

WASHINGTON STATE
VENTILATION AND INDOOR
AIR QUALITY CODE
(1997 EDITION)

CHAPTER 51-13 WAC



WASHINGTON STATE BUILDING CODE COUNCIL
EFFECTIVE JULY 1, 1998

Preface

Authority: The Washington State Building Code Council adopted the 1997 Washington State Ventilation and Indoor Air Quality Code pursuant to RCW 19.27.190. This code provides a minimum level of air quality within the structure, but allows flexibility in equipment design, construction, and heating equipment efficiencies. The design of this code allows space heating equipment efficiencies to offset or substitute for building envelope thermal performance.

Code Precedence: The 1997 Washington State Ventilation and Indoor Air Quality Code (Fourth Edition) supersedes the Third Edition. The 1997 Washington State Ventilation and Indoor Air Quality Code cannot be amended by local jurisdictions.

Organization and Numbering: This code, by design, is a stand-alone code.

Enforcement: The State Building Code Act requires that each local jurisdiction enforce the State Building Code within its jurisdiction. Any jurisdiction can contract with another jurisdiction or an inspection agency to provide the mandated enforcement activities.

Effective Date: These regulations shall be effective July 1, 1998.

Copies and Comments: The Department of Community, Trade and Economic Development provides staff and administrative services to the Council. Copies of WAC 51-13 and information on amendments to codes adopted by the State Building Code Council may be obtained from:

Washington State Building Code Council
Post Office Box 48300
Olympia, Washington 98504-8300
(360) 753-1184

Local Amendments: This code may not be amended by any jurisdiction.

Amendments to the State Building Code: The State Building Code Council has adopted review procedures and approval criteria for amendments. These procedures and criteria are found in Chapter 51-04 WAC.

Proposals to amend the State Building Code shall be made on forms provided by the Building Code Council. Forms for proposing statewide amendments to the State Building Code are available from the State Building Code Council staff. Unless directed by the State Legislature, federal mandates or court order, the Council will not enter formal rulemaking until 2000 as part of its consideration of adoption of the 2000 series of codes. Preliminary action will be taken each year on proposals submitted by the deadline.

Opinions: *Only at the request of a local enforcement official, the State Building Code Council may issue interpretations/opinions of those provisions of the State Building Code created by the Council, or provisions of the uniform codes amended by the Council. Final interpretation authority for any specific permit resides with the local enforcement official.*

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**1997 WASHINGTON STATE VENTILATION AND INDOOR AIR QUALITY CODE
TABLE OF CONTENTS**

CHAPTER 1 Administration and Enforcement

SECTION 101 — Scope And General Requirements	
101.1 Title	1
101.2 Intent	1
101.3 Scope	1
101.3.1 Application to Existing Buildings	1
101.3.1.1 Additions to Existing Buildings	1
101.3.1.2 Alterations and Repairs	1
101.3.1.3 Historic Buildings	1
SECTION 102 — Alternate Systems And Materials; Method Of Design, Construction And Installation	
102.1 Alternate Materials and Methods of Construction	1
SECTION 103 — Plans And Specifications	
103.1 General	1
103.2 Details	1
SECTION 104 — Enforcement And Inspections	
104.1 General	2
104.2 Approvals Required	2
104.3 Tests	2
104.4 Final Inspection	2
SECTION 105 — Validity	
105.1 Validity	2
SECTION 106 — Conflicts With Other Codes	
106.1 Conflicts with Other Codes	2
106.2 Authority	2
SECTION 107 — Violations	
107.1 Violations	2
SECTION 108 — Liability	
108.1 Liability	2

CHAPTER 2 Definitions

SECTION 201 — General	
201.1 General	3
SECTION 202 — Definitions	3

CHAPTER 3 Ventilation Systems

SECTION 301 — Design Criteria

301.1 General.....	7
--------------------	---

SECTION 302 — Minimum Ventilation Criteria For All Group R Occupancies Four Stories and Less

302.1 General.....	7
302.1.1 Testing.....	7
302.2 Minimum Ventilation Performance.....	7
302.2.1 Source Specific Ventilation	7
302.2.2 Whole House Ventilation Systems	7
302.3 Controls.....	7
302.3.1 Source Specific Ventilation Systems.....	7
302.3.2 Intermittently Operated Whole House Ventilation Systems	7
302.4 Noise	7
302.5 Ventilation Ducts.....	8
302.6 Outdoor Air	8
302.6.1 Outdoor Air Inlets	8
302.6.2 Individual Room Outdoor Air Inlets.....	8
302.6.3 Ventilation Integrated with Forced-Air Systems	8
302.6.4 Distribution	8

SECTION 303 — Mechanical Ventilation Criteria And Minimum Ventilation Prescriptive Requirements For All Group R Occupancies Four Stories and Less

303.1 General.....	8
303.1.1 Source Specific.....	8
303.1.2 Whole House	8
303.2 Source Specific and Whole House Exhaust Ducts.....	9

SECTION 304 — Mechanical Ventilation Criteria And Minimum Ventilation Performance For All Other Occupancies Not Covered in Sections 302 and 303

304.1 Ventilation.....	9
------------------------	---

TABLE 3-1 — Minimum Source Specific Ventilation Capacity Requirements	10
TABLE 3-2 — Whole House Ventilation Flow Requirements	10
TABLE 3-3 — Prescriptive Exhaust Duct Sizing.....	10
TABLE 3-4 — Outdoor Air Requirements For Ventilation.....	11
TABLE 3-5 — Prescriptive Integrated Forced Air Supply Duct Sizing.....	14

CHAPTER 4 Indoor Air Quality

SECTION 401 — Pollutant Source Control

401.1 Formaldehyde Reduction Measures	15
---	----

SECTION 402 — Solid Fuel Burning Appliances And Fireplaces

402.1 General.....	15
402.2 Solid Fuel Burning Appliances.....	15
402.3 Fireplaces.....	15
402.4 Masonry Heaters	15

CHAPTER 5 — Radon Resistive Construction Standards

SECTION 501 — Scope.....	17
501.1 General	17
501.2 Application	17
SECTION 502 — State-Wide Radon Requirements	
502.1 Crawlspace.....	17
502.1.1 General.....	17
502.1.2 Ventilation.....	17
502.1.3 Crawlspace Plenum Systems.....	17
SECTION 503 — Radon Prescriptive Requirements	
503.1 Scope	17
503.2 Floors in Contact with the Earth	17
503.2.1 General.....	17
503.2.2 Aggregate.....	17
503.2.3 Gradation	17
503.2.4 Soil-Gas Retarder Membrane.....	18
503.2.5 Sealing of Penetrations and Joints	18
503.2.6 Radon Vent.....	18
503.2.7 Fan Circuit and Wiring and Location	18
503.2.8 Separate Aggregate Areas	18
503.2.9 Concrete Block Walls.....	18

Chapter 1 ADMINISTRATION AND ENFORCEMENT

SECTION 101 — SCOPE AND GENERAL REQUIREMENTS

101.1 Title: This Code shall be known as the Washington State Ventilation and Indoor Air Quality Code. It is herein referred to as "this Code".

