DRAFT

Model Code

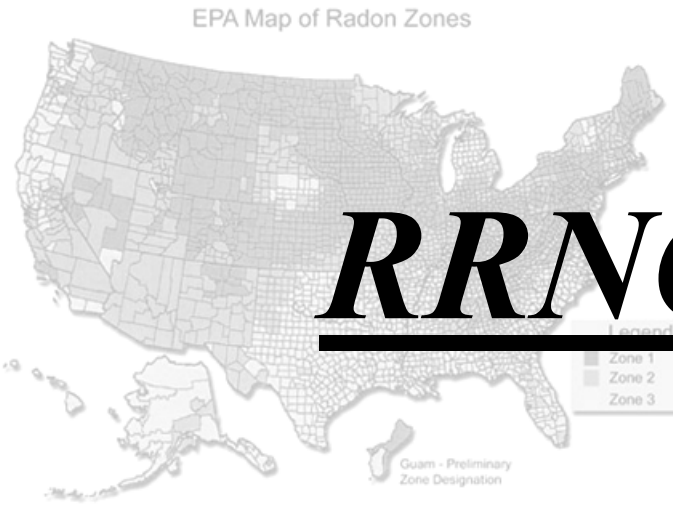
AARST CONSORTIUM
On National Radon Standards

Approved American National Standard
ANSI

RRNC 2.0

Reducing Radon In New Construction
of 1&2 Family Dwellings and Townhouses

CCAH - 2012



RRNC 2.0

FINAL DRAFT FOR 3rd PUBLIC REVIEW

Original Title: "Model Building Code for Radon-Reducing Features in New Construction of 1 & 2 Family Dwellings" **Following is the Radon in New Construction subcommittee's working title:**

"Reducing Radon in New Construction of 1 & 2 Family Dwellings and Townhouses. - Draft 11/16/11"

Designation of proposed standard: CCAH

PLEASE RETURN COMPLETED FORM(S) BY: January 31, 2012

REQUESTED PROCESS AND FORM FOR FORMAL PUBLIC REVIEW COMMENTS

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COMMENT DEADLINE: January 31, 2012.

Submittals *(MS Word preferred) may be attached by email to standards@aarst.org or submitted in paper form by fax to (913) 780-2090*

1*) Do not submit marked-up or highlighted copies of the entire document.*

2*) If a new provision is proposed, text of the proposed provision must be submitted in writing. If modification of a provision is proposed, the proposed text must be submitted utilizing the strikeout/underline format.*

3*) For substantiating statements: Be brief. Provide abstract of lengthy substantiation. (If appropriate, full text may be enclosed for project committee reference*

REQUESTED FORMAT

Title of Public Review Draft: Reducing Radon In New Construction of 1 & 2 Family Dwellings and Townhouses. – *Draft 11-16-11*

[Model Building Code for Radon-Reducing Features in New Construction of 1 & 2 Family Dwellings]

• **Name:** Affiliation:

• **Clause or Subclause**:

• **Comment/Recommendation**:

• **Substantiating Statements**:

• [___] Check here if your comment is supportive in nature and does not require substantive changes in the current proposal in order to resolve your comment.

Repeat the five bullet items above for each comment.

Requested registration of your contact information and copyright release.

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Rev. 06-01-2008

This document has been peer reviewed in workgroup forum, informal public review and with balanced representation of stakeholder groups yet has NOT at this time been approved by the consortium procedures of AARST Consortium on National Radon Standards.

Keywords

RRNC, Radon Gas, Radon Mitigation, Radon Reduction, Radon Removal, New Construction, Active Subslab Depressurization, ASD, Healthy Homes, Green Building, Vapor Intrusion, Soil Gas, Indoor Air Quality, IAQ, Energy Star IAP, Indoor Air Package, LEED

Metric Conversions

Conversions from English-American measurement units to the International System of Units (SI) are rendered herein with literal conversion. The conversions are not always provided in informational text or tables. It is acknowledged that rounding off to a similar numeric conversion is common (i.e. 4.0 pCi/L rounded to 150 Bq/m^3 rather than literal conversion to 148 Bq/m^3) for locations where the International System of Units (SI) are used in standard practice. Conversions should apply as commonly used in such locations or jurisdictions.

Consensus Process

The consortium consensus processes developed for the AARST Consortium on National Radon Standards and as accredited to meet essential requirements for American National Standards by the American National Standards Institute (ANSI) have been applied throughout the process of approving this document. This Standard is to be reviewed and updated every five years at a minimum.

Notice regarding unresolved objections: While each committee seeks to resolve objections, please notify the committee responsible for an action or inaction if you desire to re-circulate any unresolved objections to the committee for further consideration.

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ACKNOWLEDGEMENTS

RRNC 2.0: *"Reducing Radon in New Construction of 1 & 2 Family Dwellings and Townhouses"* is an AARST Consortium National Radon Standard developed to further radon risk reduction in the United States by providing a model building code to achieve indoor radon concentrations of less than 4 pCi/L [150 Bq/m^3] in new homes. RRNC 2.0 is a "code ready" standard that provides a significant improvement over the IRC Appendix F "*Radon Control Methods*". This standard has been peer reviewed and adopted by the AARST Standards Consortium Committee and was approved by the committee for release for ANSI required public comment on November 10, 2011. This standard was developed through the efforts of an AARST Standards Consortium Committee, representing a broad cross-section of radon and building professionals; consisting of the following people, et al:

Chair – (non voting)
Dave Kapturowski (MA)

Educators
Bill Angell (MN) alternate - Jack Hughes (GA)

Regulated States
Matt Shields (PA) alternate - Patrick Daniels (IL)

Unregulated States
Josh Miller (MN)

Private Proficiency Programs
Bruce Snead (KS) alternate – Shawn Price (NC)

Mitigation Professionals
Dan West - (OH) alternate - Tom Thies – (NM)

Measurement Professionals
Julie Somis - (MD) alternate - Tom Getchman, Sr. – (MO)

Home Inspection
Kurt Salomon - (UT) alternate - John Cundiff - (OH)

Federal Government
Phil Jalbert - (USEPA) alternate - David Wilson – (DOE)

Mitigation Manufacturers
Dave Hill - (MA)

Consumer Advocates
Jane Malone – (NCHH)

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Andrew E Harris – (CO) alternate - Steve Tucker – (OR)

Architects
Jacques Sirvain - (MD) alternate – Tim Pitman – (SC)

Code Officials
Gregg Gress - (ICC) alternate - Matt Koch – (GA)

Public Health NGO
Kevin Stewart – (ALA) alternate – Bill Field - (UIOWA)

ASTM Liaison – (non voting)
Bill Brodhead – (PA)

AARST Consortium – (non voting)
Gary Hodgden – (KS)

INTRODUCTION

This Introduction provides an overview to the reader and user but is not intended to be promulgated as a part of any model code.

i. General.

Radon is a colorless, odorless radioactive gas present in the soils in varying amounts throughout the United States. According to the United States Environmental Protection Agency (EPA), radon gas is a "Group A" carcinogen and it is estimated that 21,000 deaths each year are attributable to radon-induced lung cancer in the United States. The National Action Level is currently defined by the EPA as a radon gas concentration of 4.0 picoCuries per liter (pCi/L) [150 Becquerels per cubic meter (Bq/m^3)]. The World Health Organization (WHO) has established a reference level of 2.7 pCi/L [100 Bq/m^3]. The EPA and the WHO recommend reducing exposure to radon gas when indoor concentrations exceed their respective guidance. The USEPA recommends that you consider fixing a home when the radon level is between 2 pCi/L and 4 pCi/L. Reducing exposure in a dwelling is most often accomplished by installing radon control means to minimize radon entry into the building. Active Soil Depressurization (ASD) systems have been shown to be effective in reducing indoor radon concentrations. The EPA recognizes ASD as the Best Available Technology for radon control. ASD systems operate with an active fan to collect and evacuate radon and other soil gases from beneath the dwelling to control gas entry into the home. (See Appendix B)

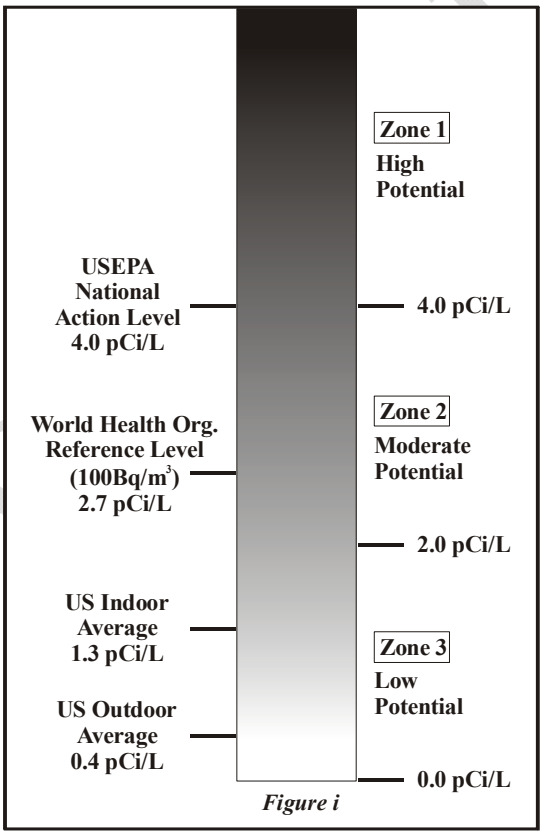

Figure i

ii. Radon Zone Designations.

The EPA has established radon Zones 1, 2 & 3 throughout the country to provide an estimate of the radon potential in any given county. **NOTE: Elevated radon levels have been found in every zone.**

***For radon potential maps and other radon information, see**:*

EPA Website:	*www.epa.gov/radon/zonemap*
State Radon Offices:	*www.epa.gov/radon/whereyoulive*

TABLE OF CONTENTS

RRNC 2.0: Reducing Radon In New Construction of 1 & 2 Family Dwellings and Townhouses.

SECTION 101
GENERAL

101.1 Purpose. The purposes of this standard shall be as follows:

1) To specify radon control methods and techniques for use in dwelling units to reduce indoor radon concentrations to below the National Action Level (NAL) of 4 pCi/L [150 Bq/m^3].

2) To provide minimum requirements for Rough-In of a Mitigation System and Activation of the Mitigation System, if required, in newly constructed dwelling units.

3) To provide a model set of requirements for adoption by states and local jurisdictions.

4) To provide a means for authorized personnel to inspect and evaluate a Mitigation System in new construction.

101.2. Scope. This standard shall be applicable only to newly constructed one- and two-family dwellings and townhouses.

SECTION 102
LIMITATIONS

102.1 General. The requirements of this standard shall have limitations as indicated in Sections 102.1.1 through 102.1.6.

102.1.1 Results not guaranteed. The application of the requirements of this standard does not guarantee that the NAL or any other specific indoor radon concentration will be attained.

102.1.2 Alterations. The application of the requirements of this standard does not guarantee that the NAL or any other specific indoor radon concentration will be maintained where modifications, alterations, structural changes or additions to a dwelling occur.

102.1.3 ASD control. The specifications within this standard are limited to the Active Soil Depressurization (ASD) means for radon mitigation.

102.1.4 Soil-borne radon. The requirements of this standard address only soil-borne radon. Radon from other sources such as water and building materials are not addressed.

102.1.5 Prior systems. This standard shall not apply to radon control means that have been installed prior to the effective date of this standard.

102.1.6 Soil Testing. This standard does not require or provide guidance for soil testing or analyzing the radon potential of a building site prior to construction of the building.

SECTION 201
DEFINITONS

201.1 Definitions. Terms not defined herein shall have their ordinary meaning within the context of their use. Ordinary meaning shall be defined in "Webster's Ninth New Collegiate Dictionary."

