

**WASHINGTON STATE  
BUILDING CODE**

**CHAPTER 51-52  
2018 Edition**

**INTERNATIONAL MECHANICAL CODE**

**Includes adoption of and amendments to  
the 2018 International Fuel Gas Code**

**And adoption of  
the 2018 National Fuel Gas Code (NFPA 54)  
and  
the 2017 Liquefied Petroleum Gas Code (NFPA 58)**



**Washington State Building Code Council**

**Effective July 1, 2020**

Copies of the State Building Codes and  
complete copies of the 2018 Model Codes  
may be obtained from:

Washington Association of Building Officials  
Post Office Box 7310  
Olympia, Washington 98507-7310  
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International Mechanical Code  
Chapter 51-52 WAC  
Effective July 1, 2020  
First Printing March 2020

First Edition based on  
WSR 20-03-041

## ***Preface***

**Authority:** The International Mechanical Code (Chapter 51-52 WAC) is adopted by the Washington State Building Code Council pursuant to Chapters 19.27 and 70.92 RCW. This code was first adopted by reference by the Washington State Legislature in 1974. In 1985, the Legislature delegated the responsibility of adoption and amendment of these codes to the State Building Code Council.

**Supersession of Previous Codes:** Chapter 51-52 WAC supersedes Chapter 51-42 WAC.

**Code Precedence:** The State Building Code Act, Chapter 19.27 RCW, establishes the following order of precedence among the documents adopted as parts of the State Building Code:

International Building Code, Standards and amendments – WAC 51-50;  
 International Residential Code, Standards and amendments – WAC 51-51;  
 International Mechanical Code, Standards and amendments – WAC 51-52;  
 International Fire Code, Standards and amendments – WAC 51-54A;  
 Uniform Plumbing Code, Standards and amendments – WAC 51-56.

Where there is a conflict between codes, an earlier named code takes precedence over a later named code. In the case of conflict between the duct insulation requirements of the International Mechanical Code and the duct insulation requirements of the Energy Code, the Energy Code, or where applicable, a local jurisdiction's energy code, shall govern.

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 conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

**Organization and Numbering:** These rules are written to allow compatible use with the International Mechanical Code. All sections which are amended, deleted, or added are referenced.

**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.

### **Amendments to the State Building Code:**

The State Building Code Council has adopted review procedures and approval criteria for local amendments. These procedures and criteria are found in Chapter 51-04 WAC. The Council has exempted from its review any amendments to the administrative provisions of the various codes.

Forms for proposing statewide amendments to the State Building Code are available from the State Building Code Council staff.

A. **Amendments of Statewide Application:** On a yearly basis the State Building Code Council will consider proposals to amend the State Building Code. The Council is not scheduled to enter formal rulemaking until 2021 as part of its consideration of adoption of the 2021 series of codes.

Proposals to amend the State Building Code shall be made on forms provided by the Building Code Council.

B. **Local Amendments:** Any jurisdiction may amend the State Building Code provided the amendments do not reduce the minimum performance standards of the codes. There are two areas where local amendments are limited or prohibited:

**Prohibited Amendments:** Residential provisions of the State Energy Code (WAC 51-11R and WAC 51-11C); any provision of the International Building Code or International Residential Code affecting accessibility; and standards specifically adopted in Chapters 19.27 and 19.27A WAC cannot be amended by any local jurisdiction.

**Residential Amendments:** Amendments by local jurisdictions which affect the construction of single family and multi-family residential buildings must be reviewed and approved by the State Building Code Council before such amendments can be enforced. The State Building Code Act provides the following definition:

Multi-family residential building: means common wall residential buildings that consist of four or fewer units, that do not exceed two stories in height, that are less than 5,000 square feet in area, and that have a one-hour fire-resistive occupancy separation between units.

Application forms for Council review of local amendments are available from the State Building Code Council Staff.

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**Printing Format:** This version of the rules is published as a series of insert or replacement pages and is intended to be printed as a two-sided document. Each page provides instructions for installing them in the model code book. Amendments to the model code, are indicated by a double line ( **||** ) in the margin next to the revised portions. Any portion of the model code that has been deleted in the amendment will be marked with ( **◀** ) symbol

**Effective Date:** These rules were adopted by the State Building Code Council on November 8, 2019. The rules are effective throughout the state on July 1, 2020. This code is based on WAC 51-56 as published in WSR 16-02-044. It is subject to review by the State Legislature during the 2020 session.)

**Building Permit Fees:** The activities of the State Building Code Council are supported by permit fees collected by each city and county. Section 19.27.085 of the State Building Code Act requires that a fee of \$6.50 be imposed on each residential permit and \$25.00 on each commercial building permit issued by each city and county. In addition, a fee of \$2.00 per unit shall be imposed for each dwelling unit after the first unit, on each building containing more than one residential unit. For the purpose of this fee, WAC 365-110-035 defines building permits as any permit to construct, enlarge, alter, repair, move, improve, remove, convert or demolish any building or structure regulated by the Building Code. Exempt from the fee are plumbing, electrical, mechanical permits, permits issued to install a mobile/manufactured home, commercial coach or factory built structure, or permits issued pursuant to the International Fire Code.

Each city and county shall remit moneys collected to the state treasury quarterly. No remittance is required until a minimum of \$50.00 has accumulated.

These permit fees are the amounts current in January 2020. Such fees may be changed by the State Legislature.

**Opinions:** RCW 19.27.031 grants the council authority to render opinions relating to the building code at the request of a local code official. For the purposes of this section, the term "code official" means the local or state official, or their designee, responsible for implementation and enforcement of the specific code provision on which the opinion is requested.

At the request of a code official, the council will issue opinions relating to the codes adopted under chapters 19.27, 19.27A, and 70.92 RCW, and council amendments to the model codes. At the request of a local code official, the council may issue opinions on the applicability of WAC 51-04-030 to a local government ordinance regulating construction. Council related opinions may be developed and approved by a standing committee of the council. Opinions approved by a standing committee may be reviewed and modified by the council.

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INTERNATIONAL MECHANICAL CODE  
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**CHAPTER 51-52 WAC  
STATE BUILDING CODE ADOPTION AND AMENDMENT  
OF THE 2015 EDITION OF THE INTERNATIONAL MECHANICAL CODE**

**WAC 51-52-001 AUTHORITY**

These rules are adopted under the authority of Chapter 19.27 RCW.

**WAC 51-52-002 PURPOSE**

The purpose of these rules is to implement the provisions of Chapter 19.27 RCW, which provides that the State Building Code Council shall maintain the State Building Code in a status which is consistent with the purpose as set forth in RCW 19.27.020. In maintaining the codes the Council shall regularly review updated versions of the codes adopted under the act, and other pertinent information, and shall amend the codes as deemed appropriate by the Council.

**WAC 51-52-003 INTERNATIONAL MECHANICAL CODE**

The 2018 edition of the International Mechanical Code published by the International Code Council is hereby adopted by reference with the exceptions noted in this Chapter of the Washington Administrative Code. ||

**WAC 51-52-004 CONFLICT BETWEEN INTERNATIONAL MECHANICAL CODE AND STATE ENERGY CODE CHAPTER 51-11 WAC**

In the case of conflict between the duct sealing or insulation requirements of Section 603 or Section 604 of this code and the duct sealing or insulation requirements of Chapter 51-11C/R WAC, the Washington State Energy Code, or where applicable, a local jurisdiction's energy code, the provisions of such energy codes shall govern.

**WAC 51-52-007 EXCEPTIONS**

The exceptions and amendments to the International Mechanical Code contained in the provisions of Chapter 19.27 RCW shall apply in case of conflict with any of the provisions of these rules.

The provisions of this code do not apply to temporary growing structures used solely for the commercial production of horticultural plants including ornamental plants, flowers, vegetables, and fruits. "Temporary growing structure" means a structure that has the sides and roof covered with polyethylene, polyvinyl, or similar flexible synthetic material and is used to provide plants with either frost protection or increased heat retention. A temporary growing structure is not considered a building for purposes of this code.

Codes referenced which are not adopted through RCW 19.27.031 or RCW 19.27A shall not apply unless specifically adopted by the authority having jurisdiction.

**WAC 51-52-008 IMPLEMENTATION**

The International Mechanical Code adopted by Chapter 51-52 WAC shall become effective in all counties and cities of this state on July 1, 2020. ||

**101.2 Scope.** This code shall regulate the design, installation, maintenance, alteration and inspection of mechanical systems that are permanently installed and utilized to provide control of environmental conditions and related processes within buildings. This code shall also regulate those mechanical systems, system components, equipment and appliances specifically addressed herein. The installation of fuel gas distribution piping and equipment, fuel gas-fired appliances and fuel gas-fired appliance venting systems shall be regulated by the *International Fuel Gas Code*. References in this code to Group R shall include Group I-1, Condition 2 assisted living facilities licensed by Washington state under chapter 388-78A WAC and Group I-1, Condition 2 residential treatment facilities licensed by Washington state under chapter 246-337 WAC.

