket, shall be provided for sump installations.

**425.2.4.4 Ductwork.** Where ductwork passes through a crawl space, or through or beneath a slab, all openings and joints shall be seamless or taped or sealed water-tight.

**25.2.4.5. Top floor ceilings.** Openings in top-floor ceilings shall be closed, gasketed or otherwise sealed with materials approved for such applications.

**425.2.5 Provision for depressurization fan**. A section of the vent stack pipe that is located outside of the building or in a non-conditioned space above the basement or crawl space shall be accessible for the future installation of an in-line depressurization fan. Where provided, the fan shall not be mounted in any location where pipe positively pressurized by the fan is located inside of a conditioned or occupiable space.

**425.2.5.1 Accessible fan installation location.** A space having a vertical height of not less than 48 inches (1220 mm) and a diameter of not less than 21 inches (530 mm) shall be provided in the area designated for a depressurization fan.

**425.2.5.2 Electrical connection for fan.** An outlet box for an electrical connection, supplied by a branch circuit ,shall be installed within 6 feet (1829 mm) of the area designated for a depressurization fan.

**425.2.6 Labeling.** Radon vent pipes shall be identifiable and labeled as a component of a radon reduction system at intervals of not less than 10 feet (3048 mm) and not less than once in every room or space. The section of vent pipe above the roof shall have a label that cautions against placement of air intake openings within 10 feet (3048 mm) of the vent pipe discharge.

**Add new standard to Chapter 35 as follows:**

**ASTM**
ASTM E 1745-11 Standard Specification for Plastic Water Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

**Figure 425.1 EPA Map of Radon Zones**

The United States Environmental Protection Agency and the United States Geological Survey have evaluated the radon potential in the United States and developed this map of radon zones. The map assigns each of the 3,141 counties in the United States to one of three zones based on radon potential. Zone 1 areas have a predicted average indoor radon screening level greater than 4 pCi/L (picocuries per liter). Table 425.1 lists the Zone 1 counties illustrated on the map.