101.2 Intent: The purpose of this Code is to provide minimum standards for the design and installation of mechanical ventilation systems, the selection of structural materials used within the conditioned space, and the construction of radon mitigation systems for new construction.

It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques. These provisions are structured to permit compliance with the intent of this Code by demonstration of performance through on-site testing or through engineered design. This Code is not intended to abridge any safety or health requirements required under any other applicable codes or ordinances.

101.3 Scope: This Code sets forth minimum requirements for ventilation in all occupancies, including the design of new construction.

101.3.1 Application to Existing Buildings

101.3.1.1 Additions to Existing Buildings: Additions to existing buildings or structures may be made without making the entire building comply, provided that the new addition shall conform to the provisions of this Code.

EXCEPTIONS: 1. Additions with less than 500 square feet of conditioned floor area are exempt from the requirements in this Code for Whole House Ventilation Systems, Section 302.2.2.

2. Additions or alterations to existing buildings which do not require the construction of foundations, crawlspaces, slabs or basements shall not be required to meet the requirements for radon protection.

101.3.1.2 Alterations and Repairs: All alterations and repairs may be made to existing or moved buildings built or permitted prior to the enforcement of this Code without making the entire building comply with the provisions of this Code, provided the alterations or repairs comply with this Code.

EXCEPTION: Air handling/conditioning equipment, which is being replaced without alteration or repair of the associated air distribution system is exempt from the requirements of this Code.

101.3.1.3 Historic Buildings: Historic buildings are exempt from this Code only to the extent necessary to preserve those features essential to their historical appearance or function.

SECTION 102 — ALTERNATE SYSTEMS AND MATERIALS - METHOD OF DESIGN, CONSTRUCTION AND INSTALLATION

102.1 Alternate Materials and Methods of Construction: The provisions of this Code are not intended to prevent the use of any material, method of construction, design or ventilation system not specifically prescribed herein, provided that such construction, design, or ventilation system has been approved by the building official.

The building official may approve any such alternate, provided that the proposed design is satisfactory and complies with the provisions of this Code and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this Code in suitability, effectiveness, safety, and indoor air quality.

The building official may require plans and specifications to be submitted in support of an application for a building permit. Plans and specifications may be required by the building official to be stamped and authenticated by an engineer or architect licenced by the state to practice as such.

SECTION 103 — PLANS AND SPECIFICATIONS

103.1 General: With each application for a building permit, and when required by the building official, plans and specifications demonstrating compliance with this Code shall be submitted. The building official may require that plans and specifications be stamped and authenticated by an engineer, architect, or other qualified professional licensed to practice in the state.

103.2 Details: The plans and specifications shall show in sufficient detail pertinent data and features of the materials, equipment and systems as herein governed, including, but not limited to: design criteria, structural panel materials, size and type of apparatus and equipment, systems and equipment controls, provisions for combustion air to fuel burning appliances, and other pertinent data to indicate conformance with the requirements of this Code.

SECTION 104 — ENFORCEMENT AND INSPECTIONS

104.1 General: Pertinent data and features of the building and the materials, equipment and/or systems as herein governed shall be subject to inspection by the building official.

104.2 Approvals Required: No materials, equipment, systems, or portions thereof, shall be concealed without first obtaining approval from the building official.

104.3 Tests: Whenever there is insufficient evidence of compliance with any of the provisions in this Code or evidence that any material or construction does not conform to the requirements of this Code, the building official may require tests as proof of compliance to be made at no expense to the local jurisdiction.

Test methods shall be as specified by this Code or by other recognized test standards. If there are no recognized or accepted test methods for the proposed alternate, the building official shall determine test procedures.

104.4 Final Inspection: All materials, equipment, and systems herein governed shall be inspected and approved before the building shall be deemed ready for occupancy.

SECTION 105 — VALIDITY

105.1 Validity: If a section, subsection, sentence, clause or phrase of this Code is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portion of this Code.

SECTION 106 — CONFLICTS WITH OTHER CODES

106.1 Conflicts with Other Codes: In addition to the requirements of this Code, buildings must conform to the provisions of the State Building Code (Chapter 19.27 RCW and Chapters 51-40 WAC, 51-42 WAC, 51-44 WAC, and 51-46 WAC). In case of conflicts between the Uniform Building, Uniform Plumbing, Uniform Mechanical, and Uniform Fire Codes as adopted and amended in Chapters 51-40 WAC, 51-42 WAC, 51-44 WAC, 51-46 WAC, the provisions of Chapter 51-13 shall govern. This Code is not intended to abridge any safety or health requirements under any other applicable codes or ordinances.

Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

Wherever in this Code reference is made to the appendix, the provisions of the appendix shall not apply unless specifically adopted.

106.2 Authority: Local legislative authorities are authorized and directed to enforce this Code. Local legislative authorities are authorized to promulgate, adopt, and issue those rules and regulations necessary for the effective and efficient administration of this Code.

SECTION 107 — VIOLATIONS

107.1 Violations: It shall be unlawful for any persons, firm, or corporation to erect or construct any building, or remodel or rehabilitate any existing building or structure in the state, or allow the same to be done in violation of any of the provisions of this Code.

SECTION 108 — LIABILITY

108.1 Liability: Nothing contained in this Code is intended to be nor shall be construed to create nor form the basis for any liability on the part of any city or county or its officers, employees, or agents for any injury or damage resulting from the failure of a building to conform to the provisions of this Code.

Chapter 2

DEFINITIONS

SECTION 201 — GENERAL

201.1 General: For the purposes of this Code, certain terms, phrases, words, and their derivatives shall be construed as specified in this section. Words used in the singular include the plural and the plural, the singular. Words used in the masculine gender include the feminine and feminine, the masculine.

Where terms are not defined in this section, the definitions shall be taken from Chapter 2 of the Uniform Building Code. Where terms are not defined in either this section or Chapter 2 of the Uniform Building Code, they shall have their ordinary accepted meanings within the context with which they are used. Webster's Third International Dictionary of the English Language, Unabridged, copyrighted 1981, shall be considered as providing ordinarily accepted meanings.