**Exceptions:**

1. Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories high with separate means of egress and their accessory structures shall comply with the International Residential Code.
2. The standards for liquefied petroleum gas installations shall be the 2014 Edition of NFPA 58 (Liquefied Petroleum Gas Code) and the 2015 Edition of ANSI Z223.1/NFPA 54 (National Fuel Gas Code).



**BALANCED WHOLE HOUSE VENTILATION.** Any combination of concurrently operating residential unit mechanical exhaust and mechanical supply whereby the total mechanical exhaust airflow rate is within 10 percent or 5 cfm, whichever is greater, of the total mechanical supply airflow rate. Intermittent dryer exhaust, intermittent range hood exhaust, and intermittent toilet room exhaust airflow rates above the residential dwelling or sleeping unit minimum ventilation rate are exempt from the balanced airflow calculation.

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**DISTRIBUTED WHOLE HOUSE VENTILATION.** A whole house ventilation system shall be considered distributed when it supplies outdoor air directly (not transfer air) to each dwelling or sleeping unit habitable space, (living room, den, office, interior adjoining spaces or bedroom), and exhausts air from all kitchens and bathrooms directly outside.



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|| **LOCAL EXHAUST.** An exhaust system that uses one or more fans to exhaust air from a specific room or rooms within a residential dwelling or sleeping unit.

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**PERMANENT CONSTRUCTION.** Construction that, if removed, would disturb the structural integrity of the building or the fire-resistance rating of a building assembly.



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**RELIEF AIR.** Exhausted return air from a system that provides ventilation for human usage.

**REPLACEMENT AIR.** Outdoor air that is used to replace air removed from a building through an exhaust system. Replacement air may be derived from one or more of the following: Makeup air, supply air, transfer air, and infiltration. However, the ultimate source of all replacement air is outdoor air. When replacement air exceeds exhaust, the result is exfiltration.

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

**VENTILATION ZONE.** Any indoor area that requires ventilation and comprises one or more spaces with the same occupancy category (see Table 403.3.1.1), occupant density, zone air distribution effectiveness (see Section 403.3.1.1.1.2), and design zone primary airflow per unit area.

**306.5 Equipment and appliances on roofs or elevated structures.** Where equipment requiring access or appliances are located on an elevated structure or the roof of a building such that personnel will have to climb higher than 16 feet (4877 mm), an interior or exterior means of access shall be provided. Such access shall not require climbing over obstructions greater than 30 inches (762 mm) in height or walking on roofs having a slope greater than 4 units vertical in 12 units horizontal (33 percent slope). Such access shall not require the use of portable ladders. Where access involves climbing over parapet walls, the height shall be measured to the top of the parapet wall.

Permanent ladders installed to provide the required access shall comply with the following minimum design criteria:

1. The side railing shall extend above the parapet or roof edge not less than 42 inches (1067 mm).
2. Ladders shall have rung spacing not to exceed 12 inches (305 mm) on center. The uppermost rung shall be a maximum of 24 inches below the upper edge of the roof hatch, roof or parapet, as applicable.
3. Ladders shall have a toe spacing not less than 7 inches (178 mm) deep.
4. There shall be a minimum of 18 inches (457 mm) between rails.
5. Rungs shall have a minimum 0.75-inch (19 mm) diameter and be capable of withstanding a 300-pound (136.1 kg) load.
6. Ladders over 30 feet (9144 mm) in height shall be provided with offset sections and landings capable of withstanding 100 pounds (488.2 kg/m<sup>2</sup>) per square foot. Landing dimensions shall be not less than 18 inches (457 mm) and not less than the width of the ladder served. A guard rail shall be provided on all open sides of the landing. Landing dimensions shall be not less than 18 inches and not less than the width of the ladder served. A guardrail shall be provided on all open sides of the landing.
7. Climbing clearances. The distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be a minimum of 30 inches measured perpendicular to the rungs. This distance shall be maintained from the point of ladder access to the bottom of the roof hatch. A minimum clear width of 15 inches shall be provided on both sides of the ladder measured from the midpoint of and parallel with the rungs except where cages or wells are installed.
8. Landing required. The ladder shall be provided with a clear and unobstructed bottom landing area having a minimum dimension of 30 inches by 30 inches centered in front of the ladder.
9. Ladders shall be protected against corrosion by approved means.
10. Access to ladders shall be provided at all times.

Catwalks installed to provide the required access shall be not less than 24 inches (610 mm) wide and shall have railings as required for service platforms.

**Exception:** This section shall not apply to Group R-3 occupancies.

**306.6 Appliances above ceilings.** Appliances that are located above the ceiling shall have *ready access* for inspection, service and repair without removing *permanent construction*. Appliances shall be provided with access to panel or removable ceiling tile with minimum nominal dimensions of 24 inches by 24 inches (609 mm x 609 mm).

The appliance is not required to be removable or replaceable through the access panel or removable ceiling tile. The appliance may be removed or replaced by removing the ceiling or wall assemblies adjacent to the appliance as long as they are not *permanent construction*.

**Exceptions:**

1. This section shall not apply to replacement appliances installed in existing compartments and alcoves where the working space clearances are in accordance with the equipment or appliance manufacturer's installation instructions.
2. A smaller access panel or removable ceiling tile shall be permitted when allowed by the equipment or appliance manufacturer's installation instructions.

**307.2.3 Auxiliary and secondary drain systems.** In addition to the requirements of Section 307.2.1, where damage to any building components could occur as a result of overflow from the *equipment* primary condensate removal system, one of the following auxiliary protection methods shall be provided for each cooling coil or fuel-fired *appliance* that produces condensate:

1. An auxiliary drain pan with a separate drain shall be provided under the coils on which condensation will occur. The auxiliary pan drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The pan shall have a minimum depth of 1 1/2 inches (38 mm), shall not be less than 3 inches (76 mm) larger than the unit or the coil dimensions in width and length and shall be constructed of corrosion-resistant material. Galvanized sheet steel pans shall have a minimum thickness of not less than 0.0236 inch (0.6010 mm) (No. 24 gage). Nonmetallic pans shall have a minimum thickness of not less than 0.0625 inch (1.6 mm).
2. A separate overflow drain line shall be connected to the drain pan provided with the *equipment*. Such overflow drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The overflow drain line shall connect to the drain pan at a higher level than the primary drain connection.
3. An auxiliary drain pan without a separate drain line shall be provided under the coils on which condensate will occur. Such pan shall be equipped with a water-level detection device conforming to UL 508 that will shut off the *equipment* served prior to overflow of the pan. The auxiliary drain pan shall be constructed in accordance with Item 1 of this section.
4. A water-level detection device conforming to UL 508 shall be provided that will shut off the *equipment* served in the event that the primary drain is blocked. The device shall be installed in the primary drain line, the overflow drain line, or in the equipment-supplied drain pan, located at a point higher than the primary drain line connection and below the overflow rim of such pan.

**Exceptions:**

1. Fuel-fired appliances that automatically shut down operation in the event of a stoppage in the condensate drainage system.
2. Unducted fan coil units where there is no factory option available for water-level detection devices and which are installed directly within the occupied space.

**307.2.4.1 Ductless mini-split sytem traps.** Ductless mini-split equipment that produces condensate shall be provided with an inline check valve located in the drain line, a trap, or other means of condensate drainage in accordance with the manufacturer's instructions.



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**401.2 Ventilation required.** Every occupied space other than enclosed parking garages and buildings used for repair of automobiles shall be ventilated in accordance with Section 401.2.1, 401.2.2 or 401.2.3. Enclosed parking garages and buildings used for the repair of automobiles shall be ventilated by mechanical means in accordance with Sections 403 and 404.

**401.2.1 Group R occupancies.** Ventilation in Group R occupancies shall be provided in accordance with Section 403.4.

**401.2.2 Ambulatory care facilities and Group I-2 occupancies.** Ambulatory care facilities and Group I-2 occupancies shall be ventilated by mechanical means in accordance with Section 407.

**401.2.3 All other occupancies.** Ventilation in all other occupancies shall be provided by natural means in accordance with Section 402 or by mechanical means in accordance with Sections 403.1 to 403.7.

**401.3 When required.** Group R occupancies shall be vented continuously or intermittently in accordance with Section 403.4. Ventilation in all other occupancies shall be provided during the periods that the room or space is occupied.

**401.4 Intake opening location.** Air intake openings shall comply with all of the following:

1. Intake openings shall be located not less than 10 feet (3048 mm) from lot lines or buildings on the same lot. Lot lines shall not be defined as a separation from a street or public way.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet (3048 mm) horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or Section 501.3.1. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Intake openings shall be located not less than 3 feet (914 mm) below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening.