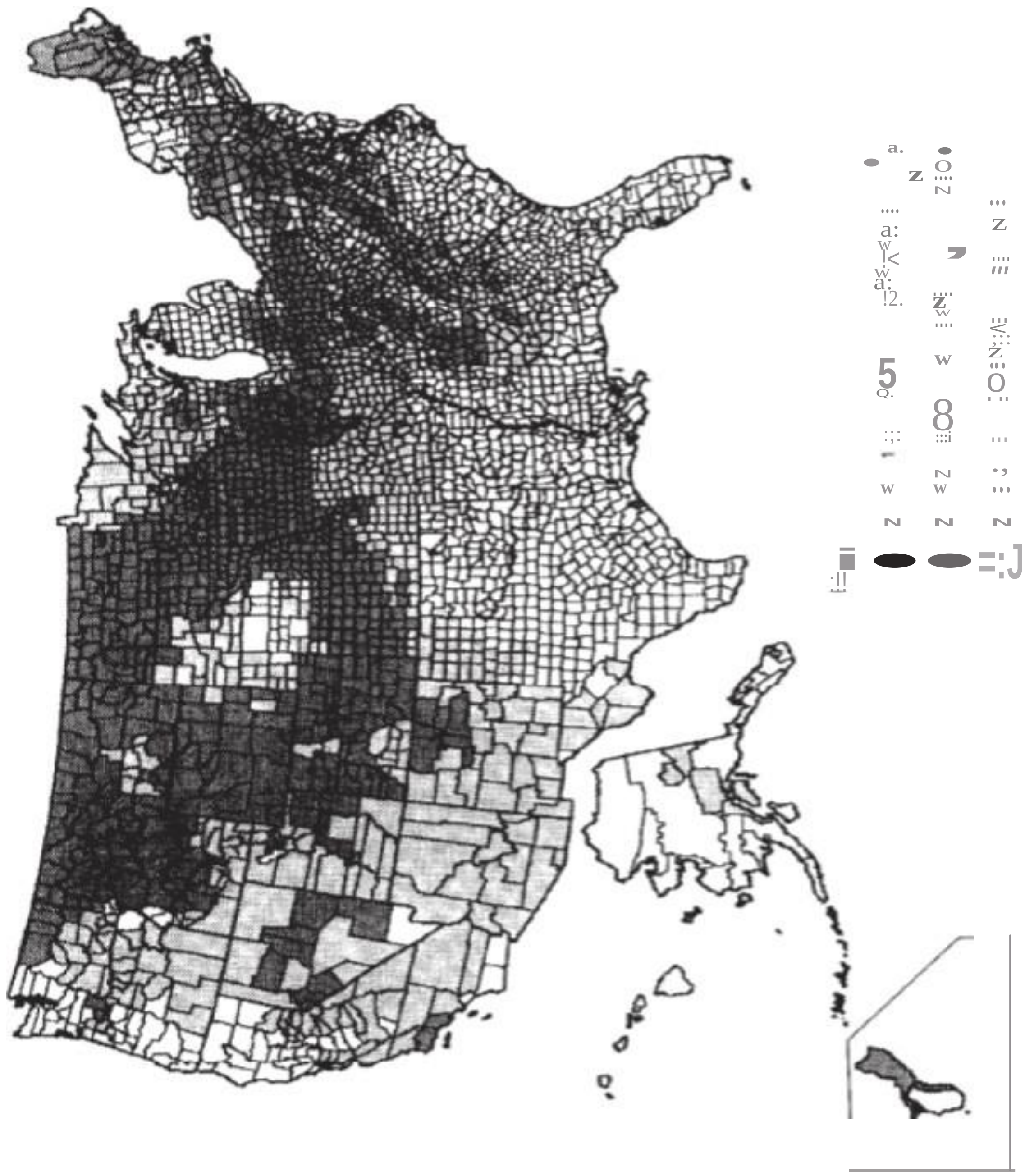


**Table 425.1**
**List of Counties with High Radon Potential (Zone 1)**

**ALABAMA**
Calhoun
Clay
Cleburne
Colbert
Coosa
Franklin
Jackson
Lauderdale
Lawrence
Limestone
Madison
Morgan
Talladega

**CALIFORNIA**
Santa Barbara
Ventura

**COLORADO**
Adams
Arapahoe
Baca
Bent
Boulder
Chaffee
Cheyenne
Clear Creek
Crowley
Custer
Delta
Denver
Dolores
Douglas
El Paso
Elbert
Fremont
Garfield
Gilpin
Grand
Gunnison
Huerfano
Jackson
Jefferson
Kiowa
Kit Carson
Lake
Larimer
Las Animas
Lincoln
Logan
Mesa
Moffat
Montezuma
Montrose
Morgan
Otero
Ouray
Park
Phillips
Pitkin
Prowers
Pueblo
Rio Blanco
San Miguel
Summit
Teller
Washington
Weld
Yuma

**CONNECTICUT**
Fairfield
Middlesex
New Haven
New London

**GEORGIA**
Cobb
De Kalb
Fulton
Gwinnett

**IDAHO**
Benewah
Blaine
Boise
Bonner
Boundary
Butte
Camas
Clark
Clearwater
Custer
Elmore
Fremont
Gooding
Idaho
Kootenai
Latah
Lemhi
Shoshone
Valley

**ILLINOIS**
Adams
Boone
Brown
Bueau
Calhoun
Carroll
Cass
Champaign
Coles
De Kalb
De Witt
Douglas
Edgar
Ford
Fulton
Greene
Grundy
Hancock
Henderson
Henry
Iroquois
Jerse
Jo Daviess
Kane
Kendall
Knox
La Salle
Lee
Livingston
Logan
Macon
Marshall
Mason
McDonough
McLean
Menard
Mercer
Morgan
Moultrie
Ogle
Peoria
Piatt
Pike
Putnam
Rock Island
Sangamon
Schuyler
Scott
Stark
Stephenson
Tazewell
Vermilion
Warren
Whiteside
Winnebago
Woodford

**INDIANA**
Adams
Allen
Bartholomew
Benton
Blackford
Boone
Carroll
Cass
Clark
Clinton
De Kalb
Decatur
Delaware
Elkhart
Fayette
Fountain
Fulton
Grant
Hamilton
Hancock
Harrison
Hendricks
Henry
Howard
Huntington
Jay
Jennings
Johnson
Kosciusko
Lagrange
Lawrence
Madison
Marion
Marshall
Miami
Monroe
Montgomery
Noble
Orange
Putnam
Randolph
Rush
Scott
Shelby
Steuben
St. Joseph
Tippecanoe
Tipton
Union
Vermillion
Wabash
Warren
Washington
Wayne
Wells
White
Whitley