SECTION 202 — DEFINITIONS

ADDITION: An extension or increase in floor area or height of a building or structure.

AGGREGATE: Crushed stone, stone, or other inert material or combinations thereof having hard, strong, durable pieces.

AIR BARRIER: A continuous material or system of materials utilized for the purpose of minimizing the movement of air across a defined boundary, and capable of withstanding the maximum pressure developed across it, without failing by becoming significantly more leaky.

AIR, EXHAUST: Air removed from a space and not reused therein.

AIR, OUTDOOR: Air taken from the external atmosphere and, therefore, not previously circulated through the HVAC system or the conditioned space.

AIR, SUPPLY: That air delivered to the conditioned space and used for ventilation, heating, cooling, humidification or dehumidification.

AIR, TRANSFER: The movement of indoor air from one space to another.

AIR, VENTILATION: That portion of supply air that is outdoor air plus any recirculated air that has been treated for the purpose of maintaining acceptable indoor air quality.

AMCA: Air Movement and Control Association, Inc.

APPROVED: As to material and types of construction, refers to approved by the building official as the result of investigation and tests conducted by him, or by reason of accepted principles or tests by recognized authorities, technical or scientific organizations.

ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

AUTOMATIC: Self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature, or mechanical configuration.

BACK-DRAFT DAMPER: A damper installed to restrict introduction of unconditioned air from an unconditioned space to a conditioned space.

BAROMETRIC DAMPER: Shall be any listed non-manual device that freely allows the flow of air in one direction, but does not allow conditioned air to escape. Any installed combustion air damper shall meet the installation requirements of the manufacturer.

BUILDING OFFICIAL: The officer or other designated authority charged with the administration and enforcement of this code, or his duly authorized representative.

CERTIFIED LOCAL GOVERNMENT: The local government has been certified by the State Historical Preservation Officer as having established its own historic preservation commission and a program meeting Federal and State Standards.

CFM: Cubic feet per minute.

CONDITIONED FLOOR AREA: The floor area within the conditioned space.

CONDITIONED SPACE: That part of a building that is heated or cooled or both for the comfort of occupants.

DEHUMIDISTAT: An automatic control device which measures changes in humidity and controls a device(s) for maintaining a maximum specified humidity range or level.

EXFILTRATION: The uncontrolled outward air leakage through cracks and concealed spaces in any building element and around sole plates, wall outlets, duct systems, windows, and doors of a building, caused by the pressure effect of wind and/or the effect of differences in the indoor and outdoor air density.

GRAVEL: A type of aggregate.

HABITABLE SPACE (ROOM): Space in a structure for living, sleeping, eating, or cooking. Bathrooms, toilet compartments, closets, halls, storage, or utility space and similar areas, are not considered habitable space. For the purpose of this Code, a single habitable space may consist of adjoining rooms when one half of the area of the common wall is open and unobstructed and provides an opening of not less than one-tenth of the floor area of the interior room or twenty-five square feet, whichever is greater.

HEAT RECOVERY VENTILATION SYSTEM: A device or combination of devices applied to provide the outdoor air for ventilation in which energy is transferred between the intake and exhaust airstream.

HISTORIC BUILDINGS: "Historic Building" is any structure, collection of structures, and their associated sites, deemed of importance to the history, architecture, or culture of an area by an appropriate local, state, or federal government jurisdiction. Included shall be structures on official national, state, or local listings such as the National Register of Historic Places, the State Register of Historic Places, state points of historical interest, and registers or listings of historical or architecturally significant sites, places, historic districts, or landmarks as adopted by a certified local government.

HUMIDISTAT: An automatic control device which measures changes in humidity and controls a device(s) for maintaining a minimum specified humidity range or level.

HVAC: Heating, ventilating, and air conditioning.

HVI: Home Ventilating Institute of America, Inc.

INFILTRATION: The uncontrolled inward air leakage through cracks and concealed spaces in any building element and around sole plates, wall outlets, duct systems, windows, and doors of a building, caused by the pressure effect of wind and/or the effect of differences in the indoor and outdoor air density.

MANUAL: Capable of being operated by human intervention.

MASONRY HEATER: A heating system which is predominantly masonry construction, having a mass of at least 1764 pounds (800 kg) excluding chimney and base. Within the masonry mass are contained a firebox and multiple heat exchange channels which store the heat and allow for extremely high temperature fires to be burned.

MITIGATE: To design, select, apply, and install systems, materials and processes that reduce radon concentrations in the indoor air of a building, and/or prevent entry of radon into the indoor air of a building, so that the average indoor radon concentration is reduced to an acceptable level.

NEW CONSTRUCTION: Any building, addition or change in occupancy permitted on or after the effective date of this Code.

PICOCURIE, pCi: A measure of radioactive activity equal to one trillionth of a curie. A curie is the amount of any radionuclide that undergoes 37 billion nuclear disintegrations per second, hence a picocurie is 0.037 nuclear disintegrations per second.

PICOCURIE PER LITER, pCi/L: A common unit of measurement of the concentration of radioactivity in a gas. One pCi/L corresponds to 2.22 radioactive disintegrations per minute per liter of air.

R-VALUE: See **THERMAL RESISTANCE (R)**

READILY ACCESSIBLE: Readily accessible means capable of being reached safely and quickly for operation, repair, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles, or to resort to the use of portable access equipment.

SOIL DEPRESSURIZATION SYSTEM (SDS): A radon control technique that depressurizes the space below a concrete slab or other soil gas retarder relative to the space above it. The purpose of SDS is to maintain a slightly lower pressure in the soil gas under the slab or other soil gas retarder, compared to the indoor pressure above it, to ensure that flows are from the indoors to the soil, thus preventing mass transport of radon contaminated soil gas to the indoor air.

SOIL GAS RETARDER MEMBRANE: A flexible sheet material placed between the soil and the indoor air for the purpose of reducing the flow of soil gas into the building.

SOLID FUEL BURNING APPLIANCE: Any factory-built appliance designed to burn solid fuels.

SOURCE SPECIFIC VENTILATION SYSTEM: A mechanical ventilation system including all fans, controls, and ducting, which is dedicated to exhausting contaminant-laden air to the exterior of the building from the room or space in which the contaminant is generated.

SYSTEM: A combination of equipment and/or controls, accessories, interconnecting means, and terminal elements by which air is transferred.

TERMINAL ELEMENT: The means by which the transferred air from a system is finally delivered; i.e., registers, diffusers, through-the-wall vents, roof caps, etc.

THERMAL RESISTANCE (R): The resistance of a material to heat flow, measured as the inverse of heat flow per unit area, per unit time, per unit temperature difference across the thickness of material considered. In this Code, R has units of $\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$.