ACCESS (limited). Point of entry to fan location that allows service personnel to reach an ASD fan or intended fan location for the purpose of installing or replacing an ASD fan. Such access does not require walkways, service platforms, level working spaces, receptacle and lighting outlets or clear and unobstructed passageways with continuous solid flooring such as are typically required for appliances that require periodic maintenance, servicing and inspection.

ACTIVE SOIL DEPRESSURIZATION (ASD). A family of radon mitigation systems involving fan-powered soil depressurization, including but not limited to sub-slab depressurization and sub-membrane depressurization.

ASD FAN. A particular type of fan that is designed and rated by the manufacturer for continuous duty and for use in an ASD system.

BECQUERELS PER CUBIC METER [Bq/m^3]. A unit of measure for the amount of radioactivity in one cubic meter of air. CONVERSION: 1 Bq/m^3 equals 0.027 picoCuries per liter (pCi/L).

CERTIFIED. A designation applied to individuals or companies that have met qualification requirements or are authorized by the state to provide radon laboratory, measurement or mitigation services. Programs providing national certifications for radon laboratories, measurement and mitigation professionals are those of the National Environmental Health Association - National Radon Proficiency Program (NEHA-NRPP) and the National Radon Safety Board (NRSB). Also see LICENSED.

CHECK VALVE. A mechanical device that will allow water to flow in one direction while preventing airflow in the opposite direction.

CUBIC FEET PER MINUTE (CFM). A measure of the flow rate of a fluid, such as air. CONVERSION: 1 cfm = 1.699 cubic meters / hour [m^3/hr].

COMBINATION FOUNDATIONS. Buildings constructed with more than one foundation type, e.g., basement/crawlspace or basement/slab-on-grade.

COMMUNICATION TEST. A diagnostic test, also referred to as a Pressure Field Extension test, that evaluates the potential effectiveness of a sub-slab system by using a vacuum cleaner or other fan or vacuum device to draw air from the space below a slab and then measuring the change in pressure at various small test holes through the slab or membrane in a crawlspace using a micro-manometer or heatless smoke.

CRAWL SPACE. A foundation type with an open area beneath the livable space of a dwelling that typically has either a concrete slab or earthen floor. The crawl space can have an open height of a few inches to several feet. The crawl space may or may not be ventilated to the outdoors.

CUBIC METERS PER HOUR [m^3/hr]. A measure of the flow rate of a fluid, such as air. CONVERSION: 1 cubic meter / hour = 0.589 cfm.

DEPRESSURIZATION. A negative pressure induced in one area relative to another.

DIAGNOSTIC TESTS. Procedures, including Communication Tests and other tests, used to identify or characterize conditions under, beside and within buildings that could contribute to radon entry or elevated radon levels or that could provide information regarding the performance of a radon mitigation system.

DWELLING. Any building that contains one or two dwelling units used, intended, or designed to be built, used, rented, leased, let or hired out to be occupied or that are occupied for living purposes.

GEOTEXTILE MATTING. A product suitable for soil contact, that provides a void space laterally through the material to allow air movement. The void space is created through a matrix of woven mesh, "egg crate" support of a fabric enclosure or similar means. Also referred to as "Vent Strip".

GRAVEL. An unconsolidated mixture of crushed rock or naturally occurring pebbles. Commercially, it is classified according to the size of the particles.

INCHES OF WATER COLUMN ("WC). A measure of pressure. CONVERSION: 1 "WC = 248.8 Pascals.

KARST. An area of irregular limestone in which erosion has produced fissures, sinkholes, underground streams, and caverns.

LICENSED. A designation applied to individuals and/or companies that are qualified and specifically authorized as radon laboratories, measurement and/or mitigation professionals within certain states or jurisdictions that regulate radon services. Also see CERTIFIED.

MIL. - 1mil=1/1000 of an inch = 0.0254 millimeters.

MITIGATOR. A certified/licensed individual who designs, installs or directly supervises the installation of the radon ASD mitigation systems.

MITIGATION SYSTEM. Any system or steps designed to reduce radon concentrations in the indoor air of a building.

NATIONAL ACTION LEVEL (NAL). The indoor radon concentration at which mitigation is recommended. The current NAL as determined by the US Environmental Protection Agency is 4 pCi/L [150 Bq/m^3].

OUTDOOR AMBIENT RADON LEVELS. The amount of radon naturally occurring in outdoor air at a locality. The annual US national average outdoor radon level is 0.4 pCi/L [15 Bq/m^3] but local conditions will vary.

PASCAL [Pa]. A measure of pressure. CONVERSION: 1 Pa = 0.004 Inches of Water ("WC).

PICOCURIES PER LITER (pCi/L). A unit of measure for the amount of radioactivity in a liter of air. CONVERSION: 1 pCi/L equals 37 Becquerels per Cubic Meter.

PIPE LOOP. A continuous length of perforated pipe extending around the inside perimeter of the foundation.

PRESSURE FIELD EXTENSION. The distance that a pressure change, created by drawing soil-gas through a suction point, extends outward in a sub-slab gas permeable layer or under a membrane.

RADON. A naturally occurring, chemically inert, radioactive element (Rn-222) which exists as a gas.

ROUGH-IN. The installation of all parts and materials of an ASD 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 are gas permeable layers, soil gas retarders, plenums, membranes, piping, suction points, discharge point and wiring.

SOIL GAS. The gas mixture present in soil, which could contain radon and water vapor.

SOIL GAS COLLECTION PLENUM. A constructed enclosure for collecting radon and other soil gases from under a foundation.

SOIL GAS COLLECTOR. A gas permeable conduit constructed of gravel, perforated pipe or geotextile matting for collecting radon and other soil gases from within a soil gas collection plenum and connecting the plenum to the ASD pipe system.

SOIL GAS RETARDER. A continuous membrane or other comparable material laid over a soil gas plenum or earthen floor area that is used to retard the flow of soil gases into a building.

SUB-MEMBRANE DEPRESSURIZATION. A radon mitigation technique designed to maintain lower air pressure in the space under a soil gas retarder membrane than above it by use of an ASD fan drawing air from beneath the membrane.

SUB-SLAB DEPRESSURIZATION. A radon mitigation technique designed to maintain lower air pressure under a floor slab than above it. An ASD fan is installed in the radon system piping that draws air from below the floor slab.

SUCTION POINT. Location where the soil gas collector is connected to the ASD system piping.

TOWNHOUSE. A single family dwelling unit constructed in a group of three or more attached units where each unit extends from the foundation to the roof and has a yard or public way on at least two sides.

SECTION 301
MITIGATION SYSTEM

301.1 System required. A mitigation system Rough-in shall be installed in dwellings located in radon potential zones 1 and 2 in accordance with Section 302.1. The radon potential zones shall be determined in accordance with Section 1201.1.

> **Exception:** Where the foundation system does not have any enclosed area of soil contact and where prior to occupancy, testing in accordance with Section 1101.1 indicates that the building has a radon level below the National Action Level (NAL).

301.2 Design. The design of radon mitigation systems shall comply with this standard, and for buildings having a total foundation area of greater than 2500 sq. ft. [232 sq. m], shall be performed by a mitigator who is certified/licensed to design such systems. Designs of radon mitigation systems for foundation types other than those specified herein shall be performed by a mitigator who is certified/licensed to design such systems.

301.3 Foundation area. As addressed in this standard, the foundation area shall be calculated from the inside perimeter dimensions of the foundation walls.

SECTION 302
MITIGATION SYSTEM
ROUGH-IN INSTALLATION

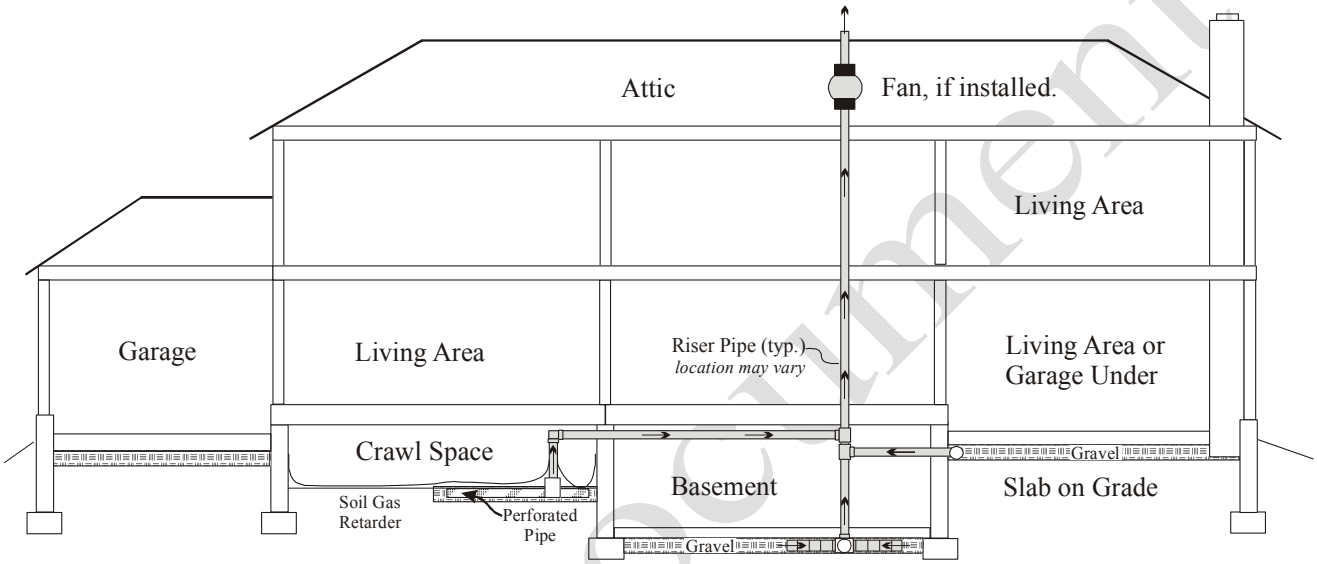

FIGURE 302.1
FOUNDATION TYPES

302.1 Mitigation System Rough-In required. The Rough-in installation of a mitigation system shall be required for all foundations and combination foundations types, including crawl space, basement, slab-on-grade and slab-on-grade garage located below a living area. The installation shall be in accordance with Sections 401.1 through 901.1. Figure 302.1 illustrates the four foundation types.

SECTION 401
SOIL GAS COLLECTION PLENUMS

401.1 Soil gas collection plenums. Foundation areas shall be constructed so as to create sealed soil gas collection plenums in accordance with Sections 402.1 through Sections 404.1.6.

SECTION 402
SUBMEMBRANE SOIL GAS COLLECTION PLENUMS

402.1 Crawl spaces with earthen floors. For each suction point, a soil gas collector shall be installed in accordance with Sections 402.1.1 through 402.1.7 and Section 404.1.

402.1.1 Soil gas collector. One soil gas collector for each suction point (402.1.2) shall be installed in accordance with Section 402.1.1.1, 402.1.1.2 or 402.1.1.3.

402.1.1.1 Pipe soil gas collector. The soil gas collector shall consist of a perforated pipe of 4 inch [10 cm] nominal diameter minimum. The pipe shall be not less than 10 feet [3 m] in length. Such piping shall be placed in a trench backfilled with clean aggregate meeting the criteria of Section 403.1.1.1 such that the pipe is completely surrounded by not less than 4 inches [10 cm] of aggregate.

402.1.1.2 Geotextile soil gas collector. The soil gas collector shall consist of a strip of geotextile drain matting not less than 10 feet [3 m] in length and having a cross sectional area of not less than 12 square inches [77 sq. cm]. The strip of matting shall be placed on top of the soil or in a trench.