**IOWA**
All Counties

**KANSAS**
Atchison
Barton
Brown
Cheyenne
Clay
Cloud
Decatur
Dickinson
Douglas
Ellis
Ellsworth
Finney
Ford
Geary
Gove
Graham
Grant
Gray
Greeley
Hamilton
Haskell
Hodgeman
Jackson
Jewell
Johnson
Keary
Kingman
Kiowa
Lane
Leavenworth
Lincoln
Logan
Marion
Marshall
McPherson
Meade
Mitchell
Nemaha
Ness
Norton
Osborne
Ottawa
Pawnee
Phillips
Pottawatomie
Pratt
Rawlins
Republic
Rice
Riley
Rooks
Rush
Russell
Saline
Scott
Sheridan
Sherman
Smith
Stanton
Thomas
Trego
Wallace
Washington
Wichita
Wyandotte

**KENTUCKY**
Adair
Allen
Barren
Bourbon
Boyle
Bullitt
Casey
Clark
Cumberland
Fayette
Franklin
Green
Harrison
Hart
Jefferson
Jessamine
Lincoln
Marion
Mercer
Metcalfe
Monroe
Nelson
Pendleton
Pulaski
Robertson
Russell
Scott
Taylor
Warren
Woodford

**MAINE**
Androscoggin
Aroostook
Cumberland
Franklin
Hancock
Kennebec
Lincoln
Oxford
Penobscot
Piscataquis
Somerset
York

**MARYLAND**
Baltimore
Calvert
Carroll
Frederick
Harford
Howard
Montgomery
Washington

**MASS.**
Essex
Middlesex
Worcester

**MICHIGAN**
Branch
Calhoun
Cass
Hillsdale
Jackson
Kalamazoo
Lenawee
St. Joseph
Washtenaw

**MINNESOTA**
Becker
Big Stone
Blue Earth
Brown
Carver
Chippewa
Clay
Cottonwood
Dakota
Dodge
Douglas
Faribault
Fillmore
Freeborn
Goodhue
Grant
Hennepin
Houston
Hubbard
Jackson
Kanabec
Kandiyohi
Kittson
Lac Qui Parle
Le Sueur
Lincoln
Lyon
Mahnomen
Marshall
Martin
McLeod
Meeker
Mower
Murray
Nicollet
Nobles
Norman
Olmsted
Otter Tail
Pennington
Pipestone
Polk
Pope
Ramsey
Red Lake
Redwood
Renville
Rice
Rock
Roseau
Scott
Sherburne
Sibley
Stearns
Steele
Stevens
Swift
Todd
Traverse
Wabasha
Wadena
Waseca
Washington
Watonwan
Wilkin
Winona
Wright
Yellow Medicine

**MISSOURI**
Andrew
Atchison
Buchanan
Cass
Clay
Clinton
Holt
Iron
Jackson
Nodaway
Platte

**MONTANA**
Beaverhead
Big Horn
Blaine
Broadwater
Carbon
Carter
Cascade
Chouteau
Custer
Daniels
Dawson
Deer Lodge
Fallon
Fergus
Flathead
Gallatin
Garfield
Glacier
Granite
Hill
Jefferson
Judith Basin
Lake
Lewis and Clark
Liberty
Lincoln
Madison
McCone
Meagher
Mineral
Missoula
Park
Phillips
Pondera
Powder River
Powell
Prairie
Ravalli
Richland
Roosevelt
Rosebud
Sanders
Sheridan
Silver Bow
Stillwater
Teton
Toole
Valley
Wibaux

## Table 425.1 (continued)
## List of US Counties with High Radon Potential (Zone 1)

Yellowstone National Park

**NEBRASKA**
Adams
Boone
Boyd
Burt
Butler
Cass
Cedar
Clay
Colfax
Cuming
Dakota
Dixon
Dodge
Douglas
Fillmore
Franklin
Frontier
Furnas
Gage
Gosper
Greeley
Hamilton
Harlan
Hayes
Hitchcock
Hurston
Jefferson
Johnson
Kearney
Knox
Lancaster
Madison
Nance
Nemaha
Nuckolls
Otoe
Pawnee
Phelps
Pierce
Platte
Polk
Red Willow
Richardson
Saline
Sarpy
Saunders
Seward
Stanton
Thayer
Washington
Wayne
Webster
York

