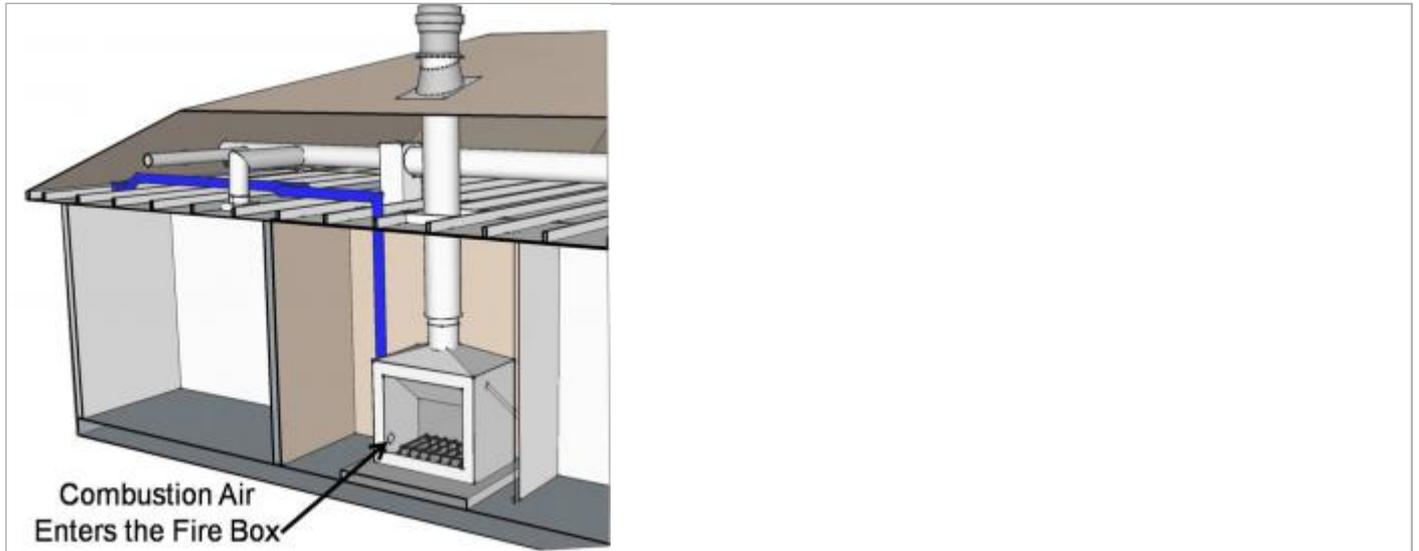


Fireplaces/Stoves with Proper Ventilation

Last Updated: 03/14/2016

Scope



If fireplaces are installed, ensure that ventilation air is provided directly to the fireplace and conduct combustion safety testing to ensure the fireplace will not be backdrafted by other exhaust fans in the home.

- Meet applicable code requirements for the installed fireplace, woodstove, pellet stove, or masonry heater.

See the [Compliance Tab](#) for related codes and standards requirements, and criteria to meet national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.

Description

A fireplace needs adequate combustion air to function properly and safely. Combustion air can come from inside the home or from outdoors. Like other combustion appliances, fireplaces come in three types: natural-draft, mechanically drafted, and direct-vent sealed-combustion. The first two take all or some of their combustion air from the indoor space. The third, direct-vent sealed-combustion, takes 100% of its combustion air directly from outdoors.

A direct-vent fireplace has a dedicated combustion air inlet that ducts air from the outside directly to the fireplace box and tightly fitting glass doors across the face of the fireplace opening to prevent room air from being used as combustion air. Direct vent fireplaces are typically gas fueled. Because a direct-vent sealed-combustion fireplace draws its combustion air directly from outdoors, it is not affected by house air tightness or exhaust fan size.

Figure 1. A direct-vent sealed-combustion fireplace takes its combustion air directly from outside through a dedicated air inlet ducted to the firebox and vents combustion products directly outside. Tightly fitting glass doors (not shown) cover the firebox combustion chamber and prevent the fireplace from back-drafting. 