THERMOSTAT: An instrument which measures changes in temperature and control device(s) for maintaining a desired temperature.

UNCONDITIONED SPACE: (See **CONDITIONED SPACE**)

VENTILATION: The process of supplying and removing air by natural or mechanical means to and from any space. Such air may or may not be conditioned.

VENTILATION, MECHANICAL: The introduction and distribution of outdoor air and the removal of indoor air by mechanical means.

VENTILATION, NATURAL: Ventilation other than by mechanical means.

VIRGIN POLYETHYLENE: Extruded polyethylene sheets made from nonreprocessed resins.

WHOLE HOUSE VENTILATION SYSTEM: A mechanical ventilation system, including fans, controls, and ducts, which replaces, by direct or indirect means, air from the habitable rooms with outdoor air.

WOOD STOVE: (See **SOLID FUEL BURNING APPLIANCE**)

ZONE: A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

Chapter 3

VENTILATION SYSTEMS

SECTION 301 — DESIGN CRITERIA

301.1 General: The criteria of this chapter establish the design conditions upon which the minimum ventilation systems are to be based for all occupancies.

SECTION 302 — MINIMUM VENTILATION CRITERIA FOR ALL GROUP R OCCUPANCIES FOUR STORIES AND LESS

302.1 General: This section shall apply to all Group R occupancies four (4) stories or less as defined by the Washington State Building Code. Residential structures greater than four (4) stories in height shall comply with Section 304, for outdoor air supply requirements. For Source specific ventilation requirements, see Section 302.2.1. Compliance with this section shall be demonstrated through engineering calculations or performance testing. Documentation of calculations shall be submitted to the building official where required. Performance testing shall be conducted in accordance with recognized test methods.

302.1.1 Testing: At the discretion of the building official, flow testing may be required to verify that the mechanical system(s) satisfies the requirements of this section. Flow testing may be performed using flow hoods measuring at the intake or exhaust points of the system, in-line pitot tube, or pitot-traverse type measurement systems in the duct, short term tracer gas measurements, or other means approved by the building official.

302.2 Minimum Ventilation Performance: Each dwelling unit or guest room shall be equipped with source specific and whole house ventilation systems designed and installed to satisfy the ventilation requirements of this chapter.

EXCEPTION: All public corridors shall meet the ventilation requirements in Section 1203.3 of the Uniform Building Code.

302.2.1 Source Specific Ventilation: Source specific exhaust ventilation shall be required in each kitchen, bathroom, water closet, laundry room, indoor swimming pool, spa, and other rooms where excess water vapor or cooking odor is produced.

The minimum source specific ventilation effective exhaust capacity shall be not less than levels specified in Table 3-1.

302.2.2 Whole House Ventilation Systems: Each dwelling unit shall be equipped with a whole house ventilation system which shall be capable of providing at least 0.35 air changes per hour, but not less than 15 cubic feet per minute per bedroom plus an additional 15 cubic feet per minute. Whole house ventilation systems shall be designed to limit ventilation to a level no greater than 0.5 air changes per hour under normal operation conditions. Whole house ventilation systems shall supply outdoor air to all habitable rooms through individual outdoor air inlets, forced-air heating system, ducting or equivalent means. Doors and operable lites in windows are deemed not to meet the outdoor air supply intake requirements.

EXCEPTION: For dwelling units of no more than 1,400 square feet, the maximum ventilation rate shall be 0.65 air changes per hour.

302.3 Controls: All ventilation system controls shall be readily accessible. Controls for whole house ventilation systems shall be capable of operating the ventilation system without energizing other energy-consuming appliances.

EXCEPTION: Continuously operated whole house ventilation systems switch shall not be readily accessible by the occupant.

302.3.1 Source Specific Ventilation Systems: Source specific ventilation systems shall be controlled by manual switches, dehumidistats, timers, or other approved means.

302.3.2 Intermittently Operated Whole House Ventilation Systems: The intermittently operated whole house ventilation systems shall be constructed to have the capability for continuous operation, and shall have a manual control and an automatic control, such as a clock timer. At the time of final inspection, the automatic control timer shall be set to operate the whole house fan for a minimum of eight hours a day.

302.4 Noise: Whole house fans located four feet or less from the interior grille shall have a sone rating of 1.5 or less measured at 0.1 inches water gauge. Remotely mounted fans shall be acoustically isolated from the structural elements of the building and from attached duct work using insulated flexible duct or other approved material.

EXCEPTION: Whole house ventilation systems which are integrated with forced-air heating systems or heat-recovery ventilation systems are exempt from the sone rating requirements of this section.

302.5 Ventilation Ducts: All ducts shall terminate outside the building. Exhaust ducts in systems which are designed to operate intermittently shall be equipped with back-draft dampers. All exhaust ducts in unconditioned spaces shall be insulated to a minimum of R-4. All supply ducts in the conditioned space shall be insulated to a minimum of R-4.

302.6 Outdoor Air: A mechanical system shall supply outdoor air as required in Section 302.2.2. The mechanical system may consist of exhaust fans, supply fans, or both.

302.6.1 Outdoor Air Inlets: Inlets shall be screened or otherwise protected from entry by insects, leaves, or other material. Outdoor air inlets shall be located so as not to take air from the following areas:

- a. Closer than 10 feet from an appliance vent outlet, unless such vent outlet is 3 feet above the outdoor air inlet.
- b. Where it will pick up objectionable odors, fumes or flammable vapors.
- c. A hazardous or unsanitary location.
- d. A room or space having any fuel-burning appliances therein.
- e. Closer than 10 feet from a vent opening of a plumbing drainage system unless the vent opening is at least 3 feet above the air inlet.
- f. Attic, crawl spaces, or garages.

302.6.2 Individual Room Outdoor Air Inlets: Individual room outdoor air inlets shall:

- a. have controllable and secure openings;
- b. be sleeved or otherwise designed so as not to compromise the thermal properties of the wall or window in which they are placed;
- c. provide not less than four square inches of net free area of opening for each habitable space. Any inlet or combination of inlets which provide 10 cfm at 10 Pascals as determined by the Home Ventilating Institute Air Flow Test Standard are deemed equivalent to four square inches net free area.

302.6.3 Ventilation Integrated with Forced-Air Systems: The outdoor air connection to the return air stream shall be located upstream of the forced-air system blower and shall not be connected directly into a furnace cabinet to prevent thermal shock to the heat exchanger.