402.1.1.3 Gravel soil gas collector. A uniform layer of clean aggregate, not less than 4 inches [10 cm] in depth, shall be placed over the soil. The aggregate shall have a void ratio of not less than 35 percent or shall be in accordance with Size Number 4, 5, 56, or 6 as classified by ASTM C33.

402.1.2 Suction points. One suction point shall be provided for each soil gas collector. Suction points shall be installed in accordance with Section 402.1.2.1, 402.1.2.2 or 402.1.2.3 as applicable for the type of plenum installed.

402.1.2.1 Suction point for pipe soil gas collector. The suction point for a pipe soil gas collector shall consist of a pipe fitting or other device having not less than three openings with two openings oriented so as to create multiple horizontal intake openings. The perforated pipe plenum shall be inserted into both of the horizontal openings of the pipe fitting or device. One opening of the fitting or device shall be oriented in a vertical "up" position.

402.1.2.2 Suction point for geotextile soil gas collector. The suction point for a geotextile soil gas collector shall consist of a pipe fitting or other device having not less three openings with two openings oriented so as to create multiple horizontal intake openings. The horizontal openings shall be connected to the matting in a manner to facilitate airflow from the collector. One opening of the fitting or device shall be oriented in a vertical "up" position.

402.1.2.3 Suction point for gravel soil gas collector. The suction point for a gravel soil gas collector shall consist of a pipe fitting or other device having not less than three openings with two openings oriented so as to create multiple horizontal intake openings. The horizontal openings shall be provided with not less than 5 feet [1.5 m] of perforated pipe, with a minimum of 1 sq. inch [645 sq. mm] of opening per each lineal foot of pipe, extending from each opening of the fitting or device into the gravel layer.

402.1.3 Suction points not permitted. Suction points are not permitted on sump lids

402.1.4 Fasten suction points. Suction point fittings and devices shall be fixed in place to prevent dislocation.

402.1.5 Seal top of the soil gas collection plenum. A soil gas retarder shall cover the top of the soil gas collection plenum and all exposed soil. The installation of the soil gas retarder shall be in accordance with Sections 402.1.5.1 through 402.1.5.4.

402.1.5.1 Sheeting. The soil gas retarder membrane shall meet ASTM E1745 Class A, B or C.

402.1.5.2 Seams. The seams between adjacent membrane sheets shall be overlapped not less than 12 inches [30 cm] and shall be sealed with a caulk complying with ASTM C920 class 25 or greater, or equivalent method.

402.1.5.3 Repairs. Tears or punctures in the membrane shall be sealed by one or more of the following methods:

1. A tape recommended by the membrane manufacturer.

2. An additional sheet of the membrane material that covers and overlaps the tear or puncture not less than 12 inches [30 cm] on all sides and that is sealed with a caulk complying with ASTM C920 class 25 or greater.

3. An equivalent method.

402.1.5.4 Penetrations. Openings in the soil gas retarder membrane for piping, utilities, structural supports or similar penetrations shall be sealed.

402.1.6 Seal sides of the soil gas collection plenum. The soil gas retarder membrane shall turn up onto foundation walls not less than 6 inches [15 cm] and shall be sealed to the wall with a caulk complying with ASTM C920 class 25 or higher or equivalent method.

402.1.7 Label required (membranes). Soil gas retarder membranes shall be marked in a conspicuous place with a label to identify that the membrane is a component of a radon reduction system. The label lettering shall be of a height of not less than 1/4 inch [6.35 mm] and shall be of a color in contrast to the color of the background on which the lettering is applied.

SECTION 403
SUBSLAB SOIL GAS COLLECTION PLENUMS

403.1 Concrete floors. The floors of basement, concrete crawlspace and slab-on-grade foundation systems shall be provided with a soil gas collection plenum installed in accordance with Sections 403.1.1 through 404.1.6.

403.1.1 Soil Gas Collector. A soil gas collector shall be installed in accordance with Section 403.1.1.1, 403.1.1.2 or 403.1.1.3.

403.1.1.1 Gravel. A uniform layer of clean aggregate, not less than 4 inches [10 cm] in depth, shall be placed over the soil. The aggregate shall have a void ratio of not less than 35 percent or shall be in accordance with Size Number 4, 5, 56, or 6 as classified by ASTM C33.

403.1.1.2 Geotextile. A layer of geotextile drainage matting shall be placed over a uniform layer of either soil or sand. The geotextile drainage matting shall be designed to allow the lateral flow of soil gasses to the system's suction point fitting. The geotextile matting shall have a cross-sectional area of not less than 12 square inches [77 sq. cm] and shall be placed, at a minimum, along the entire inside perimeter of the foundation at a distance of 12 inches [30 cm] to 18 inches [46 cm] from the foundation wall to the edge of the drainage matting. Deviation from the 12 inches [30 cm] to 18 inch [46 cm] distance to the foundation wall shall be allowed to avoid obstacles such as plumbing and other utilities.

403.1.1.3 Pipe loop. A loop of 4 inch [10 cm] minimum diameter perforated pipe shall be placed along the entire inside perimeter of the foundation at a distance of 12 inches [30 cm] to 18 inches [46 cm] from the centerline of the pipe to the foundation walls. Such piping shall be placed in a trench backfilled with clean aggregate meeting the criteria of Section 403.1.1.1 and surrounding the pipe on at least 2 sides. The cross-sectional area of the aggregate and pipe soil gas collector shall be at least 50 square inches [323 sq cm]. The piping shall form a continuous loop. Deviation from the 12 inches [30 cm] to 18 inch [46 cm] distance to the foundation wall shall be allowed to avoid obstacles such as plumbing and other utilities.

403.2.2 Suction points. One suction point shall be provided for each soil gas collector. Not less than one suction point shall be provided for each foundation type. Suction points shall be installed in accordance with Section 403.2.2.1, 403.2.2.2 or 403.2.2.3 as applicable for the type of soil gas collector installed.

403.2.2.1 Gravel layer soil gas collector. A suction point for a gravel type soil gas collector shall consist of a pipe fitting or other device having not less than two openings oriented so as to create multiple horizontal intake openings within the gravel layer. The horizontal openings shall be provided with not less than 5 feet [1.5 m] of perforated pipe, with a minimum of 1 sq. inch [645 sq. mm] of opening per each lineal foot of pipe, extending from each opening of the fitting or device into the gravel layer. Suction point openings above the slab shall be protected from the entry of aggregate, concrete and debris.

403.2.2.2 Geotextile layer soil gas collector. A suction point for a geotextile type soil gas collector shall consist of a pipe fitting or other device having not less than three openings with two oriented so as to create multiple horizontal intake openings connected to the geotextile mat in a manner to maintain airflow capacity from the plenum. Suction point openings above the slab shall be protected from the entry of aggregate, concrete and debris.

403.2.2.3 Pipe loop soil gas collector. A suction point for a pipe loop type collector shall consist of a pipe tee fitting or pipe saddle device installed in the loop piping. Suction point openings above the slab shall be protected from the entry of aggregate, concrete and debris.

403.2.3 Multiple soil gas collection plenums. Where interior footings divide a soil gas collector into two or more areas, each such area shall be provided with the required suction points and joined with mitigation system piping in accordance with Section 501. Alternatively, each area so created by the interior footings shall be interconnected by a pipe loop soil gas collector that is constructed in accordance with Section 403.1.1.3 and served by one or more suction points.

403.2.4 Suction points not permitted. Suction points are not permitted on sump lids.

403.2.5 Fasten Suction Points. Suction point fittings and piping shall be fastened in place to prevent dislocation during placement of the gas permeable layer, soil gas retarder and concrete.

403.2.6 Seal top of the soil gas plenum. The soil gas collector and all exposed soil shall be covered with a soil gas retarder installed in accordance with Sections 403.2.6.1.

403.2.6.1 Sheeting. Polyethylene sheeting of not less than 6 mils [0.152 mm] in thickness or cross-laminated polyethylene sheeting of not less than 3 mils [0.076 mm] in thickness shall be installed on top of the soil gas collector and shall completely cover the area under the concrete floor and be sealed in accordance with Sections 403.2.6.1.1 through 404.1.6. Where sheet foam board insulation is installed on top of the soil gas collector, the polyethylene sheeting shall be installed below the foam board insulation.

403.2.6.1.1 Seams. Seams between adjacent polyethylene sheets shall be overlapped not less than 12 inches [30 cm] and sealed with a caulk complying with ASTM C920 class 25 or higher, or equivalent method.

403.2.6.1.2 Repairs. Tears or punctures in the polyethylene sheeting shall be sealed or an additional sheet of polyethylene shall cover the tear or puncture with an overlap of not less than 12 inches [30 cm] on all sides. Such additional sheet shall be sealed and fixed in place to prevent displacement during slab casting.

403.2.6.1.3 Penetrations. Openings in the soil gas retarder membrane for piping, utilities, structural posts and similar penetrations shall be sealed.

403.2.7 Concrete Floors. The concrete floor shall be cast directly upon the soil gas retarder or upon the sheet foam board insulation where it is installed on top of the soil gas retarder.

403.2.8 Penetrations. Penetrations through the concrete slab and soil gas retarder shall be sealed with a caulk complying with ASTM C920 class 25 or higher, or equivalent method.

403.2.9 Block-outs. Where openings are cast or constructed in the concrete slab under plumbing fixtures, the openings shall be filled with expanding foam or a non-shrink grout or other appropriate method. Other openings such as support posts shall be sealed with a non-shrink grout.

403.2.10 Seal sides of the soil gas collection plenum. The intersection of floors and foundation walls shall be sealed with a caulk complying with ASTM C920 class 25 or higher or equivalent method. Sealing shall be performed in accordance with Section 403.2.10.1 or 403.2.10.2 or 403.2.10.3.

403.2.10.1 Seal floor to foundation wall. The intersection of floors and walls shall be sealed.

403.2.10.2 Seal soil gas retarder to footing or wall. Where foundation walls are solid concrete, the soil gas retarder shall be sealed to the footing or to the wall.

403.2.10.3 Seal soil gas retarder to wall. Where foundation walls are masonry block the soil gas retarder shall be sealed to the wall.

SECTION 404
SEALING SOIL GAS COLLECTION PLENUMS

404.1 General sealing of soil gas collection plenums. Sealing of potential soil gas pathways shall be in accordance with Sections 404.1.1 through 404.1.6.

404.1.1 Sumps in floors. Sumps in interior floors shall have a rigid lid and the lid shall be sealed with a gasket or silicone caulk and mechanically fastened in a manner to facilitate removal for maintenance. Pipe and wiring penetrations through the lid shall be sealed. The intersection of the floor and sump basin shall be sealed with a caulk complying with ASTM C920 class 25 or higher or equivalent method.

404.1.2 Hollow masonry unit walls. The top course of hollow block masonry 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 that ledge shall be made of solid masonry units or the top course shall be fully grouted**.** Other penetrations through foundation walls shall be sealed**.**

404.1.3 Floor drains. Floor drains and condensate drains shall not allow soil gas entry.

404.1.4 Air ducts. Air ducts located below concrete slabs shall be sealed and constructed in accordance with the International Residential Code (IRC).

404.1.5 Foundation drains. Gravity foundation drainage systems shall include a trap, check valve or other mechanical means to isolate the soil gas collection plenum from any exterior drain line. Access shall be provided for maintenance.

404.1.6 Access Openings. Access openings in the floor provided for drain maintenance shall not allow soil gas entry.

SECTION 501
MITIGATION SYSTEM PIPING

501.1 Piping. The mitigation system piping that extends from the soil gas plenum to the point of discharge shall be in accordance with Sections 501.2 through 501.10.