The mechanically drafted fireplace uses an exhaust fan attached to the top of the chimney. The exhaust fan pulls combustion gases up and out of the chimney while the fireplace is in use. Some, if not all, of the combustion air typically comes from the conditioned space. Mechanically drafted fireplaces are less affected by building air tightness or indoor exhaust fans but they do have the ability to backdraft other naturally drafted appliances.

Natural-draft fireplaces are the most affected by the combination of building air tightness and mechanical exhaust systems. When a natural-draft fireplace is in full operation or at maximum burn, the natural draft of the fireplace will be hard to overcome; it can move as much as 400 CFM of air up the chimney. Because of the density expansion factor (about 1.6), only about 250 CFM is actually being exhausted out of the building. Nevertheless, it is possible for a natural-draft fireplace, at full burn, to backdraft other natural-draft-vented combustion appliances in the home.

However, when the chimney is cooler, such as when a fire is just getting started in a cold fireplace or when a fire has burned down or is on a low flame, the natural-draft fireplace is more vulnerable to being backdrafted. During these conditions, a small kitchen or bath exhaust fan (50 CFM) could backdraft the combustion pollutants from the fireplace into the home. To avoid this, install a dedicated combustion air duct to bring outside air directly to the fireplace for combustion air and select a fireplace with tight-fitting glass doors.

For wood-burning stoves and other appliances EPA implemented the Residential Wood Heater New Source Performance Standard (NSPS) and two voluntary programs - the Fireplace Program and the Hydronic Heater Program to help improve wood-burning devices and substantially reduce pollutant emissions to the outdoor air while maintaining energy efficiency.

EPA-Certified wood stoves meet the requirements of the NSPS, which has governed the manufacture and sale of wood stoves and certain wood-burning fireplace inserts based on emissions testing since 1988. EPA-Qualified appliances, such as wood fireplaces and wood hydronic heaters, meet emission levels set by EPA's Voluntary Fireplace and Hydronic Heater Programs. An EPA-certified appliance must adhere to regulatory emission requirements established by EPA, while appliances that meet the voluntary emission standards set by EPA are considered "EPA-qualified."

EPA-Certified wood stoves typically use up to one-third less firewood than older, less-efficient stoves. When wood is not completely burned, a complex mixture of gases and particles is created and emitted as wood smoke. In EPA-certified stoves, most of the wood is burned, resulting in more heat for the home from the same amount of wood. EPA-certified wood stoves are designed with better insulation and improved airflow, which promotes more efficient combustion. This overall improved combustion process reduces the risks of producing pollutants from incomplete combustion, which could leak from the appliance itself directly into the indoor environment. Additionally, as more gases and particles are burned inside the stove, less smoke and fewer chemical and particulate pollutants are emitted from the vent stack or chimney into the ambient outdoor atmosphere. This helps improve outdoor air quality and reduces the amount of pollutants that could be drawn back into the home (or neighboring homes) through imperfect air barriers or other openings in the building envelope.

EPA maintains and periodically revises the list of EPA-Certified and EPA-Qualified wood-burning appliances to help housing professionals and homeowners make better purchasing decisions. The listed models have been tested and shown to burn cleaner and more efficiently than other, similar models. Any wood stove or fireplace that meets the requirements of the EPA Certified or EPA Qualified designation are identified with metal tags. See the References/Additional Information section below for lists of EPA-certified wood stoves and EPA-qualified wood hydronic heaters and wood fireplaces.

The Washington State Department of Ecology publishes [more information about wood stoves](#) along with a list of wood stoves compliant with Washington state standards.

How to Test for Proper Ventilation of Natural-Draft Fireplaces

1. If installing a natural-draft fireplace, install a dedicated combustion air duct that brings outside air directly into the firebox. Install a fireplace that has tight-fitting glass doors across the face of the fireplace opening.
2. The rater will verify that the total net rated exhaust flow of the two largest exhaust fans is ≤ 15 CFM per 100 ft² of occupiable space.