**Exception:** Separation is not required between intake air openings and living space environmental air exhaust air openings of an individual dwelling unit or sleeping unit where a factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions. A minimum of 3 feet (914 mm) separation shall be maintained between other environmental air exhaust outlets and other dwelling or sleeping unit factory-built intake/exhaust combination termination fittings.

4. Intake openings on structures in flood hazard areas shall be at or above the elevation required by Section 1612 of the International Building Code for utilities and attendant equipment.

**Exception:** Enclosed parking garage and repair garage ventilation air intakes are permitted to be located less than 10 feet horizontally from or 25 feet vertically above a street, alley, parking lot or loading dock.

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



**403.1 Ventilation system.** Mechanical ventilation shall be provided by a method of supply air and return or exhaust air. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6.

**403.2 Outdoor air required.** The minimum outdoor airflow rate shall be determined in accordance with Section 403.3.

**Exceptions:**

1. Where the registered design professional demonstrates that an engineered ventilation system design will prevent the maximum concentration of contaminants from exceeding that obtainable by the rate of outdoor air ventilation determined in accordance with Section 403.3, the minimum required rate of outdoor air shall be reduced in accordance with such engineered system design.
2. Alternate systems designed in accordance with ASHRAE Standard 62.1 Section 6.2, Ventilation Rate Procedure, shall be permitted.

**403.2.1 Recirculation of air.** The air required by Section 403.3 shall not be recirculated. Air in excess of that required by Section 403.3 shall not be prohibited from being recirculated as a component of supply air to building spaces, except that:

1. Ventilation air shall not be recirculated from one dwelling to another or to dissimilar occupancies.
2. Supply air to a swimming pool and associated deck areas shall not be recirculated unless such air is dehumidified to maintain the relative humidity of the area at 60 percent or less. Air from this area shall not be recirculated to other spaces where 10 percent or more of the resulting supply airstream consists of air recirculated from these spaces.
3. Where mechanical exhaust is required by Note b in Table 403.3.1.1, recirculation of air from such spaces shall be prohibited. All air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3.1.1.
4. Where mechanical exhaust is required by Note g in Table 403.3.1.1, mechanical exhaust is required and recirculation from such spaces is prohibited where more than 10 percent of the resulting supply airstream consists of air recirculated from these spaces. Return air from such spaces shall only be permitted to be recirculated when returned to an energy recovery ventilation system complying with Section 514. Recirculation of air that is contained completely within such spaces shall not be prohibited.

**403.3 Outdoor air and local exhaust airflow rates.** Group R occupancies shall be provided with outdoor air and local exhaust in accordance with Section 403.4. All other buildings intended to be occupied shall be provided with outdoor air and local exhaust in accordance with Section 403.3.1.

**403.3.1.1 Outdoor airflow rate.** Ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate determined in accordance with this section. In each occupiable space, the ventilation system shall be designed to deliver the required rate of outdoor airflow to the breathing zone. Outdoor air shall be supplied directly to each occupiable space from an air handling unit through a fully ducted path or ducted to within 12 inches of the return air opening of a fan-powered terminal unit used to transfer the outdoor air to the occupiable space. The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3.1.1. Ventilation rates for occupancies not represented in Table 403.3.1.1 shall be those for a listed occupancy classification that is most similar in terms of occupant density, activities and building construction; or shall be determined by an approved engineering analysis. The ventilation system, including transfer fan-powered terminal units, shall be designed to supply the required rate of ventilation air continuously during the period the building is occupied, except as otherwise stated in other provisions of the code.

With the exception of smoking lounges, the ventilation rates in Table 403.3.1.1 are based on the absence of smoking in occupiable spaces. Where smoking is anticipated in a space other than a smoking lounge, the ventilation system serving the space shall be designed to provide ventilation over and above that required by Table 403.3.1.1 in accordance with accepted engineering practice.

**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 403.3.1.1 estimated maximum occupancy rates.

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**403.3.1.1.2.3 Multiple zone recirculating systems.** For ventilation systems wherein one or more air handlers supply a mixture of outdoor air and recirculated air to more than one ventilation zone, the outdoor air intake flow ( $V_{ot}$ ) shall be determined in accordance with Sections 403.3.1.1.2.3.1 through 403.3.1.1.2.3.4.

**403.3.1.1.2.3.1 Uncorrected outdoor air intake.** The uncorrected outdoor air intake flow ( $V_{ot}$ ) shall be determined in accordance with Equation 4-5.

$$V_{ou} = D \sum_{all\ zones} (R_p \times P_z) + \sum_{all\ zones} (R_a \times A_z) \quad \text{(Equation 4-5)}$$

**403.3.1.1.2.3.1.1 Occupant diversity.** The occupant diversity ratio (D) shall be determined in accordance with Equation 4-6 to account for variations in population within the ventilation zones served by the system.

$$D = P_s / \sum_{\text{all zones}} P_z \quad \text{(Equation 4-6)}$$

where:

$P_s$  = System population: The total population in the area served by the system.

**Exception:** Alternative methods to account for occupant diversity shall be permitted, provided the resulting  $V_{ou}$  value is no less than that determined using Equation 4-5.

**403.3.1.1.2.3.1.2 Design system population.** Design system population ( $P_s$ ) shall equal the largest (peak) number of people expected to occupy all ventilation zones served by the ventilation system during use.

**Note:** Design system population is always equal to or less than the sum of design zone population for all zones in the area served by the system because all zones may or may not be simultaneously occupied at design population.

**403.3.1.1.2.3.2 System ventilation efficiency.** The system ventilation efficiency ( $E_v$ ) shall be determined in accordance with Section 403.3.1.1.2.3.3 for the Simplified Procedure or Appendix A of ASHRAE 62.1 for the Alternative Procedure.

**Note:** These procedures also establish zone minimum primary airflow rates for VAV systems.

**403.3.1.1.2.3.3 Simplified procedure.**

**403.3.1.1.2.3.3.1 System ventilation efficiency.** System ventilation efficiency ( $E_v$ ) shall be determined in accordance with Equation 4-6a or 4-6b.

$$E_v = 0.88 \times D + 0.22 \text{ for } D < 0.60 \quad \text{(Equation 4-6a)}$$

$$E_v = 0.75 \text{ for } D \geq 0.60 \quad \text{(Equation 4-6b)}$$

**403.3.1.1.2.3.3.2 Zone minimum primary airflow.** For each zone, the minimum primary airflow ( $V_{pz-min}$ ) shall be determined in accordance with Equation 4-7.

$$V_{pz-min} = V_{oz} \times 1.5 \quad \text{(Equation 4-7)}$$

**403.3.1.1.2.3.4 Outdoor air intake.** The design outdoor air intake flow ( $V_{ot}$ ) shall be determined in accordance with Equation 4-8.

$$V_{ot} = V_{ou} / E_v \quad \text{(Equation 4-8)}$$

**403.3.2 Group R-2, R-3 and R-4 occupancies.** This section is not adopted. See Section 403.4

**403.3.2.1 Outdoor air for dwelling units.** This section is not adopted.

**403.3.2.2 Outdoor air for other spaces.** This section is not adopted.

**403.3.2.3 Local exhaust.** This section is not adopted.

**403.4 Group R whole house mechanical ventilation system.** Each dwelling unit or sleeping unit shall be equipped with a whole house ventilation system that complies with Sections 403.4.1 through 403.4.6. Each dwelling unit or sleeping unit shall be equipped with local exhaust complying with Section 403.4.7. All occupied spaces, including public corridors, other than the Group R dwelling and sleeping unit, that support the Group R occupancy shall meet the ventilation requirements of Section 402 or the mechanical ventilation requirements of Sections 403.1 through 403.3.

**403.4.1 System design.** The whole house ventilation system shall consist of one or more supply fans, one or more exhaust fans, or an ERV/HRV with integral fans; and the associated ducts and controls. Local exhaust fans shall be permitted to serve as part of the whole house ventilation system when provided with the proper controls in accordance with Section 403.4.5. The systems shall be designed and installed to supply and exhaust the minimum outdoor airflow rates per Section 403.4.2 as corrected by the balanced and/or distributed whole house ventilation system coefficients in accordance with Section 403.4.3 where applicable.

**403.4.2 Whole house mechanical ventilation rates.** The sleeping unit whole house mechanical ventilation minimum outdoor airflow rate shall be determined in accordance with the breathing zone ventilation rates minimum outdoor airflow rate shall be determined in accordance with the breathing zone ventilation rates requirements of Section 403.3.1.1.1.2 using Equation 4-2. The dwelling unit whole house mechanical ventilation minimum outdoor airflow rate shall be determined in accordance with Equation 4-10 or Table 403.4.2.

$$Q_r = 0.01 \cdot A_{\text{floor}} + 7.5 \cdot (N_{\text{br}} + 1) \quad \text{(Equation 4-10)}$$

where:

- $Q_r$  = Ventilation airflow rate, cubic feet per minute (cfm) but not less than 30 cfm for each dwelling unit.
- $A_{\text{floor}}$  = Conditioned floor area, square feet (ft<sup>2</sup>)
- $N_{\text{br}}$  = Number of bedrooms, not less than one.