501.2 Pipe size. All mitigation system pipe shall be not less than 3 inch [7.6 cm] nominal inside diameter.

501.3 ABS piping. ABS pipe shall comply with ASTM D2661, F628 or F1488. The pipe wall thickness shall be Schedule 40.

501.4 PVC piping. PVC pipe shall comply with ASTM D2665, F891, or F1488. The pipe wall thickness shall be Schedule 40.

Exception: Rigid, non-perforated PVC pipe meeting ASTM D2729 shall be permitted as an alternative to the material specified herein for use vertically within enclosed wall cavities.

501.5 Slope. Above ground piping shall have a slope of not less than 1/8 inch [3.2 mm] per foot [30 cm]. Piping shall slope downwards towards the suction point. Piping arrangements that could allow water to collect are prohibited.

501.6 Joints. Plastic pipe joints shall be solvent welded in accordance with Sections 501.6.1 and 501.6.2. Where disassembly of piping is required such as for removal of a fan, the joints shall be made with flexible couplings complying with ASTM D5926 or ASTM C1173 or equivalent method.

501.6.1 ABS plastic pipe joints. ABS plastic pipe joints shall be solvent welded in accordance with the pipe manufacturer's instructions with solvent cement conforming to ASTM D 2235.

501.6.2 PVC plastic pipe joints. The joint surfaces for PVC plastic pipe and fittings to be solvent welded shall be prepared with a primer conforming to ASTM F 656. PVC plastic pipe joints shall be solvent welded in accordance with the pipe manufacturer's instructions with solvent cement conforming to ASTM D 2564.

501.7 Support. Above ground piping shall be supported by the structure of the building using hangers or strapping designed for piping support. Supports for horizontal piping shall be installed at intervals not exceeding 4 feet [1.2 m] and supports for vertical piping shall be installed at intervals not exceeding 10 feet [3 m].

501.8 Protection against physical damage. Where pipes penetrate top or bottom plates of stud walls and the nearest edge of the hole is within 1 ½ inches [3.8 cm] of the face of the member, the pipe shall be protected by steel shield plates. Such shield plates shall have a thickness of not less than 0.0575 inches [1.463 mm] (No. 16 gage). Such plates shall cover the area of the pipe where the plate is bored, and shall extend not less than 2 inches above bottom plates and not less than 2 inches below top plates.

501.9 Insulation required. In spaces where mitigation system piping is subject to freezing temperatures and in spaces where the exterior of mitigation system piping is subject to the formation of condensation, such piping shall be provided with insulation having an external vapor barrier and an R-value of not less than 1.8.

501.10 Labels required (piping). Mitigation system piping shall be marked with not less than one label at each floor level and at intervals not greater than 10 feet [3 m] along the developed length of the piping. The label shall identify that the item is a component of a radon reduction system. The label lettering shall be of a height of not less than 1/4 inch [6.35 mm] and shall be of a color in contrast to the color of the background on which the lettering is applied.

SECTION 601
MITIGATION SYSTEM TERMINATION

601.1 Outdoors. The discharge point of a mitigation system shall be to the outdoors and shall be directed vertically upward.

601.2 Elevation and vertical walls. The point of discharge of a mitigation system shall comply with all of the following:

1) it shall be not less than 1 foot [30 cm] above the roof at the point penetrated.

2) it shall be not less than 10 feet [3 m] above grade nearest the point of discharge.

3) it shall be not less than 10 feet [3 m] horizontally from a vertical wall that extends above the roof penetrated.

601.3 Windows and doors. The discharge point of a mitigation system shall be not less than 2 feet [60 cm] above or not less than 10 feet [3 m] from windows, doors or other gravity intake openings into the structure or an adjacent structure excluding attic ventilation openings. The 10 foot [3 m] distance shall be measured around intervening obstacles.

601.4 Equipment air intake. The discharge point of a mitigation system shall be not less than 3 feet [91 cm] above or 10 feet [3 m] away from mechanical air intake openings such as those for evaporative coolers, make-up air, and heat/energy recovery ventilators. The ten foot [3 m] distance shall be measured around intervening obstacles.

SECTION 701
ACTIVE SOIL DEPRESSURIZATION (ASD) SYSTEM FAN

701.1 Provision for ASD Fan A 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 area where the ASD fan will be installed if required. The space provided for the ASD fan shall be located according to Section 901.8. The ASD pipe shall be centered in this space.

701.2 Electrical. Branch circuit conductors shall supply a receptacle outlet located within 6 feet [1.8 m] of an interior ASD fan location.

701.2.1 Label. The overcurrent device for the branch circuit supplying the ASD fan shall be labeled to indicate that it supplies the radon fan.

701.2.3 Disconnect required. Where the fan is not cord and plug connected a means of electrical disconnect shall be provided for and in sight of the ASD fan. The electrical disconnect shall be labeled as to its purpose.

701.3 Fan access. Limited access shall be provided for each ASD fan location to allow installation of ASD fans and replacement of same. Access entry shall be located not greater than 20 feet [6 m] from the ASD fan location.

SECTION 801
TEST KIT

801.1 Radon Test Kit required. A minimum of one long term radon-in-air test kit from a certified/licensed laboratory shall be provided for the occupants of each dwelling unit.

SECTION 901
ACTIVE SOIL DEPRESSURIZATION
(ASD) SYSTEM FINISH INSTALLATION

901.1 Completion of ASD system. Prior to occupancy, the ASD system shall be completed and activated in accordance with Sections 901.3 through 1101.1.

Exception: Where prior to occupancy, testing in accordance with Section 1101.1 indicates that the building has a radon level below the National Action Level (NAL) and the rough-in piping is labeled according to Section 901.2.

901.2 Labels Required (System Rough-in). Mitigation system piping shall be marked with not less than one label in a conspicuous location. An additional label shall be placed on or within 12 inches [30 cm] of the electrical service panel. The labels shall identify that the radon system has not been activated with a radon fan and an advisory stating that the building should be tested for radon at least every 2 years or as required or recommended by state or federal agencies. The label lettering shall be of a height of not less than 1/4 inch [6.35 mm] and shall be of a color in contrast to the color of the background on which the lettering is applied.

901.3 Fan selection. Fans installed in the ASD system shall be recommended by the manufacturer for radon mitigation. Such fans shall be designed and sealed by the manufacturer to minimize leakage of water or soil gas from the fan housing and shall be sized in accordance with Table 901.3 or as specified by a certified/licensed radon mitigator.

TABLE 901.3
FAN SIZING[a]

NOMINAL PIPE SIZE (I.D.)	TOTAL FOUNDATION AREA					
	LESS THAN 1600 sq. feet LESS THAN 149 sq. meters		1600 sq ft to 2500 sq. feet 149 sq. m to 232 sq. meters		GREATER THAN 2500 sq ft GREATER THAN 232 sq m.	
	MINIMUM AIRFLOW [(b)] AT RATED STATIC PRESSURE	RATED STATIC PRESSURE [(b)]	MINIMUM AIRFLOW [(b)] AT RATED STATIC PRESSURE	RATED STATIC PRESSURE [(b)]	MINIMUM AIRFLOW [(b)] AT RATED STATIC PRESSURE	RATED STATIC PRESSURE [(b)]
(3 ‘’) [7.6 cm]	(50 cfm) [85 m^3/hr]	(0.5 “WC) [125 Pa]	(75 cfm) [127 m^3/hr]	(1.0 “WC) [250Pa]	To be sized by certified/licensed radon mitigator	
(4 ‘’) [10 cm]	(50 cfm) [85 m^3/hr]	(0.5 “WC) [125 Pa]	(50 cfm) [85 m^3/hr]	(0.5 “WC) [125 Pa]	To be sized by certified/licensed radon mitigator	

a. Additional guidelines for sizing ASD fans and piping can be found in the reference documents in Appendix D
b. Flow and pressure ratings are manufacturer specifications.

901.4 Orientation. ASD inline fans shall be installed only on vertical ASD piping.

901.5 Installation. ASD fans shall be installed in accordance with the manufacturer's instructions.

901.6 Flexible connectors required. ASD fans shall be connected to the ASD piping using flexible unshielded couplings complying with ASTM D5926 or ASTM C1173 or an equivalent method. Connections shall be air and water-tight.

901.7 Fan startup. ASD fans shall be electrically energized upon installation in the ASD system piping.

901.8 Fan Location. ASD fans shall be installed only outdoors, in attics or in garages that are not beneath conditioned spaces. ASD 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 shall not be mounted in any location where pipe positively pressured by the fan is located inside conditioned or occupiable space.

SECTION 1001
SYSTEM MONITORING AND OCCUPANT INFORMATION

1001.1 System Monitor required. Each ASD system shall be provided with a system negative pressure monitor to indicate system operation. The system monitor shall be located indoors in an area where the monitor is readily observable by the occupants.

1001.2 Startup marking. ASD system monitors, such as manometer type pressure gauges, shall be clearly marked to indicate the pressure that existed when the system was initially activated. The monitor device shall have a durable label on or in close proximity to it that describes how to interpret the monitor and what to do if the monitor indicates that system performance has degraded.

1001.3 Automatic reset. Pressure activated electrical ASD system monitors, whether visual or audible, shall be supplied by un-switched electrical circuits and designed to reset automatically when power is restored after power supply failure. Battery operated monitoring devices shall not be used except where they are equipped with a low power warning feature.

1001.4 Labels required (system and sump). System description labels made of durable material shall be placed on or within 12 inches [30 cm] of the electric service panel and also on the ASD system or other prominent location. The lettering on the label shall be not less than 1/4 inch [6.35 mm] in height and shall be of a color in contrast to the color of the background on which the lettering is applied. The label shall state "Radon Reduction System;" the installer's name, phone number, and applicable certification identification; date of installation, an advisory stating that the building should be tested for radon at least every 2 years or as required or recommended by state or federal agencies and shall include notice of additional radon resources at www.epa.gov/radon and the radon hotline 1-800-SOS-RADON.

1001.4.1 Label sump basins. Sump basin covers shall be identified with a durable label that reads "Component of a Radon Reduction System. Do not tamper with or disconnect." or equivalent wording. The lettering on the label shall be not less than 1/4 inch [6.35 mm] in height and shall be of a color in contrast to the color of the background on which the lettering is applied.

1001.5 Documentation Package. The occupants of the dwelling shall be provided with a documentation package that includes the following: 1) A description of system operation, such as shown in Appendix C "Understanding a Radon Reduction System". 2) All radon test data for the property. 3) The annual energy consumption of the installed ASD fan(s), whether estimated or actual, and the projected monetary cost of such energy.

SECTION 1101
RADON TESTING

1101.1 Radon Testing Prior to Occupancy. A radon test shall be performed prior to occupancy and shall be performed by a certified/licensed measurement professional. Testing shall be performed in accordance with applicable state protocols or requirements; or if there are no state protocols or requirements, with accepted Federal protocols or "Protocols for Radon Measurements in Homes", AARST Consortium on National Radon Standards. Where testing results are greater than the NAL, a certified/licensed Mitigator shall be required to perform diagnostic tests, remediation action and radon testing shall be required until radon concentrations below the NAL are achieved.

SECTION 1201
RADON POTENTIAL ZONES

1201.1 EPA established zones. The radon potential of a building site shall be estimated from the United States Environmental Protection Agency radon potential map as shown in Figure 1201.1 or from United States Environmental Protection Agency radon potential by county listing as shown in Table 1201.1. Where state or local jurisdictions have published radon potential data, such data shall supersede the information in Figure 1201.1 and Table 1201.1.