302.6.4 Distribution: Outdoor air shall be distributed to each habitable room by individual inlets, separate duct systems, or a forced-air system. Where outdoor air supplies are separated from exhaust points by doors,

provisions shall be made to ensure air flow by installation of distribution ducts, undercutting doors, installation of grilles, transoms, or similar means where permitted by the Uniform Building Code. Doors shall be undercut to a minimum of one-half inch above the surface of the finish floor covering.

SECTION 303 — MECHANICAL VENTILATION CRITERIA AND MINIMUM VENTILATION PRESCRIPTIVE REQUIREMENTS FOR ALL GROUP R OCCUPANCIES FOUR STORIES AND LESS

303.1 General: This Section establishes minimum prescriptive design requirements for intermittently operated systems. Continuously operated systems shall comply with Section 302. System characteristics not addressed in the following sections shall comply with Section 302. A system which meets the requirements of this section shall be deemed to satisfy the requirements of this chapter.

303.1.1 Source Specific: Exhaust fans providing source specific ventilation shall have a minimum fan flow rating not less than 50 cfm at 0.25 inches water gauge for bathrooms, laundries, or similar rooms and 100 cfm at 0.25 inches water gauge for kitchens. Manufacturers' fan flow ratings shall be determined as per HVI 916 (July 1989) or AMCA 210.

EXCEPTION: Where a range hood or down draft exhaust fan is used to satisfy the source specific ventilation requirements for kitchens, the range hood or down draft exhaust shall not be less than 100 cfm at 0.10 inches water gauge.

303.1.2 Whole House: Whole house ventilation systems may consist of whole house exhaust, integration with forced-air systems or dedicated heat recovery ventilation systems. Whole house ventilation systems shall provide ventilation capacity as specified in Table 3-2 and meet the following requirements:

a. Exhaust fans providing whole house ventilation shall have a flow rating at 0.25 inches water gauge as specified in Table 3-2. Manufacturers' fan flow ratings shall be determined as per HVI 916 (July 1989) or AMCA 210. Table 3-2 shall not be used for dwelling units with more than five (5) bedrooms.

b. Integrated forced-air ventilation systems shall have an outdoor air inlet duct connecting a terminal element on the outside of the building to the return air plenum of the forced-air system, at a point within four (4) feet upstream of the air handler, and be equipped with one of the following:

1. A motorized damper connected to the automatic ventilation control as specified in Section 302.3.2; or

2. A damper installed and set to meet measured flow rates as specified in Table 3-2, by either field testing or following manufacturer's installation instructions based on site conditions; or
3. An automatic flow regulated device with field measured or field calculated minimum negative pressure of 0.07 inches water gauge at the point where the outside air duct is connected to the return air plenum.

c. Heat recovery ventilation systems: All duct work in heat recovery ventilation systems shall be not less than six (6) inch diameter. Balancing dampers shall be installed on the inlet and exhaust side. Flow measurement grids shall be installed on the supply and return. System minimum flow rating shall be not less than that specified in Table 3-2. Maximum flow rates in Table 3-2 do not apply to heat recovery ventilation systems.

303.2 Source Specific and Whole House Ventilation

Ducts: Exhaust ducts shall meet all requirements of Section 302.5. Duct diameter, length, and number of elbows for exhaust fans shall be as specified in Table 3-3. Terminal elements for exhaust fan duct systems shall have at least the equivalent net free area of the duct work. Duct diameter, length, and number of elbows for integrated forced air systems shall be as specified in Table 3-5. Terminal elements for integrated systems shall be the same size as the connecting ductwork or eight (8) inches in diameter, whichever is greater.

SECTION 304 — MECHANICAL VENTILATION CRITERIA AND MINIMUM VENTILATION PERFORMANCE FOR ALL OTHER OCCUPANCIES NOT COVERED IN SECTIONS 302 AND 303.

304.1 Ventilation: The minimum requirements for operable area to provide natural ventilation are specified in the Uniform Building Code (UBC) as adopted by the state of Washington.

Where a mechanical ventilation system is installed, the mechanical ventilation system shall be capable of supplying ventilation air to each zone with the minimum outdoor air quantities specified in Table 3-4.

EXCEPTION: Where occupancy density is known and documented in the plans, the outside air rate may be based on the design occupant density. Under no circumstance shall the occupancies used result in outside air less than one-half that resulting from application of Table 3-4 estimated maximum occupancy values.

The outdoor air shall be ducted in a fully enclosed path directly to every air handling unit in each zone not provided with sufficient operable area for natural ventilation.

EXCEPTION: Ducts may terminate within 12 inches of the intake to an HVAC unit provided they are physically fastened so that the outside air duct is directed into the unit intake.

In all parking garages, other than open parking garages as defined in UBC Section 311.9, used for storing or handling of automobiles operating under their own power and on all loading platforms in bus terminals, ventilation shall be provided at 1.5 cfm per square foot of gross floor area. The building official may approve an alternate ventilation system designed to exhaust a minimum 14,000 cfm for each operating vehicle. Such system shall be based on the anticipated instantaneous movement rate of vehicles but not less than 2.5 percent (or one vehicle) of the garage capacity. Automatic carbon monoxide sensing systems may be submitted for approval.

In all buildings used for the repair of automobiles, each repair stall shall be equipped with an exhaust extension duct, extending to the outside of the building, which if over 10 feet in length, shall mechanically exhaust 300 cfm. Connecting offices and waiting rooms shall be supplied with conditioned air under positive pressure.

Combustion air requirements shall conform to the requirements of Chapter 7 of the UMC.

Mechanical refrigerating equipment and rooms storing refrigerates shall conform to the requirements of Chapter 11 of the UMC.

TABLE 3-1
MINIMUM SOURCE SPECIFIC VENTILATION CAPACITY REQUIREMENTS

	Bathrooms	Kitchens
Intermittently operating	50 cfm	100 cfm
Continuous operation	20 cfm	25 cfm

TABLE 3-2
WHOLE HOUSE EXHAUST FAN PRESCRIPTIVE REQUIREMENTS¹

Bedrooms	CFM	
	Minimum	Maximum
2 or less	50	75
3	80	120
4	100	150
5	120	180

1. This table shall not be used for dwelling units containing more than 5 bedrooms.

TABLE 3-3
PRESCRIPTIVE EXHAUST DUCT SIZING

Fan Tested CFM @ 0.25 W.G.	Minimum Flex Diameter	Maximum Length Feet	Minimum Smooth Diameter	Maximum Length Feet	Maximum Elbows¹
50	4 inch	25	4 inch	70	3
50	5 inch	90	5 inch	100	3
50	6 inch	No Limit	6 inch	No Limit	3
80	4 inch ²	NA	4 inch	20	3
80	5 inch	15	5 inch	100	3
80	6 inch	90	6 inch	No Limit	3
100	5 inch ²	NA	5 inch	50	3
100	6 inch	45	6 inch	No Limit	3
125	6 inch	15	6 inch	No Limit	3
125	7 inch	70	7 inch	No Limit	3

1. For each additional elbow subtract 10 feet from length.
2. Flex ducts of this diameter are not permitted with fans of this size.