**TABLE 403.4.2  
WHOLE HOUSE MECHANICAL VENTILATION AIRFLOW RATE  
(CONTINUOUSLY OPERATING SYSTEM)**

Floor area (ft <sup>2</sup> )	Bedrooms <sup>1</sup>				
	1	2	3	4	≥5
<500	30	30	35	45	50
500 – 1000	30	35	40	50	55
1001 - 1500	30	40	45	55	60
1501 – 2000	35	45	50	60	65
2001 – 2500	40	50	55	65	70
2501 – 3000	45	55	60	70	75
3001 – 3500	50	60	65	75	80
3501 – 4000	55	65	70	80	85
4001 – 4500	60	70	75	85	90
4501 – 5000	65	75	80	90	95

1. Minimum airflow (Q<sub>r</sub>) is set at not less than 30 cfm for each dwelling unit.

(Continued on page 40a)

**404.3 Automobile repair facilities.** In 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. Exhaust extension duct over 10 feet in length shall mechanically exhaust at least 300 cfm. Connecting offices and waiting rooms shall be supplied with conditioned air under positive pressure.

**407.1 General.** Mechanical ventilation for health care facilities licensed by Washington state shall be designed and installed in accordance with this code and the following provisions of the Washington Administrative Code (WAC):

1. Mechanical ventilation in ambulatory care facilities shall comply with chapter 246-330 WAC.
2. Mechanical ventilation for acute care hospitals shall comply with chapter 246-320 WAC.
3. Mechanical ventilation for nursing homes shall comply with chapter 388-97 WAC.

Mechanical ventilation for unlicensed ambulatory care facilities shall be designed and installed in accordance with this code and ASHRAE 170.

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**TABLE 403.3.1.1—continued  
MINIMUM VENTILATION RATES**

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT <sup>2a</sup>	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE R <sub>p</sub> CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE R <sub>a</sub> CFM/FT <sup>2a</sup>	EXHAUST AIRFLOW RATE CFM/FT <sup>2</sup>
<b>Office</b>				
Conference rooms	50	5	0.06	--
Kitchenettes <sup>k</sup>	25	5	0.06	0.30
Office spaces	5	5	0.06	--
Reception areas	30	5	0.06	--
Telephone/data entry	60	5	0.06	--
Main entry lobbies	10	5	0.06	--
<b>Private dwellings, single and multiple</b>				
Garages, common for multiple units <sup>b</sup>	--	--	--	0.75
Kitchens				See Table 403.4.7
Living areas <sup>c</sup>		See Table 403.4.2	--	--
Toilet rooms, bathrooms and laundry areas <sup>9,i</sup>	--	--	--	See Table 403.4.7
<b>Public spaces</b>				
Corridors serving other than Group R occupancies	--	--	0.06	--
Corridors serving Group R dwelling or sleeping units with whole house exhaust system	--	--	0.12	--
Corridors serving Group R dwelling or sleeping units with other than whole house exhaust system	--	--	0.06	--
Courtrooms	70	5	0.06	--
Elevator car	--	--	--	1
Elevator lobbies in parking garage	--	--	1.0	--
Legislative chambers	50	5	0.06	--
Libraries	10	5	0.12	--
Museums (children's)	40	7.5	0.12	--
Museums/galleries	40	7.5	0.06	--
Places of religious worship	120	5	0.06	--
Shower room (per showerheat) <sup>9</sup>	--	--	--	50/20 <sup>f</sup>
Smoking lounges <sup>b</sup>	70	60	--	--
Toilet rooms—Public <sup>9</sup>	--	--	--	50/70 <sup>e</sup>

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**TABLE 403.3.1.1—continued  
MINIMUM VENTILATION RATES**

<b>OCCUPANCY CLASSIFICATION</b>	<b>OCCUPANT DENSITY #/100FT<sup>2a</sup></b>	<b>PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE R<sub>p</sub> CFM/PERSON</b>	<b>AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE R<sub>a</sub> CFM/FT<sup>2a</sup></b>	<b>EXHAUST AIRFLOW RATE CFM/FT<sup>2</sup></b>
<b>Sports and amusement</b>				
Disco/dance floors	100	20	0.06	--
Bowling alleys (seating areas)	40	10	0.12	--
Game arcades	20	7.5	0.18	--
Ice arenas, without combustion engines <sup>i</sup>	--	--	0.30	0.5
Gym, stadium, arena (play area) <sup>j</sup>	--	--	0.30	--
Spectator areas	150	7.5	0.06	--
Swimming pools (pool and deck area)	--	--	0.48	--
Health club/aerobics room	40	20	0.06	--
Health club/weight room	10	20	0.06	--
<b>Storage</b>				
Janitor closets, trash rooms, recycling rooms	--	--	--	1.0
Repair garages, enclosed parking garage <sup>b,d</sup>	--	--	--	0.75
Storage rooms, chemical	--	--	--	1.5
Warehouses	--	--	0.06	--

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**TABLE 403.3.1.1—continued  
MINIMUM VENTILATION RATES**

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/100FT <sup>2a</sup>	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE R <sub>p</sub> CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE R <sub>a</sub> CFM/FT <sup>2a</sup>	EXHAUST AIRFLOW RATE CFM/FT <sup>2</sup>
<b>Workrooms</b>				
Bank vaults/safe deposit	5	5	0.06	--
Computer (without printing)	4	5	0.06	--
Copy, printing rooms	4	5	0.06	0.5
Darkrooms	--	--	--	1.0
Freezer and refrigerated spaces (<50°F)	0	10	0	0
Meat processing <sup>c</sup>	10	15	--	--
Pharmacy (prep area)	10	5	0.18	--
Photo studios	10	5	0.12	--

- a. Based upon net occupiable floor area.
- b. Mechanical exhaust required and the recirculation of air from such spaces is prohibited. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Item 3).
- c. Spaces unheated or maintained below 50°F are not covered by these requirements unless the occupancy is continuous.
- d. Ventilation systems in enclosed parking garages shall comply with Section 404.
- e. Rates are per water closet or urinal. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.
- f. Rates are per room unless otherwise indicated. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.
- g. Mechanical exhaust is required and recirculation from such spaces is prohibited except that recirculation shall be permitted where the resulting supply airstream consists of not more than 10 percent air recirculated from these spaces. Return air from such spaces shall only be permitted to be recirculated when returned to an energy recovery ventilation system complying with Section 514. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Items 2 and 4).
- h. For nail salons, manicure and pedicure stations shall be provided with a *source capture system* capable of exhausting not less than 50 cfm per station. Exhaust inlets shall be located in accordance with Section 502.20. Where one or more required source capture systems operate continuously during occupancy, the exhaust rate from such systems shall be permitted to be applied to the exhaust flow rate required by Table 403.3.1.1 for the nail salon.
- i. A laundry area within a kitchen or bathroom is not required to have local exhaust. For the laundry area to qualify as being within the kitchen, the laundry room door must open directly into the kitchen and not into an adjacent corridor. Where there are doors that separate the laundry area from the kitchen or bathroom, the door shall be louvered.
- j. When combustion equipment is intended to be used on the playing surface, additional dilution ventilation and/or source control shall be provided.
- k. Kitchenettes require exhaust when they contain a domestic cooking appliance range or oven that is installed in accordance with Table 507.2.1. Kitchenettes that only contain a microwave cooking appliance are not required to have exhaust. A kitchenette may not contain commercial cooking appliances that require Type I or Type II exhaust as these occupancies are required to be exhausted to the kitchen category in Table 403.3.1.1.



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**403.4.3 Ventilation quality adjustment.** The minimum whole house ventilation rate from Section 403.4.2 shall be adjusted by the system coefficient in Table 403.4.3 based on the system type not meeting the definition of a balanced whole house ventilation system and/or not meeting the definition of a distributed whole house ventilation system.

$$Q_v = Q_r * C_{\text{system}} \quad \text{(Equation 4-11)}$$

where:

- $Q_v$  = Quality-adjusted ventilation airflow rate in cubic feet per minute (cfm)  
 $Q_r$  = Ventilation airflow rate, cubic feet per minute (cfm) from Equation 4-10 or Table 403.4.1  
 $C_{\text{system}}$  = System coefficient from Table 403.4.3

**Table 403.4.3**  
**SYSTEM COEFFICIENT ( $C_{\text{system}}$ )**

System Type	Distributed	Not Distributed
Balanced	1.0	1.25
Not Balanced	1.25	1.5

**403.4.4 Whole house ventilation residential occupancies.** Residential dwelling and sleeping unit whole house ventilation systems shall meet the requirements of Sections 403.4.4.1 or 403.4.4.2 depending on the occupancy of the residential unit.