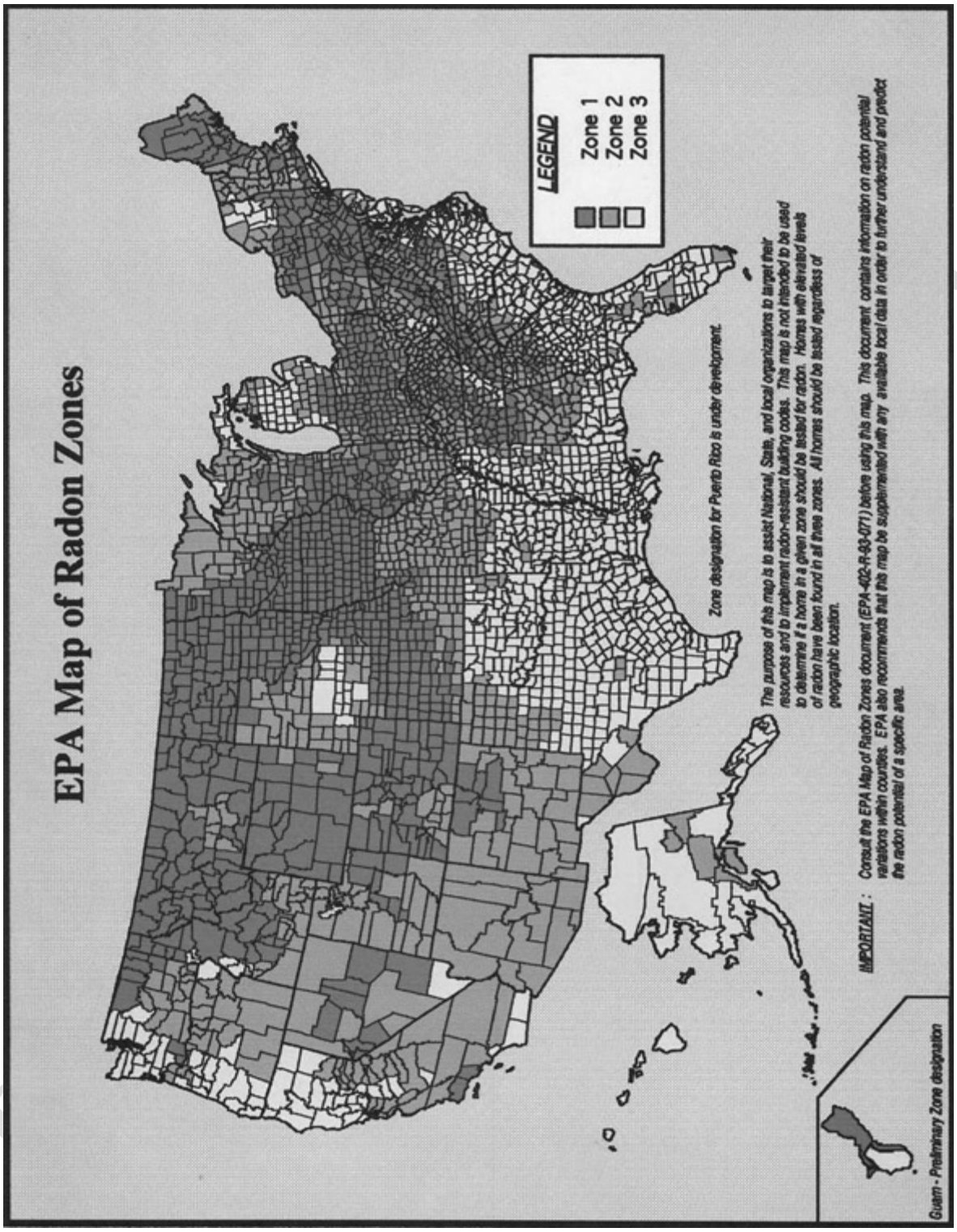

FIGURE 1201.1

RADON POTENTIAL ZONES MAP

TABLE 1201.1 EPA RADON ZONE 1 and 2 COUNTIES BY STATE

Alabama

Zone 1
Calhoun
Clay
Cleburne
Colbert
Coosa
Franklin
Jackson
Lauderdale
Lawrence
Limestone
Madison
Morgan
Talladega

Zone 2
Autauga
Barbour
Bibb
Blount
Bullock
Cherokee
Chilton
Cullman
Dallas
DeKalb
Elmore
Etowah
Fayette
Greene
Hale
Jefferson
Lamar
Lee
Lowndes
Macon
Marion
Marshall
Montgomery
Perry
Pickens
Randolph
Russell
Shelby
St Clair
Sumter
Tuscaloosa
Walker
Winston

Alaska

Zone 2
Anchorage Municipality
Dillingham Census Area
Fairbanks North Star Borough
Kenai Peninsula Borough
Matanuska-Susitna Borough
Southeast Fairbanks Census Area

Arizona

Zone 2
Apache
Cochise
Coconino
Gila
Graham
Greenlee
La Paz
Maricopa
Mohave
Navajo
Pima
Pinal
Santa Cruz
Yavapai
Yuma

Arkansas

Zone 2
Baxter
Benton
Boone
Carroll
Fulton
Garland
Independence
Izard
Marion
Montgomery
Randolph
Searcy
Sharp
Stone

California

Zone 1
Santa Barbara
Ventura

Zone 2
Alameda
Alpine
Amador
Calaveras
Contra Costa
El Dorado
Fresno
Inyo
Kern
Los Angeles
Madera
Mariposa
Mono
Monterey
Nevada
Placer
Plumas
Riverside
San Benito
San Bernardino
San Francisco
San Luis Obispo
San Mateo
Santa Clara
Santa Cruz
Sierra
Tulare
Tuolumne
Yuba

Colorado

Zone 1
Adams
Arapahoe
Baca
Bent
Boulder
Broomfield
Chaffee
Cheyenne
Clear Creek
Crowley
Custer
Delta
Denver
Dolores
Douglas
El Paso
Elbert
Fremont
Garfield
Gilpin
Grand
Gunnison
Huerfano
Jackson
Jefferson
Kiowa
Kit Carson
La Plata
Larimer
Las Animas
Lincoln
Logan
Mesa
Moffat
Montezuma
Montrose
Morgan
Otero
Ouray
Park
Phillips
Pitkin
Prowers
Pueblo
Rio Blanco
San Miguel
Sedgwick
Summit
Teller
Washington
Weld
Yuma

Zone 2
Alamosa
Archuleta
Conejos
Costilla
Eagle
Hinsdale
Lake
Mineral
Rio Grande
Routt
Saguache
San Juan

Connecticut

Zone 1
Fairfield
Middlesex
New Haven
New London

Zone 2
Litchfield
Tolland
Windham

Delaware

Zone 2
New Castle

Florida

Zone 2
Alachua
Citrus
Columbia
Hillsborough
Leon
Marion
Miami-Dade
Polk
Union

Georgia

Zone 1
Cobb
DeKalb
Fulton
Gwinnett

Zone 2
Banks
Barrow
Bartow
Butts
Carroll
Catoosa
Cherokee
Clarke
Clayton
Coweta
Dawson
Douglas
Elbert
Fannin
Fayette
Floyd
Forsyth
Franklin
Gilmer
Greene
Habersham
Hall
Haralson
Harris
Hart
Heard
Henry
Jackson
Jasper
Lamar
Lumpkin
Madison
Meriwether
Monroe
Morgan
Newton
Oconee
Oglethorpe
Paulding
Pickens
Pike
Rabun
Richmond
Rockdale
Spalding
Stephens
Talbot
Towns
Troup
Union
Upson
Walker
Walton
White
Whitfield

Hawaii

------None-----

Idaho

Zone 1
Benewah
Blaine
Boise
Bonner
Boundary
Butte
Camas
Clark
Clearwater
Custer
Elmore
Fremont
Gooding
Idaho
Kootenai
Latah
Lemhi
Shoshone
Valley

Zone 2
Ada
Bannock
Bear Lake
Bingham
Bonneville
Canyon
Caribou
Cassia
Franklin
Jefferson
Jerome
Lincoln
Madison
Minidoka
Oneida
Owyhee
Payette
Power
Teton
Twin Falls

Illinois

Zone 1
Adams
Boone
Brown
Bureau
Calhoun
Carroll
Cass
Champaign
Coles
De Witt
DeKalb
Douglas
Edgar
Ford
Fulton
Greene
Grundy
Hancock
Henderson
Henry
Iroquois
Jersey
Jo Daviess
Kane
Kendall
Knox
LaSalle
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

Zone 2
Bond
Christian
Clark
Clay
Clinton
Cook
Crawford
Cumberland
DuPage
Edwards
Effingham
Fayette
Franklin
Gallatin
Hamilton
Hardin
Jackson
Jasper
Jefferson
Johnson
Kankakee
Lake
Lawrence
Macoupin
Madison
Marion
McHenry
Monroe
Montgomery
Perry
Pope
Randolph
Richland
Saline
Shelby
St Clair
Union
Wabash
Washington
Wayne
White
Will
Williamson

Indiana

Zone 1
Adams
Allen
Bartholomew
Benton
Blackford
Boone
Carroll
Cass
Clark
Clinton
Decatur
DeKalb
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
St Joseph
Steuben
Tippecanoe
Tipton
Union
Vermillion
Wabash
Warren
Washington
Wayne
Wells
White
Whitley

Zone 2
Brown
Clay
Crawford
Daviess
Dearborn
Dubois
Floyd
Franklin
Gibson
Greene
Jackson
Jasper
Jefferson
Knox
Lake
LaPorte
Martin
Morgan
Newton
Ohio
Owen
Parke
Perry
Pike
Porter
Posey
Pulaski
Ripley
Spencer
Starke
Sullivan
Switzerland
Vanderburgh
Vigo
Warrick

Iowa

Zone 1
Adair
Adams
Allamakee
Appanoose
Audubon
Benton
Black Hawk
Boone
Bremer
Buchanan
Buena Vista
Butler
Calhoun
Carroll
Cass
Cedar
Cerro Gordo
Cherokee
Chickasaw
Clarke
Clay
Clayton
Clinton
Crawford
Dallas
Davis
Decatur
Delaware
Des Moines
Dickinson
Dubuque
Emmet
Fayette
Floyd
Franklin
Fremont
Greene
Grundy
Guthrie
Hamilton
Hancock
Hardin
Harrison
Henry
Howard
Humboldt
Ida
Iowa
Jackson
Jasper
Jefferson
Johnson
Jones
Keokuk
Kossuth
Lee
Linn
Louisa
Lucas
Lyon
Madison
Mahaska
Marion
Marshall
Mills
Mitchell
Monona
Monroe
Montgomery
Muscatine
O'Brien
Osceola
Page
Palo Alto
Plymouth
Pocahontas
Polk
Pottawattamie
Poweshiek
Ringgold
Sac
Scott
Shelby
Sioux
Story
Tama
Taylor
Union
Van Buren
Wapello
Warren
Washington
Wayne
Webster
Winnebago
Winneshiek
Woodbury
Worth
Wright

Kansas

Zone 1
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
Kearny
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

Zone 2
Allen
Anderson
Barber
Bourbon
Butler
Chase
Chautauqua
Cherokee
Clark
Coffey
Comanche
Cowley
Crawford
Doniphan
Edwards
Elk
Franklin
Greenwood
Harper
Harvey
Jefferson
Labette
Linn
Lyon
Miami
Montgomery
Morris
Morton
Neosho
Osage
Reno
Sedgwick
Seward
Shawnee
Stafford
Stevens
Sumner
Wabaunsee
Wilson
Woodson

Kentucky

Zone 1
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

Zone 2
Anderson
Bath
Bell
Boone
Boyd
Bracken
Breathitt
Breckinridge
Butler
Caldwell
Campbell
Carroll
Carter
Christian
Clay
Clinton
Crittenden
Daviess
Edmonson
Elliott
Estill
Fleming
Floyd
Gallatin
Garrard
Grant
Grayson
Greenup
Hancock
Hardin
Harlan
Henderson
Henry
Hopkins
Jackson
Johnson
Kenton
Knott
Knox
Larue
Laurel
Lawrence
Lee
Leslie
Letcher
Lewis
Livingston
Logan
Lyon
Madison
Magoffin
Martin
Mason
McCreary
McLean
Meade
Menifee
Montgomery
Morgan
Muhlenberg
Nicholas
Ohio
Oldham
Owen
Owsley
Perry
Pike
Powell
Rockcastle
Rowan
Shelby
Simpson
Spencer
Todd
Trigg
Trimble
Union
Washington
Wayne
Webster
Whitley
Wolfe