TABLE 3-4
OUTDOOR AIR REQUIREMENTS FOR VENTILATION¹
Occupancies not Subject to Sections 302 and 303

Application	Estimated Maximum ² Occupancy P/1000 ft ² or 100 m ²	Outdoor Air Requirements cfm/person
Dry Cleaners, Laundries³		
Commercial laundry	10	25
Commercial dry cleaner	30	30
Storage, pick up	30	35
Coin-operated laundries	20	15
Coin-operated dry cleaner	20	15
Dwelling Units in Buildings Greater Than Four Stories or Attached to I-Occupancy Facilities		
Bedrooms & living areas ²⁴		15
Food and Beverage Service		
Dinning rooms	70	20
Cafeteria, fast food	100	20
Bars, cocktail lounges ⁴	100	30
Kitchens(cooking) ²³	20	15
Garages, Repair, Service Stations		
Enclosed parking garage ⁵		1.50 cfm/ft.sq.
Auto repair rooms		1.50 cfm/ft.sq.
Hotels, Motels, Resorts, Congregate Residences with More Than Four Stories⁶		
Bedrooms		30 cfm/room
Living Rooms		30 cfm/room
Bath ⁷		35 cfm/room
Lobbies	30	15
Conference rooms	50	20
Assembly rooms	120	15
Gambling casinos ⁴	120	30
Offices		
Office space ⁹	7	20
Reception area	60	15
Telecommunication centers and data entry areas	60	20
Conference rooms	50	20
Public Spaces		
Corridors and utilities		0.05 cfm/ft.sq.
Public restroom, cfm/wc or urinal ¹⁰		50
Lockers and dressing rooms		0.50 cfm/ft.sq.
Smoking lounge ¹¹	70	60
Elevators ¹²		1.0 cfm/ft.sq.
Retail Stores, Sales Floors, and Show Room Floors		
Basement and street	30	0.30 cfm/ft.sq.
Upper floors	20	0.20 cfm/ft.sq.
Storage rooms	15	0.15 cfm/ft.sq.
Dressing rooms		0.20 cfm/ft.sq.
Malls and arcades	20	0.20 cfm/ft.sq.
Shipping and receiving	10	0.15 cfm/ft.sq.
Smoking lounge ¹¹	70	60
Warehouses	5	0.05 cfm/ft.sq.

TABLE 3-4
OUTDOOR AIR REQUIREMENTS FOR VENTILATION¹
 (Continued)

Application		Estimated Maximum ² Occupancy P/1000 ft ² or 100 m ²	Outdoor Air Requirements cfm/person
Specialty Shops			
	Barber	25	15
	Beauty	25	25
	Reducing salons	20	15
	Florists ¹³	8	15
	Clothiers, furniture		0.30 cfm/ft.sq.
	Hardware, drugs, fabric	8	15
	Supermarkets	8	15
	Pet shops		1.00 cfm/ft.sq.
Sports and Amusement¹⁴			
	Spectator areas	150	15
	Game rooms	70	25
	Ice arenas(playing areas)		0.50 cfm/ft.sq
	Swimming Pools(pool and deck area) ¹⁵		0.50 cfm/ft.sq.
	Playing floor(gymnasium)	30	20
	Ballrooms and discos	100	25
	Bowling alleys(seating areas)	70	25
Theaters¹⁶			
	Ticket booths	60	20
	Lobbies	150	20
	Auditorium	150	20
	Stages, studios	70	15
Transportation¹⁷			
	Waiting rooms	100	15
	Platforms	100	15
	Vehicles	150	15
Workrooms			
	Meat processing ¹⁸	10	15
	Photo studios	10	15
	Darkrooms	10	0.50 cfm/ft.sq.
	Pharmacy	20	15
	Bank vaults	5	15
	Duplicating, printing ¹⁹		0.50 cfm/ft.sq.
INSTITUTIONAL FACILITIES			
Education			
	Classroom	50	15
	Laboratories ²⁰	30	20
	Training shop	30	20
	Music rooms	50	15
	Libraries	20	15
	Locker rooms		0.50 cfm/ft.sq.
	Corridors		0.10 cfm/ft.sq.
	Auditoriums	150	15
	Smoking lounges ¹¹	70	60

TABLE 3-4
OUTDOOR AIR REQUIREMENTS FOR VENTILATION¹
(Continued)

Application	Estimated Maximum ² Occupancy P/1000 ft ² or 100 m ²	Outdoor Air Requirements cfm/person
Hospitals, Nursing and Convalescent Homes		
Patient rooms ²¹	10	25
Medical procedure	20	15
Operating rooms	20	30
Recovery and ICU	20	15
Autopsy rooms ²²		0.50 cfm/ft.sq.
Physical Therapy	20	15
Correctional Facilities		
Cells	20	20
Dining halls	100	15
Guard station	40	15

1. Derived from ASHRAE Standard 62-1989.
2. Net occupiable space.
3. Dry-cleaning process may require more air.
4. Supplementary smoke-removal equipment may be required.
5. Distribution among people must consider worker location and concentration of running engine; stands where engine are run must incorporate systems for positive engine exhaust withdrawal. Contaminant sensors may be used to control ventilation.
6. Independent of room size.
7. Installed capacity for intermittent use.
8. See also food and beverage service, merchandising, barber and beauty shops, garages.
9. Some office equipment may require local exhaust.
10. Mechanical exhaust with no recirculation is recommended.
11. Normally supplied by transfer air, local mechanical exhaust; with no recirculation recommended.
12. Normally supplied by transfer air.
13. Ventilation to optimize plant growth may dictate requirements.
14. When internal combustion engines are operated for maintenance of playing surfaces, increased ventilation rates may be required.
15. Higher values may be required for humidity control.
16. Special ventilation will be needed to eliminate special stage effects.
17. Ventilation within vehicles may require special considerations.
18. Spaces maintained at low temperatures(-10°F. to +50°F) are not covered by these requirements unless the occupancy is continuous. Ventilation from adjoining spaces is permissible. When the occupancy is intermittent, infiltration will normally exceed the ventilation requirements.
19. Installed equipment must incorporate positive exhaust and control of undesirable contaminants.
20. Special contamination control systems may be required for processes or functions including laboratory animal occupancy.
21. Special requirements or codes and pressure relationships may determine minimum ventilation rates and filter efficiency. Procedures generating contaminants may require higher rates.
22. Air shall not be recirculated into other spaces.
23. Makeup air for hood exhaust may require more ventilating air.
24. Occupant loading shall be based on the number of bedrooms as follows: First bedroom, two persons; each additional bedroom, one person. Where higher occupant loadings are known, they shall be used.