**403.4.4.1 Whole house ventilation in Group R-2 occupancies.** Residential dwelling and sleeping units in Group R-2 occupancies system shall include supply and exhaust fans and be a balanced whole house ventilation system in accordance with Section 403.4.6.3. The system shall include a heat or energy recovery ventilator with a sensible heat recovery effectiveness as prescribed in Section C403.3.6 of the *Washington State Energy Code*. The whole house ventilation system shall operate continuously at the minimum ventilation rate determined in accordance with Section 403.4. The whole house supply fan shall provide ducted outdoor ventilation air to each habitable space within the residential unit.

**403.4.4.2 Whole house ventilation for other than Group R-2 occupancies.** Residential dwelling and sleeping units in other than Group R-2 occupancies, including I-1 condition 2 occupancies, shall have a whole house mechanical ventilation system with supply and exhaust fans in accordance with Section 403.4.6.1, 403.4.6.2, 403.4.6.3, or 403.4.6.4. The whole house ventilation system shall operate continuously at the minimum ventilation rate determined in accordance with Section 403.4.2 unless configured with intermittent off controls in accordance with Section 403.4.6.5. The whole house supply fan shall provide ducted outdoor ventilation air to each habitable space within the residential unit.

**403.4.5 Whole house ventilation system controls.** Controls for the whole house ventilation system shall comply with the following:

1. The whole house ventilation system shall be controlled with manual switches, timers or other means that provide for automatic operation of the ventilation system that have ready access for the occupant.
2. The whole house mechanical ventilation system shall be provided with controls that enable manual override off of the system by the occupant during periods of poor outdoor air quality. Controls shall include permanent text or a symbol indicating their function. Recommended control permanent labeling to include text similar to the following: "Leave on unless outdoor air quality is very poor." Manual controls shall have ready access for the occupant.
3. Whole house ventilation systems shall be configured to operate continuously except where intermittent off controls are provided in accordance with Section 403.4.6.5 and allowed by Section 403.4.4.2.

(Insert As Page 40a)

**403.4.6 Whole house ventilation system component requirements.** Whole house ventilation supply and exhaust fans specified in this section shall have a minimum efficacy as prescribed in the *Washington State Energy Code*. The fans shall be rated for sound at a maximum of 1.0 sone at design airflow and static pressure conditions. Design and installation of the system or equipment shall be carried out in accordance with manufacturer's installation instructions.

**Exceptions:**

1. Central supply or exhaust fans serving multiple residential units do not need to comply with the maximum fan sone requirements.
2. Interior joining spaces provided with a 30 cfm transfer fan or a 25 square foot permanent opening do not require supply ventilation air directly to the space. Transfer fans shall meet the sone rating above and have whole house ventilation controls in accordance with Section 403.4.5.

**403.4.6.1 Exhaust fans.** Exhaust fans required shall be ducted directly to the outside in accordance with Section 501.3. Exhaust air outlets shall be designed to limit the pressure difference to the outside to limiting the outlet free area maximum velocity to 500 feet per minute and equipped with backdraft dampers or motorized dampers in accordance with *Washington State Energy Code*. Exhaust fans shall be tested and rated in accordance with HVI 915, HVI 916, and HVI 920. Exhaust fans required in this section may be used to provide local ventilation. Exhaust fans that are designed for intermittent exhaust airflow rates higher than the continuous exhaust airflow rates in Table 403.4.3 shall be provided with occupancy sensors or humidity sensors to automatically override the fan to the high speed airflow rate. The exhaust fans shall be tested and the testing results shall be submitted and posted in accordance with Section 403.4.6.7.

**Exception:** Central exhaust fans serving multiple residential units do not need to comply with the HVI testing requirements.

**403.4.6.2 Supply fans.** Supply fans used in meeting the requirements of this section shall supply outdoor air from intake openings in accordance with Sections 401.4 and 401.5. Intake air openings shall be designed to limit the pressure difference to the outside to limiting the inlet free area maximum velocity to 500 feet per minute and when designed for intermittent off operation shall be equipped with motorized dampers in accordance with the *Washington State Energy Code*. Supply fans shall be tested and rated in accordance with HVI 915, HVI 916, and HVI 920. Where outdoor air is provided to each habitable dwelling unit or sleeping unit by supply fan systems the outdoor air shall be filtered. The filter shall be provided with access for regular maintenance and replacement. The filter shall have a Minimum Efficiency Rating Value (MERV) of at least 8.

**Exception:** Central supply fans serving multiple residential units do not need to comply with the HVI testing requirements.

**403.4.6.3 Balanced whole house ventilation system.** A balanced whole house ventilation system shall include both supply and exhaust fans. The supply and exhaust fans shall have airflow that is within 10 percent of each other. The tested and balanced total mechanical exhaust airflow rate is within 10 percent or 5 cfm, whichever is greater, of the total mechanical supply airflow rate. The flow rate test results shall be submitted and posted in accordance with Section 403.4.6.6. The exhaust fan shall meet the requirements of Section 403.4.6.2. The supply fan shall meet the requirements of Section 403.4.6.3. For R-2 dwelling and sleeping units, the system is required to have balanced whole house ventilation but is not required to have distributed whole house ventilation where the not distributed system coefficient from Table 403.4.2 is utilized to correct the whole house mechanical ventilation rate. The system shall be design and balanced to meet the pressure equalization requirements of Section 501.4. Intermittent dryer exhaust, intermittent range hood exhaust, and intermittent toilet room exhaust airflow rates above the residential dwelling or sleeping unit minimum ventilation rate are exempt from the balanced airflow calculation.

**403.4.6.4 Furnace integrated supply.** Systems using space condition heating and/or cooling air handler fans for outdoor air supply air distribution are not permitted.

**Exception:** Air handler fans shall be permitted that have multi-speed or variable speed supply airflow control capability with a low speed operation not greater than 25 percent of the rated supply air flow capacity during ventilation only operation. Outdoor air intake openings must meet the provisions of Sections 401.4 and 401.5 and must include a motorized damper that is activated by the whole house ventilation system controller. Intake air openings shall be designed to limit the pressure difference to the outside to limiting the inlet free area

maximum velocity to 500 ft per min. The motorized damper must be controlled to maintain the outdoor airflow intake airflow within 10 percent of the whole house mechanical exhaust airflow rate. The supply air handler shall provide supply air to each habitable space in the residential unit. The whole house ventilation system shall include exhaust fans in accordance with Section 403.4.6.2 to meet the pressure equalization requirements of Section 501.4. The flow rate for the outdoor air intake must be tested and verified at the minimum ventilation fan speed and the maximum heating or cooling fan speed. The results of the test shall be submitted and posted in accordance with Section 403.4.6.6.

**403.4.6.5 Intermittent off operation.** Whole house mechanical ventilation systems shall be provided with advanced controls that are configured to operate the system with intermittent off operation and shall operate for a least two hours in each four-hour segment. The whole house ventilation airflow rate determined in accordance with Section 403.4.2 as corrected by Section 403.4.3 shall be multiplied by the factor determined in accordance with Table 403.4.6.5.

**TABLE 403.4.6.5  
INTERMITTENT WHOLE HOUSE MECHANICAL VENTILATION RATE FACTORS<sup>a,b</sup>**

Run-time Percentage in Each 4-hour Segment	50%	66%	75%	100%
Factor <sup>a</sup>	2	1.5	1.3	1.0

- For ventilation system run-time values between those given, the factors are permitted to be determined by interpolation.
- Extrapolation beyond the table is prohibited.

**403.4.6.6 Testing.** Whole house mechanical ventilation systems shall be tested, balanced and verified to provide a flow rate not less than the minimum required by Sections 403.4.2 and 403.4.3. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals, outlet terminals or grilles or in the connected ventilation ducts. Where required by the building official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official and shall be posted in the residential unit in accordance with Section 403.4.6.7.

**403.4.6.7 Certificate.** A permanent certificate shall be completed by the mechanical contractor, test and balance contractor or other approved party and posted on a wall in the space where the furnace is located, a utility room, or an *approved* location inside the building. When located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. The certificate shall list the flow rate determined from the delivered airflow of the whole house mechanical ventilation system as installed and the type of mechanical whole house ventilation system used to comply with Section 403.4.3.

**403.4.7 Local exhaust.** Bathrooms, toilet rooms and kitchens shall include a local exhaust system. Such local exhaust systems shall have the capacity to exhaust the minimum airflow rate in accordance with Table 403.4.7 and Table 403.3.1.1, including notes. Fans required by this section shall be provided with controls that enable manual override or automatic occupancy sensor, humidity sensor or pollutant sensor controls. An "on/off" switch shall meet this requirement for manual controls. Manual fan controls shall be provided with ready access in the room served by the fan.