Louisiana

-------None------

Maine

Zone 1
Androscoggin
Aroostook
Cumberland
Franklin
Hancock
Kennebec
Lincoln
Oxford
Penobscot
Piscataquis
Somerset
York

Zone 2
Knox
Sagadahoc
Waldo
Washington

Maryland

Zone 1
Baltimore
Calvert
Carroll
Frederick
Harford
Howard
Montgomery
Washington

Zone 2
Allegany
Anne Arundel
Baltimore City
Cecil
Charles
Garrett
Prince George's
Somerset

Massachusetts

Zone 1
Essex
Middlesex
Worcester

Zone 2
Barnstable
Berkshire
Bristol
Dukes
Franklin
Hampden
Hampshire
Nantucket
Norfolk
Plymouth

Michigan

Zone 1
Branch
Calhoun
Cass
Hillsdale
Jackson
Kalamazoo
Lenawee
St Joseph
Washtenaw

Zone 2
Alcona
Alger
Alpena
Antrim
Baraga
Barry
Charlevoix
Clinton
Dickinson
Eaton
Emmet
Genesee
Gogebic
Houghton
Ingham
Ionia
Iron
Kent
Keweenaw
Lapeer
Leelanau
Livingston
Marquette
Menominee
Monroe
Montcalm
Montmorency
Oakland
Otsego
Presque Isle
Sanilac
Shiawassee

Minnesota

Zone 1
Becker
Big Stone
Blue Earth
Brown
Carver
Chippewa
Clay
Cottonwood
Dakota
Dodge
Douglas
Faribault Count
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

Zone 2
Aitkin
Anoka
Beltrami
Benton
Carlton
Cass
Chisago

Clearwater
Cook
Crow Wing
Isanti
Itasca
Koochiching
Lake
Lake of the Woods
Mille Lacs
Morrison
Pine
St Louis

Mississippi

Zone 2
Alcorn
Chickasaw
Clay
Lee
Lowndes
Noxubee
Pontotoc
Rankin
Union
Washington

Missouri

Zone 1
Andrew
Atchison
Buchanan
Cass
Clay
Clinton
Holt
Iron
Jackson
Nodaway
Platte

Zone 2
Adair
Audrain
Barry
Barton
Bates
Benton
Bollinger
Boone
Caldwell
Callaway
Camden
Cape Girardeau
Carroll
Carter
Cedar
Chariton
Christian
Clark
Cole
Cooper
Crawford
Dade
Dallas
Daviess
DeKalb
Dent
Douglas
Franklin
Gasconade
Gentry
Greene
Grundy
Harrison
Henry
Hickory
Howard
Howell
Jasper
Jefferson
Johnson
Knox
Laclede
Lafayette
Lawrence
Lewis
Lincoln
Linn
Livingston
Macon
Madison
Maries
Marion
McDonald
Mercer
Miller
Moniteau
Monroe
Montgomery
Morgan
Newton
Oregon
Osage
Ozark
Perry
Pettis
Phelps
Pike
Polk
Pulaski
Putnam
Ralls
Randolph
Ray
Reynolds
Ripley
Saline
Schuyler
Scotland
Shannon
Shelby
St Charles
St Clair
St Francois
St Louis city
St Louis
Ste Genevieve
Stone
Sullivan
Taney
Texas
Vernon
Warren
Washington
Wayne
Webster
Worth
Wright

Montana

Zone 1
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

Zone 2
Golden Valley
Musselshell
Petroleum
Sweet Grass
Treasure
Wheatland
Yellowstone

Nebraska

Zone 1
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
Jefferson
Johnson
Kearney
Knox
Lancaster
Madison
Nance
Nemaha
Nuckolls
Otoe
Pawnee
Phelps
Pierce
Platte
Polk
Red Willow
Richardson
Saline
Sarpy
Saunders
Seward
Stanton
Thayer
Thurston
Washington
Wayne
Webster
York

Zone 2
Antelope
Banner
Box Butte
Buffalo
Chase
Cheyenne
Custer
Dawes
Dawson
Deuel
Dundy
Hall
Howard
Keith
Keya Paha
Kimball
Merrick
Morrill
Perkins
Scotts Bluff
Sheridan
Sherman
Sioux
Valley

Nevada

Zone 1
Carson City
Douglas
Eureka
Lander
Lincoln
Lyon
Mineral
Pershing
White Pine

Zone 2
Churchill
Elko
Esmeralda
Humboldt
Nye
Storey
Washoe

New Hampshire

Zone 1
Carroll

Zone 2
Belknap
Cheshire
Coos
Grafton
Hillsborough
Merrimack
Rockingham
Strafford
Sullivan

New Jersey

Zone 1
Hunterdon
Mercer
Monmouth
Morris
Somerset
Sussex
Warren

Zone 2
Bergen
Burlington
Camden
Cumberland
Essex
Gloucester
Hudson
Middlesex
Passaic
Salem
Union

New Mexico

Zone 1
Bernalillo
Colfax
Mora
Rio Arriba
San Miguel
Santa Fe
Taos

Zone 2
Catron
Chaves
Cibola
Curry
De Baca
Dona Ana
Eddy
Grant
Guadalupe
Harding
Hidalgo

Lea
Lincoln
Los Alamos
Luna
McKinley
Otero
Quay
Roosevelt
San Juan
Sandoval
Sierra
Socorro
Torrance
Union
Valencia

New York

Zone 1
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

Zone 2
Clinton
Jefferson
Lewis
Monroe
Montgomery
Niagara
Oneida
Orleans
Oswego
Saratoga
Schenectady
St Lawrence
Wayne

North Carolina

Zone 1
Alleghany
Buncombe
Cherokee
Henderson
Mitchell
Rockingham
Transylvania
Watauga

Zone 2
Alexander
Ashe
Avery
Burke
Caldwell
Caswell
Catawba
Clay
Cleveland
Forsyth
Franklin
Gaston
Graham
Haywood
Iredell
Jackson
Lincoln
Macon
Madison
McDowell
Polk
Rutherford
Stokes
Surry
Swain
Vance
Wake
Warren
Wilkes
Yadkin
Yancey

North Dakota

Zone 1
Adams
Barnes
Benson
Billings
Bottineau
Bowman
Burke
Burleigh
Cass
Cavalier
Dickey
Divide
Dunn
Eddy
Emmons
Foster
Golden Valley
Grand Forks
Grant
Griggs
Hettinger
Kidder
LaMoure
Logan
McHenry
McIntosh
McKenzie
McLean
Mercer
Morton
Mountrail
Nelson
Oliver
Pembina
Pierce
Ramsey
Ransom
Renville
Richland
Rolette
Sargent
Sheridan
Sioux
Slope
Stark
Steele
Stutsman
Towner
Traill
Walsh
Ward
Wells
Williams

Ohio

Zone 1
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

Zone 2
Ashtabula
Athens
Brown
Clermont
Cuyahoga
Defiance
Erie
Fulton
Gallia
Geauga
Henry
Highland
Hocking
Jackson
Lake
Lawrence
Lorain
Lucas
Mahoning
Medina
Meigs
Monroe
Morgan
Noble
Ottawa
Paulding
Portage
Putnam
Sandusky
Scioto
Trumbull
Vinton
Washington
Williams
Wood

Oklahoma

Zone 2
Adair
Beaver
Cherokee
Cimarron
Delaware
Ellis
Mayes
Sequoyah
Texas

Oregon

Zone 2
Baker
Clatsop
Columbia
Crook
Gilliam
Grant
Harney
Hood River
Jefferson
Klamath
Lake
Malheur
Morrow
Multnomah
Sherman
Umatilla
Union
Wasco
Washington
Wheeler
Yamhill

Pennsylvania

Zone 1
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

Zone 2
Cambria
Crawford
Elk
Erie
Fayette
Forest
Greene
Jefferson
Lawrence
McKean
Mercer
Pike
Potter
Somerset
Warren
Washington
Wayne

Rhode Island

Zone 1
Kent
Washington

Zone 2
Newport
Providence

South Carolina

Zone 1
Greenville

Zone 2
Abbeville
Anderson
Cherokee
Laurens
Oconee
Pickens
Spartanburg
York

South Dakota

Zone 1
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

Zone 2
Bennett
Butte
Custer
Dewey
Fall River
Gregory
Haakon
Harding
Jackson
Jones
Lawrence
Meade
Mellette
Pennington
Shannon
Todd
Tripp
Ziebach

Tennessee

Zone 1
Anderson
Bedford
Blount
Bradley
Claiborne
Davidson
Giles
Grainger
Greene
Hamblen
Hancock
Hawkins
Hickman
Humphreys
Jackson
Jefferson
Knox
Lawrence
Lewis
Lincoln
Loudon
Macon
Madison
Marshall
McMinn
Meigs
Monroe
Moore
Perry
Roane
Rutherford
Smith
Sullivan
Trousdale
Union
Washington
Wayne
Williamson
Wilson

Zone 2
Benton
Cannon
Carter
Cheatham
Chester
Clay
Cocke
Coffee
Decatur
DeKalb
Dickson
Fentress
Hamilton
Hardin
Henderson
Houston
Johnson
Marion
McNairy
Montgomery
Overton
Pickett
Polk
Putnam
Robertson
Sevier
Stewart
Sumner
Unicoi
Van Buren
Warren
White

Texas

Zone 2
Armstrong
Bailey
Brewster
Carson
Castro
Crosby
Culberson
Dallam
Deaf Smith
Donley
Floyd
Garza
Gray
Hale
Hansford
Hartley
Hemphill
Hockley
Hudspeth
Hutchinson
Jeff Davis
Lamb
Lipscomb
Llano
Lubbock
Lynn
Mason
Moore
Ochiltree
Oldham
Parmer
Potter
Presidio
Randall
Reeves
Roberts
Sherman
Swisher
Terrell

Utah

Zone 1
Carbon
Duchesne
Grand
Piute
Sanpete
Sevier
Uintah

Zone 2
Beaver
Box Elder
Cache
Daggett
Davis
Emery
Garfield
Iron
Juab
Kane
Millard
Morgan
Rich
Salt Lake
San Juan
Summit
Tooele
Utah
Wasatch
Washington
Wayne
Weber

Vermont

Zone 2
Addison
Bennington
Caledonia
Essex
Franklin
Lamoille
Orange
Orleans
Rutland
Washington
Windham
Windsor

Virginia

Zone 1
Alleghany
Amelia
Appomattox
Augusta
Bath
Bland
Botetourt
Brunswick
Buckingham
Campbell
Chesterfield
Clarke
Craig
Cumberland
Dinwiddie
Fairfax
Fluvanna
Frederick
Giles
Goochland
Henry
Highland
Lee
Louisa
Montgomery
Nottoway
Orange
Page
Patrick
Pittsylvania
Powhatan
Pulaski
Roanoke
Rockbridge
Rockingham
Russell
Scott
Shenandoah
Smyth
Spotsylvania
Stafford
Tazewell
Warren
Washington
Wythe

Zone 2
Albemarle
Amherst
Arlington
Bedford
Buchanan
Carroll
Charlotte
Culpeper
Dickenson
Fauquier
Floyd
Franklin
Grayson
Greene
Halifax
Loudoun
Lunenburg
Madison
Mecklenburg
Nelson
Prince Edward
Prince William
Rappahannock
Wise