TABLE 3-5
PRESCRIPTIVE INTEGRATED FORCED AIR SUPPLY DUCT SIZING

Number of Bedrooms	Minimum Smooth Duct Diameter	Minimum Flexible Duct Diameter	Maximum Length ¹	Maximum Number of Elbows ²
2 or less	6"	7"	20'	3
3	7"	8"	20'	3
4 or more	8"	9"	20'	3

1. For lengths over 20 feet increase duct diameter 1 inch.
2. For elbows numbering more than 3 increase duct diameter 1 inch.

CHAPTER 4

INDOOR AIR QUALITY

SECTION 401 — POLLUTANT SOURCE CONTROL

401.1 Formaldehyde Reduction Measures: All structural panel components within the conditioned space such as plywood, particle board, wafer board, and oriented strand board shall be identified as "EXPOSURE 1", "EXTERIOR" or "HUD-APPROVED".

SECTION 402 — SOLID FUEL BURNING APPLIANCES AND FIREPLACES

402.1 General: Solid fuel burning appliances and fireplaces shall satisfy one of the following criteria.

402.2 Solid Fuel Burning Appliances: Solid fuel burning appliances shall be provided with the following:

- a. Tight fitting metal or ceramic glass doors.
- b. 1. A source from outside the structure of primary combustion air, connected to the appliance as per manufacturer's specification. The air inlet shall originate at a point below the fire box. The duct shall be four (4) inches or greater in diameter, not exceed 20 feet in length, and be installed as per manufacturer's instructions;

or

2. The appliance and manufacturer's recommended combustion air supply, as an installed unit, shall be certified by an independent testing laboratory to have passed Test No. 11-Negative Pressure Test, Section 12.3, of ULC S627-M1984 "Space Heaters for Use with Solid Fuels," modified as follows:
 - A. Negative pressure of eight (8) Pascal shall be initially established with the chamber sealed and the air supply, if not directly connected to the appliance, closed off.
 - B. The air supply if not directly connected to the appliance, shall then be opened.
 - C. The maximum allowable air exchange rate from chamber leakage and intentional air supply for the unit (appliance with combustion air supply) in the test chamber is 3.5 air changes per hour, or 28 cfm (cubic feet of air per minute), whichever is less.

EXCEPTION: Combustion air may be supplied to the room in which the solid fuel burning appliance is located in lieu of direct ducting, provided that one of the following conditions is met:

1. The solid fuel burning appliance is part of a central heating plant and installed in an unconditioned space in conformance with the Uniform Mechanical Code; or

2. The solid fuel burning appliance is installed in existing construction directly on a concrete floor or surrounded by masonry materials as in a fireplace.

The combustion air terminus shall be located as close to the solid fuel burning appliance as possible and shall be provided with a barometric damper or equivalent. The combustion air source shall be specified by the manufacturer or no less than four (4) inches in diameter or the equivalent in area or as approved.

402.3 Fireplaces: Fireplaces shall be provided with each of the following:

- a. Tightly fitting flue dampers, operated by a readily accessible manual or approved automatic control.

EXCEPTION: Fireplaces with gas logs shall be installed in accordance with the Uniform Mechanical Code Section 901.

- b. An outside source for combustion air ducted into the firebox. The duct shall be at least six (6) square inches, and shall be provided with an operable outside air duct damper.

EXCEPTION: Washington certified fireplaces shall be installed with the combustion air systems necessary for their safe and efficient combustion and specified by the manufacturer in accordance with the Washington State UBC Standard 31-2 (WAC 51-40-31200) and UBC Section 3102.5.4 (WAC 51-40-3102).

- c. Site built fireplaces shall have tight fitting glass or metal doors, or a flue draft induction fan or as approved for minimizing back-drafting. Factory built fireplaces shall use doors listed for the installed appliance.

402.4 Masonry Heaters: Masonry heaters shall be approved by the Department of Ecology and shall contain both of the following:

- a. Primary combustion air ducted from the outside of the structure to the appliance.

- b. Tight fitting ceramic glass or metal doors. Flue damper, when provided, shall have an external control and when in the closed position shall have a net free area of not less than five percent (5%) of the flue cross sectional area.

Chapter 5

RADON RESISTIVE CONSTRUCTION STANDARDS

SECTION 501 — SCOPE

501.1 General: The criteria of this chapter establishes minimum radon resistive construction requirements for all Group R Occupancies. These requirements are adopted pursuant to the ventilation requirements of Section 7, of Chapter 2 of the Session Laws of 1990.

501.2 Application: The requirements of this Chapter shall be adopted and enforced by all jurisdictions of the state according to the following subsections.

501.2.1: All jurisdictions of the State shall comply with Section 502.

501.2.2: Ferry, Okanogan, Pend Oreille, Skamania, Spokane, and Stevens counties shall also comply with Section 503.

SECTION 502 — STATE-WIDE RADON REQUIREMENTS

502.1 Crawlspace

502.1.1 General: All crawlspaces shall comply with the requirements of this section.

502.1.2 Ventilation: All crawlspaces shall be ventilated as specified in Section 2306.7 of the Washington State Uniform Building Code (WAC 51-40).

If the installed ventilation in a crawlspace is less than one (1) square foot for each 300 square feet of crawl space area, or if the crawlspace vents are equipped with operable louvers, a radon vent shall be installed to originate from a point between the ground cover and soil. The radon vent shall be installed in accordance with Sections 503.2.6 and 503.2.7.

502.1.3 Crawlspace Plenum Systems: In crawlspace plenum systems used for providing supply air for an HVAC system, aggregate, a permanently sealed soil gas retarder membrane and a radon vent pipe shall be installed in accordance with Section 503.2. Crawlspace shall not be used for return air plenums.

In addition, an operable radon vent fan shall be installed and activated. The fan shall be located as specified in Section 503.2.7. The fan shall be capable of providing at least 100 cfm at one inch water column static pressure. The fan shall be controlled by a readily accessible manual switch. The switch shall be labeled "RADON VENT FAN."

SECTION 503 RADON — RADON PRESCRIPTIVE REQUIREMENTS

503.1 Scope: This Section applies to those counties specified in Section 501.2.2. This section establishes prescriptive construction requirements for reducing the potential for radon entry into all Group R Occupancies, and for preparing the building for future mitigation if desired.