**NEVADA**
Carson City
Douglas
Eureka
Lander
Lincoln
Lyon
Mineral
Pershing
White Pine

**NEW HAMPSHIRE**
Carroll

**NEW JERSEY**
Hunterdon
Mercer
Monmouth
Morris
Somerset
Sussex
Warren

**NEW MEXICO**
Bernalillo
Colfax
Mora
Rio Arriba
San Miguel
Santa Fe
Taos

**NEW YORK**
Albany
Allegany
Broome
Cattaraugus
Cayuga
Chautauqua
Chemung
Chenango
Columbia
Cortland
Delaware
Dutchess
Erie
Genesee
Greene
Livingston
Madison
Onondaga
Ontario
Orange
Otsego
Putnam
Rensselaer
Schoharie
Schuyler
Seneca
Steuben
Sullivan
Tioga
Tompkins
Ulster
Washington
Wyoming
Yates

**N. CAROLINA**
Alleghany
Buncombe
Cherokee
Henderson
Mitchell
Rockingham
Transylvania
Watauga

**N. DAKOTA**
All Counties

**OHIO**
Adams
Allen
Ashland
Auglaize
Belmont
Butler
Carroll
Champaign
Clark
Clinton
Columbiana
Coshocton
Crawford
Darke
Delaware
Fairfield
Fayette
Franklin
Greene
Guernsey
Hamilton
Hancock
Hardin
Harrison
Holmes
Huron
Jefferson
Knox
Licking
Logan
Madison
Marion
Mercer
Miami
Montgomery
Morrow
Muskingum
Perry
Pickaway
Pike
Preble
Richland
Ross
Seneca
Shelby
Stark
Summit
Tuscarawas
Union
Van Wert
Warren
Wayne
Wyandot

**PENNSYLVANIA**
Adams
Allegheny
Armstrong
Beaver
Bedford
Berks
Blair
Bradford
Bucks
Butler
Cameron
Carbon
Centre
Chester
Clarion
Clearfield
Clinton
Columbia
Cumberland
Dauphin
Delaware
Franklin
Fulton
Huntingdon
Indiana
Juniata
Lackawanna
Lancaster
Lebanon
Lehigh
Luzerne
Lycoming
Mifflin
Monroe
Montgomery
Montour
Northampton
Northumberland
Perry
Schuylkill
Snyder
Sullivan
Susquehanna
Tioga
Union
Venango
Westmoreland
Wyoming
York

**RHODE ISLAND**
Kent
Washington

**S. CAROLINA**
Greenville

**S. DAKOTA**
Aurora
Beadle
Bon Homme
Brookings
Brown
Brule
Buffalo
Campbell
Charles Mix
Clark
Clay
Codington
Corson
Davison
Day
Deuel
Douglas
Edmunds
Faulk
Grant
Hamlin
Hand
Hanson
Hughes
Hutchinson
Hyde
Jerauld
Kingsbury
Lake
Lincoln
Lyman
Marshall
McCook
McPherson
Miner
Minnehaha
Moody
Perkins
Potter
Roberts
Sanborn
Spink
Stanley
Sully
Turner
Union
Walworth
Yankton

**TENNESSEE**
Anderson
Bedford
Blount
Bradley
Claiborne
Davidson
Giles
Grainger
Greene
Hamblen
Hancock
Hawkins
Hickman
Humphreys
Jackson
Jefferson
Knox
Lawrence
Lewis
Lincoln
Loudon
Marshall
Maury
McMinn
Meigs
Monroe
Moore
Perry
Roane
Rutherford
Smith
Sullivan
Trousdale
Union
Washington
Wayne
Williamson
Wilson

**UTAH**
Carbon
Duchesne
Grand
Piute
Sanpete
Sevier
Uintah

**VIRGINIA**
Alleghany
Amelia
Appomattox
Augusta
Bath
Bland
Botetourt
Bristol
Brunswick
Buckingham
Buena Vista
Campbell
Chesterfield
Clarke
Clifton Forge
Covington
Craig
Cumberland
Danville
Dinwiddie
Fairfax
Falls Church
Fluvanna
Frederick
Fredericksburg
Giles
Goochland
Harrisonburg
Henry
Highland
Lee
Lexington
Louisa
Martinsville
Montgomery
Nottoway
Orange
Page
Patrick
Pittsylvania
Powhatan
Pulaski
Radford
Roanoke
Rockbridge
Rockingham
Russell
Salem
Scott
Shenandoah
Smyth
Spotsylvania
Stafford
Staunton
Tazewell
Warren
Washington
Waynesboro
Winchester
Wythe