**TABLE 403.4.7  
MINIMUM EXHAUST RATES**

<u>Area to be exhausted</u>	<u>Exhaust Rate</u>	
	<u>Intermittent</u>	<u>Continuous</u>
<u>Kitchens</u>	<u>100 cfm</u>	<u>30 cfm</u>
<u>Bathrooms - Toilet rooms</u>	<u>50 cfm</u>	<u>20 cfm</u>

**403.4.7.1 Whole house exhaust controls.** If the local exhaust fan is included in a whole house ventilation system in accordance with Section 403.4.6, the exhaust fan shall be controlled to operate as specified in Section 403.4.5.

(Insert As Page 40c)

**403.4.7.2 Local exhaust fans.** Exhaust fans shall meet the following criteria.

1. Exhaust fans shall be tested and rated in accordance with HVI 915, HVI 916, and HVI 920.  
**Exception:** Where a range hood or down draft exhaust fan is used for local exhaust for a kitchen, the device is not required to be rated per these standards.
2. Fan airflow rating and duct system shall be designed and installed to deliver at least the exhaust airflow required by Table 403.4.4. The airflows required refer to the delivered airflow of the system as installed and tested using a flow hood, flow grid, or other airflow measurement device. Local exhaust systems shall be tested, balanced and verified to provide a flow rate not less than the minimum required by this section.
3. Design and installation of the system or equipment shall be carried out in accordance with manufacturers' installation instructions.
4. Fan airflow rating and duct system shall be designed and installed to deliver at least the exhaust airflow required by Table 403.4.3.

**Exceptions:**

1. An exhaust airflow rating at a pressure of 0.25 in. w.g. may be used, provided the duct sizing meets the prescriptive requirements of Table 403.4.7.2.
2. Where a range hood or down draft exhaust fan is used to satisfy the local ventilation requirements for kitchens, the range hood or down draft exhaust shall not be less than 100 cfm at 0.10 in. w.g.

**TABLE 403.4.7.2  
PRESCRIPTIVE EXHAUST DUCT SIZING**

Fan Tested cfm at 0.25 inches w.g.	Minimum Flex Diameter	Maximum Length in Feet	Minimum Smooth Diameter	Maximum Length in Feet	Maximum Elbows <sup>a</sup>
50	4 inches	25	4 inches	70	3
50	5 inches	90	5 inches	100	3
50	6 inches	No Limit	6 inches	No Limit	3
80	4 inches <sup>b</sup>	NA	4 inches	20	3
80	5 inches	15	5 inches	100	3
80	6 inches	90	6 inches	No Limit	3
100	5 inches <sup>b</sup>	NA	5 inches	50	3
100	6 inches	45	6 inches	No Limit	3
125	6 inches	15	6 inches	No Limit	3
125	7 inches	70	7 inches	No Limit	3

- a. For each additional elbow, subtract 10 feet from length.
- b. Flex ducts of this diameter are not permitted with fans of this size.

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**501.3.1 Location of Exhaust Outlet.** The termination point of exhaust outlets and ducts discharging to the outdoors shall be located with the following minimum distances:

1. **For ducts conveying explosive or flammable vapors, fumes or dusts:** 30 feet (9144 mm) from the property line; 10 feet (3048 mm) from operable openings into the building; 6 feet (1829 mm) from exterior walls and roofs; 30 feet (9144 mm) from combustible walls and operable openings into the building which are in the direction of the exhaust discharge; 10 feet (3048 mm) above adjoining grade.
2. **For other product-conveying outlets:** 10 feet (3048 mm) from property lines; 3 feet (914 mm) from exterior walls and roofs; 10 feet (3048 mm) from operable openings into the building; 10 feet (3048 mm) above adjoining grade.
3. **For environmental air duct exhaust other than enclosed parking garage and transformer vault exhaust:** 3 feet (914 mm) from property lines, 3 feet (914 mm) from operable openings into the building for all occupancies other than Group U, and 10 feet (3048 mm) from a mechanical air intake.
 

**Exceptions:**

  1. The separation between an air intake and exhaust outlet on a single listed package HVAC unit.
  2. Exhaust from environmental air systems other than garages may be discharged into an open parking garage.
  3. Except for Group I occupancies, where ventilation system design circumstances require building HVAC air to be relieved, such as during economizer operation, such air may be relieved into an open or enclosed parking garage within the same building.
4. Exhaust outlets serving structures in flood hazard areas shall be installed at or above the elevation required by Section 1613 of the *International Building Code* for utilities and attendant equipment.
5. **For enclosed parking garage exhaust system outlets and transformer vault exhaust system outlets:** 10 feet (3048 mm) from property lines which separate one lot from another; 10 feet (3048 mm) from operable openings into buildings; 3 feet (914 mm) horizontally from, 10 feet (3048 mm) above or 10 feet (3048 mm) below adjoining finished sidewalk.
6. **For elevator machinery rooms in enclosed or open parking garages:** Exhaust outlets may discharge air directly into the parking garage.
7. For specific systems see the following sections:
  - 7.1 Clothes dryer exhaust, Section 504.4.
  - 7.2 Kitchen hoods and other kitchen exhaust equipment, Sections 506.3.13, 506.4 and 506.5.
  - 7.3 Dust stock and refuse conveying systems, Section 511.2.
  - 7.4 Subslab soil exhaust systems, Section 512.4.
  - 7.5 Smoke control systems, Section 513.10.3.
  - 7.6 Refrigerant discharge, Section 1105.7.
  - 7.7 Machinery room discharge, Section 1105.6.1.

**501.4 Pressure equalization.** Mechanical exhaust systems shall be sized to remove the quantity of air required by this chapter to be exhausted. The system shall operate when air is required to be exhausted. Where mechanical exhaust is required in a room or space, such space shall be maintained with a neutral or negative pressure. If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust for a room, adequate means shall be provided for the natural or mechanical exhaust of the excess air supplied. If only a mechanical exhaust system is installed for a room or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate makeup air consisting of supply air, transfer air or outdoor air shall be provided to satisfy the deficiency. The calculated building infiltration rate shall not be used to satisfy the requirements of this section.

**Exception:** Intermittent domestic range exhaust, intermittent domestic dryer exhaust and intermittent local exhaust systems in R-3 occupancies and dwelling units in R-2 occupancies are excluded from the pressure equalization requirement unless required by Section 504 or Section 505.

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**504.4 Exhaust installation.** Dryer exhaust ducts for clothes dryers shall terminate on the outside of the building and shall be equipped with a backdraft damper located where the duct terminates. Dryer exhaust ducts may terminate at exterior wall louvers with openings spaced not less than 1/2-inch in any direction.

Screens shall not be installed at the duct termination. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums.

Domestic dryer exhaust ducts may terminate at a common location where each duct has an independent back-draft damper.

**504.10 Common exhaust systems for clothes dryers located in multistory structures.** Where a common multistory duct system is designed and installed to convey exhaust from multiple clothes dryers, the construction of the system shall be in accordance with all of the following:

1. The shaft in which the duct is installed shall be constructed and fire-resistance rated as required by the *International Building Code*.
2. Dampers shall be prohibited in the exhaust duct. Penetrations of the shaft and ductwork shall be protected in accordance with Section 607.5.5, Exception 2.
3. Rigid metal ductwork shall be installed within the shaft to convey the exhaust. The ductwork shall be constructed of sheet steel having a minimum thickness of 0.0187 inch (0.4712 mm) (No. 26 gage) and in accordance with SMACNA *Duct Construction Standards*.
4. The ductwork within the shaft shall be designed and installed without offsets.
5. The exhaust fan motor design shall be in accordance with Section 503.2.
6. The exhaust fan motor shall be located outside of the airstream.
7. The exhaust fan shall run continuously, and shall be connected to a standby power source.
8. Exhaust fan operation shall be monitored in an *approved* location and shall initiate an audible or visual signal when the fan is not in operation.
9. Makeup air shall be provided for the exhaust system to maintain the minimum flow for the exhaust fan when the dryers are not operating. Additionally, makeup air shall be provided when required by Section 504.5.
10. A cleanout opening shall be located at the base of the shaft to provide *access* to the duct to allow for cleaning and inspection. The finished opening shall be not less than 12 inches by 12 inches (305 mm by 305 mm).
11. Screens shall not be installed at the termination.
12. The common multistory duct system shall serve only clothes dryers and shall be independent of other exhaust systems.

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**505.3 Exhaust ducts.** Where domestic range hoods and domestic appliances equipped with downdraft exhaust are provided, such hoods and appliances shall discharge to the outdoors through sheet metal ducts constructed of galvanized steel, stainless steel, aluminum or copper. Such ducts shall have smooth inner walls, shall be air tight, shall be equipped with a backdraft damper and shall be independent of all other exhaust systems.