In all crawlspaces, except crawlspace plenums used for providing supply air for an HVAC system, a continuous air barrier shall be installed between the crawlspace area and the occupied area to limit air transport between the areas. If a wood sheet subfloor or other material is utilized as an air barrier, in addition to the requirements of Section 502.1.6.2 of the Washington State Energy Code, all joints between sheets shall be sealed.

503.2 Floors in Contact with the Earth

503.2.1 General: Concrete slabs that are in direct contact with the building envelope shall comply with the requirements of this section.

Exception: Concrete slabs located under garages or other than Group R Occupancies need not comply with this chapter.

503.2.2 Aggregate: A layer of aggregate of four (4) inch minimum thickness shall be placed beneath concrete slabs. The aggregate shall be continuous to the extent practical.

503.2.3 Gradation: Aggregate shall:

- a. Comply with ASTM Standard C-33 Standard Specification for Concrete Aggregate and shall be size No. 67 or larger size aggregate as listed in Table 2, Grading Requirements for Course Aggregate; or
- b. Meet the 1988 Washington State Department of Transportation Specification 9-03.1 (3) "Coarse Aggregate for Portland Cement Concrete", or any equivalent successor standards. Aggregate size shall be of Grade 5 or larger as listed in Section 9-03.1 (3) C, "Grading"; or
- c. Be screened, washed, and free of deleterious substances in a manner consistent with ASTM Standard C-33 with 100 percent of the gravel passing a one (1) inch sieve and less than two percent (2%) passing a four (4) inch sieve. Sieve characteristics shall conform to those acceptable under ASTM Standard C-33.

EXCEPTION: Aggregate shall not be required if a substitute material or system, with sufficient load bearing characteristics, and having approved capability to provide equal or superior air flow, is installed.

503.2.4 Soil-Gas Retarder Membrane: A soil-gas retarder membrane, consisting of at least one layer of virgin polyethylene with a thickness of at least 6 mil, or equivalent flexible sheet material, shall be placed directly under all concrete slabs so that the slab is in direct contact with the membrane. The flexible sheet shall extend to the foundation wall or to the outside edge of the monolithic slab. Seams shall overlap at least 12 inches.

EXCEPTION: If the membrane is not in direct contact with the bottom of the concrete slab, all overlapping seams shall be sealed with an approved tape or sealant, and the material shall be sealed to the foundation wall in a permanent manner. The membrane shall also be fitted tightly to all pipes, wires, and other penetrations of the membrane and sealed with an approved sealant or tape. All punctures or tears shall be repaired with the same or approved material and similarly lapped and sealed. In no case shall the membrane be installed below the aggregate.

503.2.5 Sealing of Penetrations and Joints: All penetrations and joints in concrete slabs or other floor systems and walls below grade shall be sealed by an approved sealant to create an air barrier to limit the movement of soil-gas into the indoor air.

Sealants shall be approved by the manufacturer for the intended purpose. Sealant joints shall conform to manufacturer's specifications. The sealant shall be placed and tooled in accordance with manufacturer's specifications. There shall be no gaps or voids after the sealant has cured.

503.2.6 Radon Vent: One continuous sealed pipe shall run from a point within the aggregate under each concrete slab to a point outside the building. Joints and connections shall be permanently gas tight. The continuous sealed pipe shall interface with the aggregate in the following manner, or by other approved equal method: The pipe shall be permanently connected to a "T" within the aggregate area so that the two end openings of the "T" lie within the aggregate area. A minimum of five (5) feet of perforated drain pipe of three (3) inches minimum diameter shall join to and extend from the "T." The perforated pipe shall remain in the aggregate area and shall not be capped at the ends. The "T" and its perforated pipe extensions shall be located at least five (5) feet horizontally from the exterior perimeter of the aggregate area.

The continuous sealed pipe shall terminate no less than twelve (12) inches above the eave, and more than ten (10) horizontal feet from a woodstove or fireplace chimney, or operable window. The continuous sealed pipe shall be labeled "radon vent." The label shall be placed so as to remain visible to an occupant.

The minimum pipe diameter shall be three (3) inches unless otherwise approved. Acceptable sealed plastic pipe shall be smooth walled, and may include either PVC schedule 40 or ABS schedule of equivalent wall thickness.

The entire sealed pipe system shall be sloped to drain to the sub-slab aggregate.

The sealed pipe system may pass through an unconditioned attic before exiting the building; but to the extent practicable, the sealed pipe shall be located inside the thermal envelope of the building in order to enhance passive stack venting.

EXCEPTION: A fan for sub-slab depressurization system includes the following:

- a. soil-gas retarder membrane as specified in Section 503.2.4;
- b. sealing of penetrations and joints as specified in Section 503.2.5;
- c. a three (3) inch continuous sealed radon pipe shall run from a point within the aggregate under each concrete slab to a point outside the building;
- d. joints and connections shall be gas tight, and may be of either PVC schedule 40 or ABS schedule of equivalent in wall thickness;
- e. a label of "radon vent" shall be placed on the pipe so as to remain visible to an occupant;
- f. fan circuit and wiring as specified in Section 503.2.7 and a fan.

If the sub-slab depressurization system is exhausted through the concrete foundation wall or rim joist, the exhaust terminus shall be a minimum of six (6) feet from operable windows or outdoor air intake vents and shall be directed away from operable windows and outdoor air intake vents to prevent radon re-entrainment.

503.2.7 Fan Circuit and Wiring and Location: An area for location of an in-line fan shall be provided. The location shall be as close as practicable to the radon vent pipe's point of exit from the building, or shall be outside the building shell; and shall be located so that the fan and all downstream piping is isolated from the indoor air.

Provisions shall be made to allow future activation of an in-line fan on the radon vent pipe without the need to place new wiring. A 110 volt power supply shall be provided at a junction box near the fan location.

503.2.8 Separate Aggregate Areas: If the four (4) inch aggregate area underneath the concrete slab is not continuous, but is separated into distinct isolated aggregate areas by a footing or other barrier, a minimum of one radon vent pipe shall be installed into each separate aggregate area.

EXCEPTION: Separate aggregate areas may be considered a single area if a minimum three (3) inch diameter connection joining the separate areas is provided for every 30 feet of barrier separating those areas.

503.2.9 Concrete Block Walls: Concrete block walls connected to below grade areas shall be considered unsealed surfaces. All openings in concrete block walls that will not remain accessible upon completion of the building shall be sealed at both vertical and horizontal surfaces, in order to create a continuous air barrier to limit the transport of soil-gas into the indoor air.