**WASHINGTON**
Clark
Ferry
Okanogan
Pend Oreille
Skamania
Spokane
Stevens

**W. VIRGINIA**
Berkeley
Brooke
Grant
Greenbrier
Hampshire
Hancock
Hardy
Jefferson
Marshall
Mercer
Mineral
Monongalia
Monroe
Morgan
Ohio
Pendleton
Pocahontas
Preston
Summers
Wetzel

**WISCONSIN**
Buffalo
Crawford
Dane
Dodge
Door
Fond du Lac
Grant
Green
Green Lake
Iowa
Jefferson
Lafayette
Langlade
Marathon
Menominee
Pepin
Pierce
Portage
Richland
Rock
Shawano
St. Croix
Vernon
Walworth
Washington
Waukesha
Waupaca
Wood

**WYOMING**
Albany
Big Horn
Campbell
Carbon
Converse
Crook
Fremont
Goshen
Hot Springs
Johnson
Laramie
Lincoln
Natrona
Niobrara
Park
Sheridan
Sublette
Sweetwater
Teton
Uinta
Washakie

**Commenter's Reason:** This modification is presented as a substitute for this code change proposal. It is not entirely new, rather it is the original with several modifications. It is more readily understood without strikethrough. The proposed language addresses the IBC Committee's reasons for declining the proposal as follows:

(1) "There was still concern on the need for such provisions, and it was felt that perhaps an appendix would be a better location for the requirements." Response: This extremely modest approach to reduce radon exposure risk in only buildings in the highest risk localities belongs in the body of the code. Radon is a life, safety issue and is responsible for 21,000 lung cancer deaths each year. The public deserves radon protection in high risk areas.

(2) "The map should be placed within the provisions versus simply referencing the IRC." Response: The EPA Radon Map and county list are included in the proposal as modified, and we have added a provision allowing the code official to approve the use of state and local data to supersede the older EPA information.

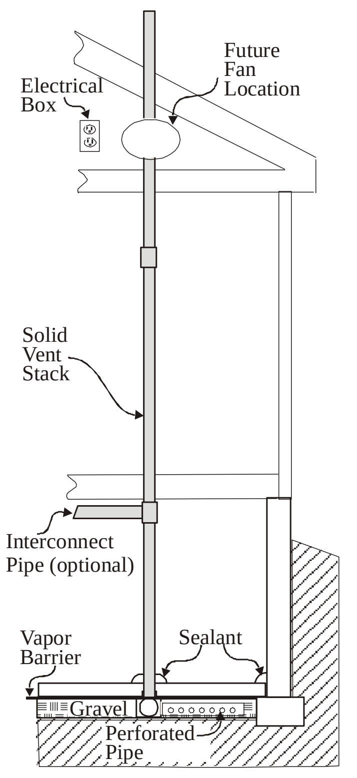
(3) "The presentation of the requirements could be simplified." Response: The requirements have gone through extensive editing and review to deliver this modified version. Text has been converted to code language and ambiguous terminology has been deleted. The section on sealing has been streamlined. The most complex section pertaining to piping has been broken down into distinct elements such as pipe dimensions, pipe support, coverage areas, interconnected coverage areas, and suction points.

During the IBC hearing, arguments were raised that are addressed briefly here:

- *Data is old:* The earth is old and progeny of radium have been finding their way into structures for a long time. The EPA maps from 1993 have withstood the test of time in the sense that they have provided a solid baseline of information for counties. New York, New Jersey, Nebraska, and other states collected additional data that have identified additional high risk counties beyond those that the EPA maps indicate. Some have compiled radon data below the county level to the zip code and municipal levels. This comment adds a provision to permit approval of the use of state and local data to supersede the EPA map and list.
- *Building tightness:* As buildings have become more tight to improve energy efficiency, the risk of radon entry into the building has grown.
- *Relation to other sections of the code:* These provisions complement but do not conflict with other segments of the building code.
- *Multiple proposals for different occupancies:* The proposals for G99 and G100, as revised by the comments, are the same. They could be combined in a single new section 425 covering both occupancies.

For reference, the figure below shows an example of how the radon-reducing features are installed.

Figure 425-1




**G100-12**

Final Action: AS AM AMPC____ D