Domestic kitchen exhaust ducts may terminate with other domestic dryer exhaust and residential local exhaust ducts at a common location where each duct has an independent back-draft damper.

Listed and labeled exhaust booster fans shall be permitted when installed in accordance with the manufacturer's installation instructions.

**Exceptions:**

1. In other than Group I-1 and I-2, where installed in accordance with the manufacturer's installation instructions and where mechanical ventilation is otherwise provided in accordance with Chapter 4, listed and labeled ductless range hoods shall not be required to discharge to the outdoors.
2. Ducts for domestic kitchen cooking appliances equipped with downdraft exhaust systems shall be permitted to be constructed of Schedule 40 PVC pipe and fittings provided that the installation complies with all of the following:
  - 2.1. The duct shall be installed under a concrete slab poured on grade.
  - 2.2. The underfloor trench in which the duct is installed shall be completely backfilled with sand or gravel.
  - 2.3. The PVC duct shall extend not more than 1 inch (25 mm) above the indoor concrete floor surface.
  - 2.4. The PVC duct shall extend not more than 1 inch (25 mm) above grade outside of the building.
  - 2.5. The PVC ducts shall be solvent cemented.

**506.3.2.4 Vibration isolation.** A vibration isolation connector for connecting a duct to a fan shall consist of noncombustible packing in a metal sleeve joint of approved design or shall be a coated-fabric flexible duct connector rated for continuous duty at a temperature of not less than 1500°F (816°C). Vibration isolation connectors shall be installed only at the connection of a duct to a fan inlet or outlet.

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**506.3.9 Grease duct cleanout location, spacing and installation.**

**506.3.9.1 Grease duct horizontal cleanout.** Cleanouts located on horizontal sections of ducts shall:

1. Be spaced not more than 20 feet (6096 mm) apart.
2. Be located not more than 10 feet (3048 mm) from changes in direction that are greater than 45 degrees (0.79 rad).
3. Be located on the bottom only where other locations are not available and shall be provided with internal damming of the opening such that grease will flow past the opening without pooling. Bottom cleanouts and openings shall be approved for the application and installed liquid-tight.
4. Not be closer than 1 inch (25.4 mm) from the edges of the duct.
5. Have dimensions of not less than 12 inches by 12 inches (305 mm by 305 mm). Where such dimensions preclude installation, the openings shall be not less than 12 inches (305 mm) on one side and shall be large enough to provide access for cleaning and maintenance.
6. Be located at grease reservoirs.

**506.3.9.2 Grease duct vertical cleanouts.** Where ducts pass vertically through floors, cleanouts shall be provided. A minimum of one cleanout shall be provided on each floor. Cleanout openings shall be not less than 1 1/2 inches (38 mm) from all outside edges of the duct or welded seams.

**506.3.11 Grease duct enclosures.** A commercial kitchen grease duct serving a Type I hood that penetrates a ceiling, wall, floor or any concealed spaces shall be enclosed from the point of penetration to the outlet terminal. In-line exhaust fans not located outdoors shall be enclosed as required for grease ducts. A duct shall penetrate exterior walls only at locations where unprotected openings are permitted by the *International Building Code*. The duct enclosure shall serve a single grease duct and shall not contain other ducts, piping or wiring systems. Duct enclosures shall be a shaft enclosure in accordance with Section 506.3.11.1, a field-applied enclosure assembly in accordance with Section 506.3.11.2 or a factory-built enclosure assembly in accordance with

Section 506.3.11.3. Duct enclosures shall have a fire-resistance rating of not less than that of the assembly penetrated. The duct enclosure need not exceed 2 hours but shall not be less than 1 hour. Fire dampers and smoke dampers shall not be installed in grease ducts.

**Exception:** A duct enclosure shall not be required for a grease duct that penetrates only a nonfire-resistance-rated roof/ceiling assembly.

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**507.1.2 Domestic cooking appliance used for commercial purposes.** Domestic cooking appliances utilized for commercial purposes shall be provided with Type I, Type II or residential hoods as required for the type of appliances and processes in accordance with Table 507.1.2 and Sections 507.2 and 507.3. Domestic cooking appliances utilized for domestic purposes shall comply with Section 505.

**TABLE 507.1.2  
TYPE OF HOOD REQUIRED FOR DOMESTIC COOKING APPLIANCES  
IN THE FOLLOWING SPACES<sup>a, b</sup>**

Type of Space	Type of Cooking	Type of Hood
Church	1. Boiling, steaming and warming precooked food	Type II hood
	2. Roasting, pan frying and deep frying	Type I hood
Community or party room in apartment and condominium	1. Boiling, steaming and warming precooked food	Residential hood <sup>c</sup> or Type II hood <sup>d</sup>
	2. Roasting, pan frying and deep frying	Type I hood
Day care	1. Boiling, steaming and warming precooked food	Residential hood <sup>c</sup> or Type II hood <sup>d</sup>
	2. Roasting, pan frying and deep frying	Type I hood
Dormitory, boarding home, nursing home	1. Boiling, steaming and warming precooked food	Type II hood
	2. Roasting, pan frying and deep frying	Type I hood
Office lunch room	1. Boiling, steaming and warming precooked food	Residential hood <sup>c</sup> or Type II hood <sup>d</sup>
	2. Roasting, pan frying and deep frying	Type I hood

- Commercial cooking appliances shall comply with Section 507.2.
- Requirements in this table apply to electric or gas fuel appliances only. Solid fuel appliances or charbroilers require Type I hoods.
- Residential hood shall ventilate to the outside.
- Type II hood required when more than one appliance is used.

**507.2 Type I hoods.** Type I hoods shall be installed where cooking appliances produce grease or smoke as a result of the cooking process. Type I hoods shall be installed over medium-duty, heavy-duty and extra-heavy-duty cooking appliances.

Exceptions:

- A Type I hood shall not be required for an electric cooking appliance where an approved testing agency provides documentation that the appliance effluent contains 5 mg/m<sup>3</sup> or less of grease when tested at an exhaust flow rate of 500 cfm in accordance with Section 17 of UL 710B.
- A Type I hood shall not be required in an R-2 type occupancy with not more than 16 residents.

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**SECTION 515**  
**WASTE OR LINEN CHUTE VENTING**

**515.1 General.** Waste or linen chutes shall be gravity vented per NFPA 82.

**Exception:** Waste or linen chutes may be mechanically ventilated by an exhaust fan in accordance with Section 713.13.7 of the *International Building Code*.

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**601.2 Air movement in egress elements.** Corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts.

**Exceptions:**

1. Use of a corridor as a source of makeup air for exhaust systems in rooms that open directly onto such corridors, including toilet rooms, bathrooms, dressing rooms, smoking lounges and janitor closets, shall be permitted provided that each such corridor is directly supplied with *outdoor air* at a rate greater than the rate of makeup air taken from the corridor.
2. Where located within a dwelling unit, the use of corridors for conveying return air shall not be prohibited.
3. Where located within tenant spaces of 1,000 square feet (93 m<sup>2</sup>) or less in area, utilization of corridors for conveying return air is permitted.
4. Incidental air movement from pressurized rooms within health care facilities, provided that the corridor is not the primary source of supply or return to the room.
5. Where such air is part of an engineered smoke control system..
6. Air supplied to corridors serving residential occupancies shall not be considered as providing ventilation air to the dwelling units and sleeping units subject to the following:
  - 6.1 The air supplied to the corridor is 100% outside air, and
  - 6.2 The units served by the corridor have conforming ventilation air independent of the air supplied to the corridor, and
  - 6.3 For other than high-rise buildings, the supply fan will automatically shut off upon activation of corridor smoke detectors installed in accordance with Section 606.2.4; or
  - 6.4 For high-rise buildings, the supply fan will automatically shut off upon activation of the smoke detectors required by Section 907.2.12.1 of the *International Fire Code* or upon receipt of another approved fire alarm signal. The supply fan is not required to be automatically shut off when used as part of an approved building stairwell or elevator hoistway pressurization system. Corridor smoke detectors shall be installed in accordance with Section 606.2.5.

**602.1 General.** Supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces and mechanical equipment rooms. Plenums shall be limited to one fire area. Air systems that serve multiple fire areas shall be ducted from the boundary of the fire area served directly to the air-handling equipment. Fuel-fired appliances shall not be installed within a plenum. ||

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**603.5.1 Gypsum ducts.** The use of gypsum boards to form air shafts (ducts) shall be limited to return air systems where the air temperatures do not exceed 125°F (52°C) and the gypsum board surface temperature is maintained above the airstream dew-point temperature. Air ducts formed by gypsum boards shall not be incorporated in air-handling systems utilizing evaporative coolers.

|| **Exception:** In other than Group I-2 occupancies, gypsum boards may be used for ducts that are only used for stairwell or elevator pressurization supply air. The gypsum duct shall not attach directly to the equipment.