Washington

Zone 1
Clark
Ferry
Okanogan
Pend Oreille
Skamania
Spokane
Stevens

Zone 2
Adams
Asotin
Benton
Columbia
Douglas
Franklin
Garfield
Grant
Kittitas
Klickitat
Lincoln
Walla Walla
Whitman
Yakima

West Virginia

Zone 1
Berkeley
Brooke
Grant
Greenbrier
Hampshire
Hancock
Hardy
Jefferson
Marshall
Mercer
Mineral
Monongalia
Monroe
Morgan
Ohio
Pendleton
Pocahontas
Preston
Summers
Wetzel
Fayette
Gilmer
Harrison
Jackson
Lewis
Lincoln
Marion
Mason
Nicholas
Pleasants
Putnam
Raleigh
Randolph
Ritchie
Roane
Taylor
Tucker
Tyler
Upshur
Wayne
Webster
Wirt
Wood

Zone 2
Barbour
Braxton
Cabell
Calhoun
Clay
Doddridge

Wisconsin

Zone 1
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

Zone 2
Adams
Ashland
Barron
Bayfield
Brown
Burnett
Calumet
Chippewa
Clark
Columbia
Douglas
Dunn
Eau Claire
Florence
Forest
Iron
Jackson
Juneau
Kenosha
Kewaunee
La Crosse
Lincoln
Manitowoc
Marinette
Marquette
Milwaukee
Monroe
Oconto
Oneida
Outagamie
Ozaukee
Polk
Price
Racine
Rusk
Sauk
Sawyer
Sheboygan
Taylor
Trempealeau
Vilas
Washburn
Waushara
Winnebago

Wyoming

Zone 1
Albany
Big Horn
Campbell
Carbon
Converse
Crook
Fremont
Goshen
Hot Springs
Johnson
Laramie
Lincoln
Natrona
Niobrara
Park
Sheridan
Sublette
Sweetwater
Teton
Uinta
Washakie

Zone 2
Platte
Weston

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Appendix A – Active Soil Depressurization System Inspection Checklist

1. **Record System Address:**

Street: _____ **Town:** _____ **State:** _____

2. **Number of Dwellings** [*1 or 2*]: ☐
3. **Radon Zone Designation** (§1201): ☐
4. **Verify ASD System Installed:** ☐

Continue inspection of items 5 through 21.

a. **Exception** (§301.1): ☐

Mitigation System not installed.

Attach certified test result below NAL.

No further inspection required.

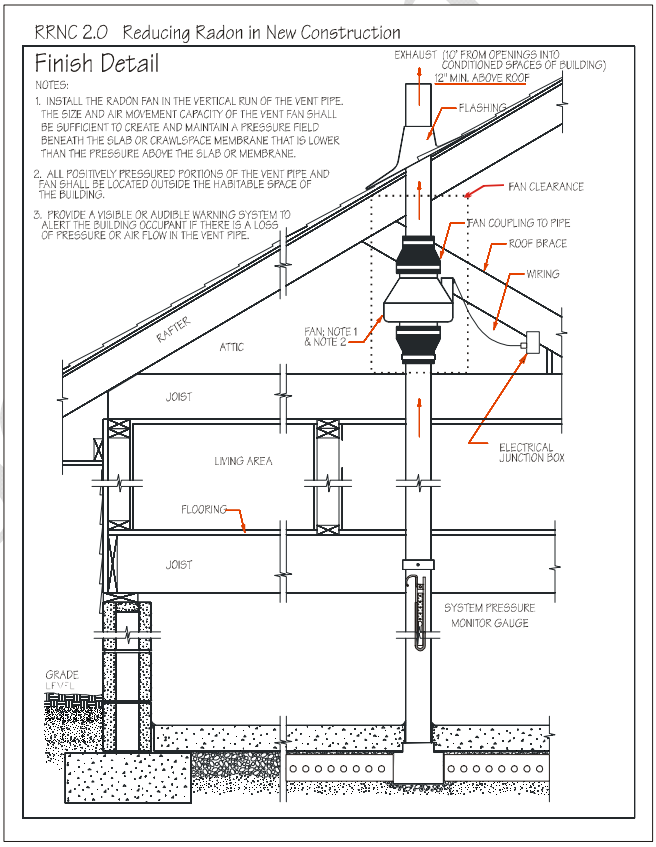
b. **Exception** (§901.1): ☐

Mitigation System Rough-in only.

Rough-in Label (§901.2): ☐

Attach certified test result below NAL.

Continue inspection of items 6 through 17.



5. **Fan Location** (§901.8): ☐

Verify fan properly located outside occupiable space: attic, garage, roof, etc.

6. **ASD Discharge** (§601): ☐ Verify pipe discharges outside the building, 1 foot [30 cm] above the roof surface, 10 feet [3 m] above the ground, and 2 feet [60 cm] above any operable door or window within 10 feet [3 m] in this building or any adjacent building.

7. **Fan Clearance** (§701.1): ☐ Verify proper clearances for fan located outside occupiable space: attic, garage, roof, etc.

8. **Foundations** (§302.1): ☐ Verify all foundation areas in contact with the soil are treated as part of the ASD system.

9. **Floor Sump** (§404.1.1): ☐ Verify lid sealed on floor sump.

10. **Masonry Foundation** (§404.1.2): ☐ Verify filled block course along top of foundation wall and under doors and windows, if applicable.

11. **Floor Drains** (§404.1.3): ☐ Verify radon resistant drains installed in any drain with exposure to the soil.

12. **Pipe Size** (§501.1): ☐ Verify pipe is minimum 3 inch [7.6 cm] diameter PVC or ABS.

13. **Pipe Slope** (§501.5): ☐ Verify slopes on all horizontal pipes slopes.

14. **Pipe Insulation** (§501.9): ☐ Verify pipe insulation, if required.

15. **Pipe Labeling** (§501.10): ☐ Verify pipe is labeled on each floor, if visible.

16. **Electrical** (§701.2): ☐ Verify junction box and disconnect for fan.

17. **Test Kit** (§801.1): ☐ **Verify long term radon-in-air test kits provided for each dwelling.**

18. **ASD Fan** (§901.3): ☐ Verify fan is installed and running.

19. **System Monitor** (§1001.1): ☐ Verify monitor is installed.

    a. **System Pressure** (§1001.2): ☐ Record ASD system start-up pressure.

    b. **System Labeling** (§1001.4): ☐ Verify System Label on pipe.

20. **System Documentation** (§1001.5): ☐ Verify documentation package.

21. **Radon Test (**§1101): ☐ **Attach certified test result below NAL**.

Inspected By:_____ **Date:**_____

Notes:_____

_____

_____

_____

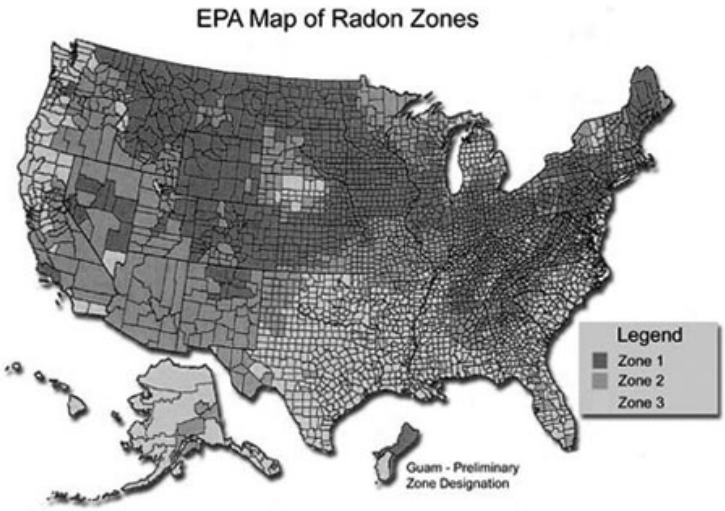
_____

_____

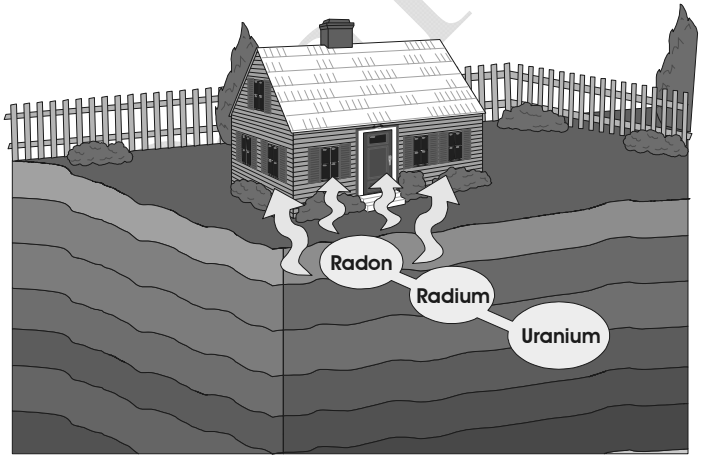
NOTE: This appendix is provided for informational purposes only.

Appendix B – Understanding Active Soil Depressurization (Builders and Code Officials)

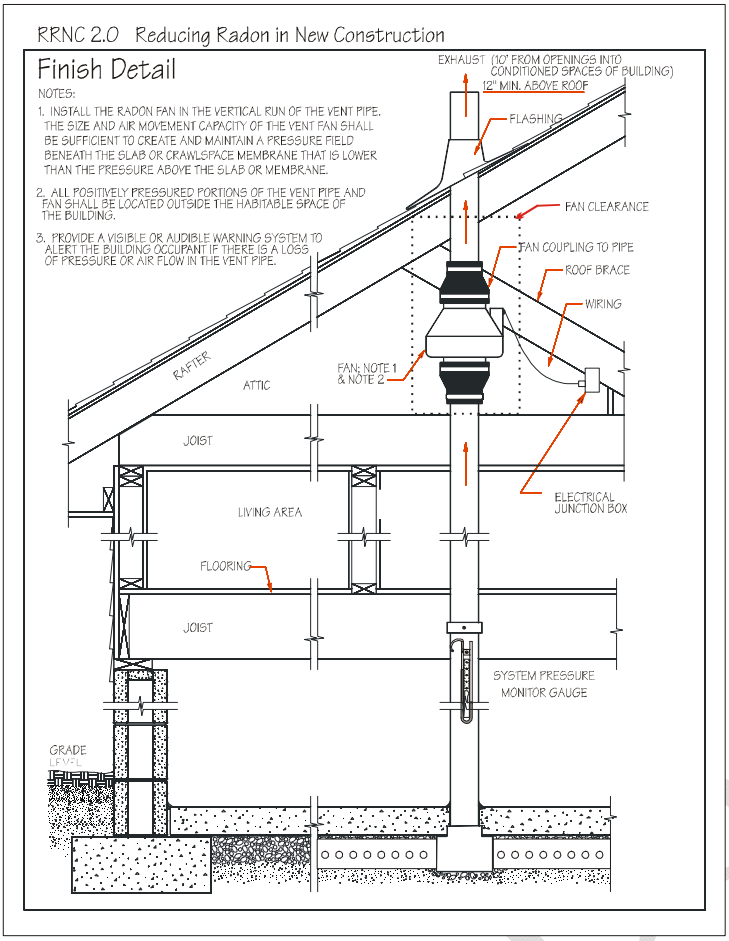
Radon: Radon is a colorless, odorless, radioactive gas that occurs naturally in all parts of the US. Radon is a "Group A" carcinogen and is the second leading cause of lung cancer after smoking and the leading cause of lung cancer in non-smokers. The EPA estimates that radon is responsible for the death of about 21,000 people in the United States every year. Radon concentrations are reported in picocuries per liter (pCi/L) or in Becquerel's per cubic meter [Bq/m3], which is a measure of radioactivity in a volume of air. The only way to determine the concentration of radon in a home is to perform a test.