- Calculate the total occupiable space of the house. Per ASHRAE 62.2-2010, occupiable space is any enclosed space inside the pressure boundary and intended for human activities, including, but not limited to, all habitable spaces, toilets, closets, halls, storage and utility areas, and laundry areas.
- Calculate the net rated exhaust flow of the two largest exhaust fans. Per ASHRAE 62.2-2010 and published addenda, the term “net-exhaust flow” is defined as flow through an exhaust system minus the compensating outdoor air flow through any supply system that is interlocked to the exhaust system. Add together the rated exhaust flow of the two largest exhaust fans in the home. Subtract the air flow of any dedicated supply ventilation.
- Verify the total net rated exhaust flow is less than or equal to 15 CFM per 100 ft² of occupiable space:

$$15 \text{ CFM per } 100 \text{ ft}^2 \geq (\text{Largest Fan Rated Flow}) \text{ CFM} + (\text{Second Largest Fan Rated Flow}) \text{ CFM} - (\text{Supply Outdoor Air Intake}) \text{ CFM} / (\text{Occupiable Space}) \text{ ft}^2$$

Or, the rater will verify that the pressure differential is ≤ -5 Pa using BPI's or RESNET's worst-case depressurization test procedure. Raters shall use either the Building Performance Institute's (BPI's) Combustion Safety Test Procedure for Vented Appliances or RESNET's Interim Guidelines for Combustion Appliance Testing & Writing Work Scope and be BPI-certified or RESNET-certified to follow the protocol. If using RESNET's worst-case depressurization protocol to evaluate fireplaces, the blower door shall not be set to exhaust 300 CFM to simulate the fireplace in operation, but the remainder of the protocol shall be followed. Note that the fireplace damper should be closed during the test.

Ensuring Success

If a fireplace is installed, make sure it has adequate ventilation. If the fireplace is naturally drafted, the rater must verify that the total net rated exhaust flow of the two largest exhaust fans is ≤ 15 CFM per 100 ft² of occupiable space, or the rater must verify that the pressure differential is ≤ -5 Pa using BPI's or RESNET's worst-case depressurization test procedure.

Climate

No climate specific information applies.

Training

Right and Wrong Images

None Available

CAD

None Available

Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

[DOE Zero Energy Ready Home](#)

The [DOE Zero Energy Ready Home Program](#) requires that builders comply with the EPA Indoor airPLUS Program. The [Indoor airPLUS checklist](#) (Item 5.1) requires that builders meet certain requirements for fuel-burning and space-heating appliances that are located in conditioned space.

Completion of the ENERGY STAR checklists (which is a DOE Zero Energy Ready Home requirement) now satisfies the following Indoor airPLUS requirements:

Fireplaces that are not mechanically drafted or direct-vented to the outdoors must meet maximum allowed exhaust flow or pressure differential (HVAC-R 10.2).

[Additional Indoor airPLUS requirements:](#)

Do not install any unvented combustion space-heating appliances.

Ensure naturally drafted fuel-burning appliances located in conditioned spaces are installed in compliance with ASHRAE 62.2-2010 (Section 6.4) or conduct a worst case depressurization combustion air zone (CAZ) test according to an established protocol.

Ensure that all fireplaces and other fuel-burning and space-heating appliances located in conditioned spaces are vented to the outdoors and supplied with adequate combustion and ventilation air according to the manufacturers' installation instructions.

Meet the following energy efficiency and emissions standards and restrictions for all fireplaces and other fuel-burning and space-heating appliances located in conditioned spaces:

- Traditional masonry fireplaces designed for open fires are not permitted, with the exception of "masonry heaters" as defined by ASTM E1602 and Section 2112.1 of the 2012 International Building Code (i.e., fireplaces engineered to store and release substantial portions of heat generated from a rapid burn).
- Factory-built wood-burning fireplaces shall meet the certification requirements of UL 127 and emission limits found in the EPA Standard for New Residential Wood Heaters.
- Natural gas and propane fireplaces shall be mechanically drafted or direct vented, as defined by NFPA 54, Section 3.3.108, have a permanently affixed glass front or gasketed door and comply with ANSI Z21.88/CSA 2.33.
- Wood stove and fireplace inserts as defined in Section 3.8 of UL 1482 shall meet the certification requirements of that standard, and they shall meet the emission requirements of the EPA Standard for New Residential Wood Heaters and WAC 173-433-100 (3).
- Pellet stoves shall meet the requirements of ASTM E1509.
- Decorative gas logs as defined in K.1.11 of NFPA 54 (National Fuel Gas Code) are not permitted.