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**605.1 General.** Heating and air-conditioning systems shall be provided with approved air filters. Filters shall be installed such that all return air, outdoor air and makeup air is filtered upstream from any heat exchanger or coil. Filters shall be installed in an approved convenient location. Liquid adhesive coatings used on filters shall have a flash point not lower than 325°F (163°C).

**Exception:** Cooling coils that are designed, controlled and operated to provide sensible cooling only do not require filtration at the terminal device.

**605.4 Particulate matter removal.** Particulate matter filters or air cleaners having a minimum efficiency reporting value (MERV) of not less than 6 for ducted air handlers and not less than 4 for ductless mini-split systems shall be provided upstream of all cooling coils or other devices with wetted surfaces through which air is supplied to an occupiable space.

**606.2.1 Return air systems.** Smoke detectors shall be installed in return air systems with a design capacity greater than 2,000 cfm (0.9 m<sup>3</sup>/s), in the return air duct or plenum upstream of any filters, exhaust air connections, outdoor air connections, or decontamination equipment and appliances.

**Exceptions:**

1. Smoke detectors are not required in the return air system where all portions of the building served by the air distribution system are protected by area smoke detectors connected to a fire alarm system in accordance with the International Fire Code. The area smoke detection system shall comply with Section 606.4.
2. Smoke detectors are not required in the air system where all of the air is exhausted and not recirculated back to any portion of the building. Additionally, smoke detectors are not required in the supply system that provides the makeup air for the exhaust system.

**606.2.2 Common supply and return air systems.** Where multiple air-handling systems share common supply or return air ducts or plenums with a combined design capacity greater than 2,000 cfm (0.9 m<sup>3</sup>/s), the return air system shall be provided with smoke detectors in accordance with Section 606.2.1.

**Exception:** Individual smoke detectors shall not be required for each fan-powered terminal unit, provided that such units do not have an individual design capacity greater than 2,000 cfm (0.9 m<sup>3</sup>/s) and will be shut down by activation of one of the following:

1. Smoke detectors required by Sections 606.2.1 and 606.2.3.
2. An approved area smoke detector system located in the return air plenum serving such units.
3. An area smoke detector system as prescribed in the exception to Section 606.2.1.

In all cases, the smoke detectors shall comply with Sections 606.4 and 606.4.1.

The shut down of fan-powered terminal units may be performed by a building automation system upon activation of smoke detection as described in Section 606.2.2, Exception Items 1, 2, or 3. The building automation system is not required to be listed as a smoke control system and is not required to comply with UL Standard 864: Standard for Control Units and Accessories for Fire Alarm Systems.

**606.2.4 Corridors serving Group R occupancies in other than high-rise buildings.** Corridors that serve Group R occupancies in other than high-rise buildings and that are mechanically ventilated with supply air shall be equipped with smoke detectors spaced in accordance with NFPA 72. The supply fan shall automatically shut off upon activation of the corridor smoke detectors.

**Exception:** Corridor smoke detection is not required when air is returned back to the supply fan from the corridor and return air smoke detectors are installed in the return air duct or plenum upstream of any filters, exhaust air connections, outdoor air connections, or decontamination equipment and appliances designed to automatically shut off the supply fan.

**606.2.5 Corridors serving Group R occupancies in high-rise buildings.** Corridors that serve Group R occupancies in high-rise buildings and that are mechanically ventilated with supply air shall be equipped with smoke detectors that are spaced in accordance with NFPA 72 and air supply inlets to the corridor shall be provided with smoke/fire dampers. The supply inlet smoke/fire dampers shall automatically close upon activation of the corridor smoke detectors.

**Exceptions:**

1. Corridor smoke detection is not required to close the supply inlet smoke/fire dampers when the smoke/fire dampers are used as part of an approved building stairwell or elevator hoistway pressurization smoke control system.
2. Corridor smoke detection is not required when air is returned back to the supply fan from the corridor and return air smoke detectors are installed in the return air duct or plenum upstream of any filters, exhaust air connections, outdoor air connections, or decontamination equipment and appliances designed to automatically shut off the supply fan.

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|| **Informational Note:** Boilers and pressure vessels are regulated by Chapter 70.79 RCW and Chapter 296.104 WAC in addition to the requirements of this code.

**1001.1 Scope.** This chapter shall govern the installation, alteration and repair of boilers, water heaters and pressure vessels.

**Exceptions:**

1. Pressure vessels used for unheated water supply.
2. Portable unfired pressure vessels and Interstate Commerce Commission containers.
3. Containers for bulk oxygen and medical gas.
4. Unfired pressure vessels having a volume of 5 cubic feet (0.14 m<sup>3</sup>) or less operating at pressures not exceeding 250 pounds per square inch (psi) (1724 kPa) and located within occupancies of Groups B, F, H, M, R, S and U.
5. Pressure vessels used in refrigeration systems that are regulated by Chapter 11 of this code.
6. Pressure tanks used in conjunction with coaxial cables, telephone cables, power cables and other similar humidity control systems.
- || 7. Any boiler or pressure vessel subject to inspection by federal or state inspection programs.

**1105.6.3 Ventilation rate.** For other than ammonia systems, the mechanical ventilation systems shall be capable of exhausting the minimum quantity of air both at normal operating and emergency conditions, as required by Sections 1105.6.3.1 and 1105.6.3.2. The minimum required emergency ventilation rate for ammonia shall be 30 air changes per hour and the room conditions shall be in accordance with IAR2. Multiple fans or multispeed fans shall be allowed to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.

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**1209.5 Thermal barrier required.** Radiant floor heating and snow melt systems shall be provided with a thermal barrier in accordance with Sections 1209.5.1 through 1209.5.4. Concrete slab-on-grade, asphalt and paver-system type pavements shall have a minimum of R-10 insulation installed under the area to be snow melted, or R-5 insulation shall be installed under and at the slab edges of the area to be snow melted. The insulation shall be located underneath the snow and ice melt hydronic piping or cable and along all edges of the pavement where the snow and ice melt system is installed in accordance with the snow and ice melt manufacturer's instructions.

**1209.5.1 Slab-on-grade installation.** Radiant piping utilized in slab-on-grade applications shall be provided with insulating materials installed beneath the piping as required by the Washington State Energy Code.

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|| **1210.7.6 Expansion tanks.** Shutoff valves shall be installed at connections to expansion tanks. A method of draining the expansion tank downstream of the shutoff valve shall be provided.

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**1402.8.1.2 Rooftop-mounted solar thermal collectors and systems.** The roof shall be constructed to support the loads imposed by roof-mounted solar collectors. Where mounted on or above the roof covering, the collector array, mounting systems and their attachments to the roof shall be constructed of noncombustible materials or fire-retardant-treated wood conforming to the *International Building Code* to the extent required for the type of roof construction of the building to which the collectors are accessory.

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# ASHRAE

ASHRAE  
1791 Tulie Circle NE  
Atlanta GA 30329

Standard reference number	Title	Referenced in code section number
ANSI/AMCA 210-		
ANSI/ASHRAE 51-07	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.....	403.3.2.4
ASHRAE-2017	ASHRAE Fundamentals Handbook .....	603.2
15-2019	Safety Standard for Refrigeration Systems.....	1101.6, 1105.8, 1108.1
34-2016	Designation and Safety Classification of Refrigerants .....	202, 1102.2.1, 1103.1
62.1-2016	Ventilation for Acceptable Indoor Air Quality.....	403.3.1.1.2.3.2
62.2-2016	Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings .....	403.4.11
170-2017	Ventilation for Health Care Facilities .....	407
180-2012	Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems .....	102.3

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**HVI**

Home Ventilating Institute  
 1740 Dell Range Blvd., Suite H PMB 450  
 Cheyenne, WY 82009

Standard reference number	Title	Referenced in code section number
HVI 915-2015	Procedure for Loudness Testing of Residential Fan Products .....	403.4.6.1, 403.4.6.2,403.4.7.2
HVI 916-2015	Airflow Test Procedure.....	403.4.6.1, 403.4.6.2,403.4.7.2
HVI 920-2015	Product Performance Certification Procedure Including Verification and Challenge .....	403.4.6.1, 403.4.6.2,403.4.7.2

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**WAC 51-52-21000 – International Fuel Gas Code**

**101.2 Scope.** This code shall apply to the installation of fuel gas piping systems, fuel gas utilization equipment, gaseous hydrogen systems and regulated accessories in accordance with Section 101.2.1 through 101.2.5.

**Exceptions:** 1. Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories high with separate means of egress and their accessory structures shall comply with the International Residential Code.

2. The standards for liquefied petroleum gas installations shall be the 2017 Edition of NFPA 58 (Liquefied Petroleum Gas Code) and the 2018 Edition of ANSI Z223.1/NFPA 54 (National Fuel Gas Code).

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