Radon Potential: The EPA Zone Map provides a county by county potential for indoor radon concentrations across the United States. Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L [150 Bq/m^3]. Zone 2 indicates a Moderate Potential for radon and Zone 3 is the lowest radon potential area. The World Health Organization (WHO) reference level is 2.7 pCi/L [100 Bq/m^3] and the WHO recommends that take action be taken to reduce occupant radon exposure to below this reference level. Your State may provide more detailed radon maps; check with your State radon or local Building Inspector office.



Radon Potential of a Building Lot: County by county mapping can predict average screening levels, however, the radon potential of any given building lot it is very dependent on the local conditions which determine whether source material is available in the soil and whether there is sufficient pathway and driving force to create a radon problem in any given dwelling.
Soil testing a building lot for radon potential has shown mixed results and has not been demonstrated to reliably predict final indoor radon concentrations. There are no nationally recognized protocols for radon testing of building lots.



Active Soil Depressurization System (ASD): ASD is a family of radon mitigation systems involving fan-powered soil depressurization, involving but not limited to sub-slab depressurization and sub-membrane pressurization. An ASD System typically consists of: a soil gas collection plenum under each foundation floor to collect radon and other soil gases, pipe to connect the soil gas collector to a specially designed radon fan and pipe from the outlet of the fan to exhaust the radon gas and other soil gases, including moisture, outside the home. The radon fan runs continuously to reduce the amount of radon and soil gas that will enter the building at the foundation. There are also specific guidelines for locating the ASD exhaust to ensure that the exhaust does not re-enter the home but rather disperses into the atmosphere.

A system pressure monitor, to verify fan pressure, is included with the system. The monitor may be a pressure gauge or an alarm to notify the occupant of fan failure or the need for other system service.

Radon Testing: Testing for radon can be performed with a number of different testing methods, including: charcoal canister, liquid scintillation, electret, alpha track or continuous radon monitor. Short-term testing must be performed under "Closed Housing Conditions" which means that the building must be near completion with all doors and windows closed (except for normal entry and exit). The building should also be heated/cooled and construction activities should be minimal during the testing period. A certified/licensed testing professional can provide the radon test device and additional information on the testing protocols.

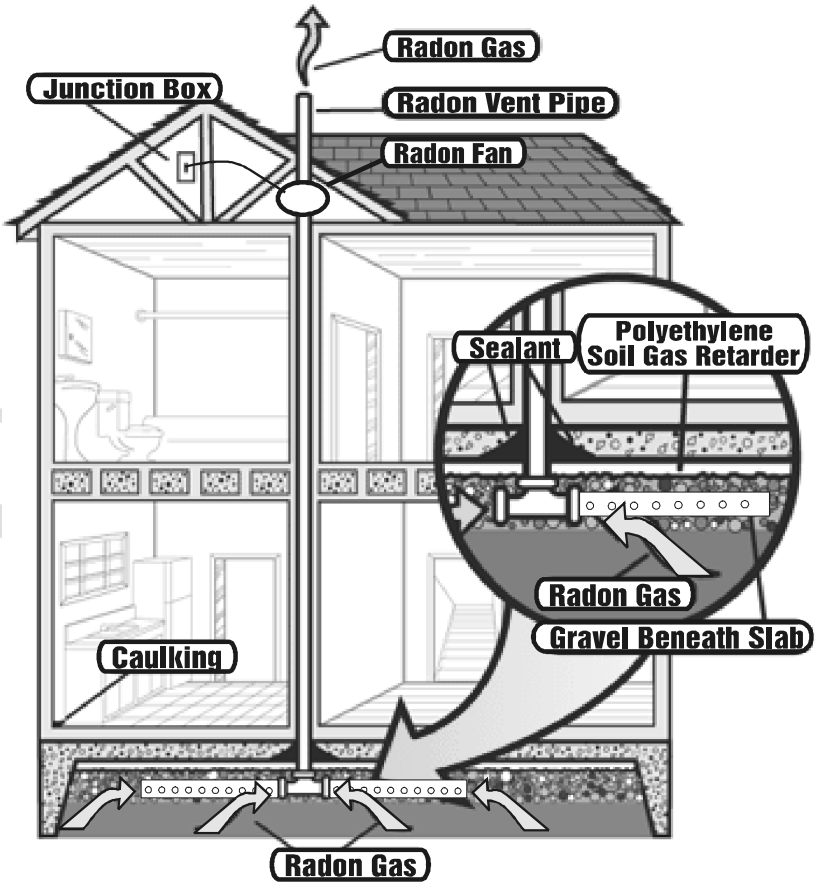
Additional Information: For more information on radon, radon testing and Active Soil Depressurization: **www.epa.gov/radon**

NOTE: This appendix is provided for informational purposes only.

Appendix C - Understanding a Radon Reduction System (Occupants)

General: Radon is a radioactive gas that has been found in homes all over the United States. It comes from the natural breakdown of uranium in soil, rock and water and gets into the air you breathe. The radon potential of any specific building lot is dependent on whether there is sufficient radon source material in the ground below the home and sufficient upward air movement for the radon to be near your home's foundation. Radon typically moves up through the ground to the air above and into your home through gaps and other holes in the foundation. The primary health concern associated with radon is lung cancer. The Environmental Protection Agency (EPA) estimates that 21,000 people die in the US each year from radon-induced lung cancer.

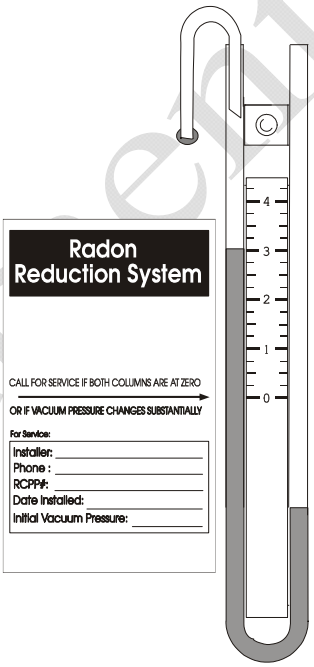
Radon Reduction System: Your new home was constructed with an Active Subslab Depressurization (ASD) System to protect your family's health. The ASD system is designed to limit radon entry into your home by keeping the soil under your home at a lower pressure than the air in your home. In doing so, radon and other soil gasses from below your home are exhausted above your roof through a specially designed radon fan. An ASD system is recognized by the EPA as the Best Available Technology for radon control because it keeps much of the radon from entering your home. The system is designed to run 24 hours a day, 7 days a week. The electrical power required to run the fan, which is the only active component in the system, will typically cost 5 to 25 cents per day depending upon the type of fan and your electrical utility rates. Cost to operate this fan would be less than operating a normal light bulb.



System Maintenance: Your ASD System is designed to provide many years of service under normal conditions without significant maintenance. As the occupant of this home, you need to routinely check the system pressure gauge or other system monitor to verify that the fan is operating correctly. There are various labeled components of your radon system such as pipe, crawlspace membrane, fan, system pressure monitor and sump basin. DO NOT ALTER OR DISCONNECT any of these components. If the sump basin is opened for required maintenance or repair, restore to the original condition

immediately after completing work. You also need to be aware that foundation settling, renovations or additions to your home can change your indoor radon concentrations. A certified/licensed radon mitigator can provide guidance when changes are to be made to the dwelling or provide a routine check-up on the operation of the system.

Understanding the System Pressure Gauge: The pressure gauge shown on the right is typical of a gauge used to monitor the pressure developed in the piping system by the radon fan. Your fan pressure should be checked regularly to ensure the fan system continues to operate properly. This gauge measures pressure in Inches Water Column (WC). This gauge does NOT measure radon.



Call for service if the measure changes substantially (20% or more) or if the gauge reads zero pressure (both columns equal).

Your ASD system may have an audible alarm to alert you to call for service in the event of a problem.

Radon Testing: Your builder left behind a long term test kit for you to use to test your home after you move in. The way you and your family live in your new home, how you set heating and cooling controls or use your clothes dryer and other exhaust fans can affect indoor radon levels. It is recommended that you test for a minimum of 3 months or preferably longer to determine your actual radon exposure in the home. Be sure to check the warranty your builder provides to make certain you complete your testing before the end of the new home warranty period.

Follow the instructions provided by the test laboratory to open, activate and place the test kit to test your radon levels.

The USEPA recommends that you retest your home at least every 2 years or if major renovations or additions are made to the dwelling.

Other sources of radon: Radon can also be found in the water from private wells. Testing can determine if your well contains significant amounts of radon

More Info: For more information on radon, radon testing or radon removal: **www.epa.gov/radon**

NOTE: This appendix is provided for informational purposes only.

Appendix D – Radon References

The following documents are sources of additional radon mitigation information and are recommended reading for all persons involved in radon ASD mitigation installations.

1. "Application of Radon Reduction Methods," EPA625/5-88/024, August 1988.
2. "Building Radon Out: A Step by Step Guide on How to Build Radon-Resistant Homes", EPA 402-K-01-002, April 2001
3. "Citizen's Guide To Radon" EPA 402-K02-006, revised September 2005
4. "Consumer's Guide to Radon Reduction," EPA 402-K-03-002, revised February 2003.
5. "Guide to Industrial Respiratory Protection," NIOSH DHHS (NIOSH) Publication No. 87-116, September, 1987
6. "Home Buyers and Sellers Guide to Radon," EPA 402-K-05-005, May 2005,
7. "Indoor Air Quality", EPA website, www.epa.gov/iaq/homes/
8. "Indoor Radon and Radon Decay Product Measurement Device Protocols", EPA 402-R-92-004, July 1992.
9. "Model Standards and Techniques for Control of Radon in New Residential Buildings", EPA 402-R-94-009, March 1994
10. "Occupational Safety and Health Regulations, Ionizing Radiation", OSHA 29 CFR 1910.96
11. "Protocols for Radon and Radon Decay Product Measurements in Homes", EPA 402-R-92-003, May 1993
12. "Protocols for Radon Measurements in Homes", (MAH September 2005), AARST National Radon Standards Consortium
13. "Radon Mitigation Standards," EPA 402-R-93-078, revised April 1994
14. "Radon Reduction Techniques for Detached Houses, Technical Guidance (Second Edition)" EPA/625/5-87/019, January 1988.
15. "Radon Reduction Techniques for Existing Detached Houses, Technical Guidance (Third Edition) for Active Soil Depressurization Systems," EPA625/R-93-011, October 1993.
16. "Reducing Radon In Structures," EPA Training Manual, (Third Edition), January 1993.

17. "Safety and Health Regulations for Construction, Ionizing Radiation," OSHA 29 CFR 1926.53

18. "Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings", ASTM E 2121-03

19. "Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings" ASTM E 1465-08a

20. "Surgeon General's National Health Advisory on Radon" www.surgeongeneral.gov/pressreleases/sg01132005

21. "Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings", ASHRAE Standard 62-2-2010

22. "WHO Handbook on Indoor Radon; A Public Health Perspective", World Health Organization (2009). WHO, Geneva.

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Appendix E – ASTM References

The following ASTM documents are referenced herein and available at www.astm.org.

1) C33/C33M – "Standard Specification for Concrete Aggregates "

2) C920 – "Standard Specification for Elastomeric Joint Sealants "

3) C1173 – "Standard Specification for Flexible Transition Couplings for Underground Piping Systems "

4) D2235 – "Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings "

5) D2564 – "Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems "

6) D2661 – "Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings "

7) D2665- "Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings "

8) D2729 – "Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings "

9) D5926 – "Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems "

10) E1745 – "Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs"

11) F628 – "Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core"

12) F656 – "Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings"

13) F891 – "Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core"

14) F1488 – "Standard Specification for Coextruded Composite Pipe"

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