Note: Unfinished basements and crawlspaces (except raised pier foundations with no walls) and attached garages that are air-sealed to the outside and intended for use as work or living space, are considered "conditioned spaces" for the purpose of this requirement.

[ENERGY STAR Certified Homes](#)

ENERGY STAR Certified Homes (Version 3/3.1, Revision 08), Rater Field Checklist

10. Combustion Appliances

10.2 Fireplaces located within the home's pressure boundary are mechanically drafted or direct-vented. See Footnote 57 for alternatives.^{54, 55, 57}

Footnotes:

(54) The pressure boundary is the primary enclosure boundary separating indoor and outdoor air. For example, a volume that has more leakage to outside than to conditioned space would be outside the pressure boundary.

(55) Per the 2009 International Mechanical Code, a direct-vent appliance is one that is constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outside atmosphere; a mechanical draft system is a venting system designed to remove flue or vent gases by mechanical means consisting of an induced draft portion under non-positive static pressure or a forced draft portion under positive static pressure; and a natural draft system is a venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.

(57) Naturally drafted fireplaces are allowed within the home's pressure boundary if the Rater has verified that the total net rated exhaust flow of the two largest exhaust fans (excluding summer cooling fans) is ? 15 CFM per 100 sq. ft. of occupiable space

when at full capacity. If the net exhaust flow exceeds the allowable limit, it shall be reduced or compensating outdoor airflow provided. Per ASHRAE 62.2-2010, the term "net rated exhaust flow" is defined as flow through an exhaust fan minus the compensating outdoor airflow through any supply fan that is interlocked to the exhaust fan. Per ASHRAE 62.2-2010, the term "occupiable space" is defined as any enclosed space inside the pressure boundary and intended for human activities, including, but not limited to, all habitable spaces, toilets, closets, halls, storage and utility areas, and laundry areas. See Footnote 43 for the definition of "habitable spaces".

ENERGY STAR Revision 08 requirements are required for homes permitted starting 07/01/2016.

[NFPA 211: Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, 2013 Edition](#)

This standard by the National Fire Protection Association provides guidelines for construction projects involving chimneys, fireplaces, venting systems, and solid fuel-burning appliances.

[EPA New Source Performance Standards](#)

Federal emission standards established by EPA as required by Section 111 of the Clear Air Act. These standards set limits for source categories that cause or contribute significantly to air pollution. These standards are intended to promote use of the best air pollution control technologies, taking into account the cost of such technology and any other non-air quality, health, and environmental impact and energy requirements.

[ANSI/ASHRAE Standard 62.2](#)

Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. The standard applies to spaces intended for human occupancy in single-family homes and multifamily homes that are three stories or less, including manufactured and modular homes. The standard provides minimum acceptable requirements for mechanical and natural ventilation in these spaces.

[2009 IECC](#)

Wood-burning fireplaces should have doors with gaskets and should have outdoor combustion air.

[2009 IRC](#)

Chapter 10 of the 2009 IRC describes fireplace and chimney requirements, including clearances, flues, and seismic reinforcement. Section R1006 specifies that fireplaces must be equipped with an exterior air supply that brings air from outside or from a vented attic or crawlspace directly to the firebox for combustion, unless the room is mechanically ventilated in a way that maintains neutral or positive air pressure in the room.

[2012 IECC](#)

Wood-burning fireplaces should have tight-fitting flue dampers and should have outdoor combustion air.

[2012 IRC](#)

Chapter 10 of the 2012 IRC describes fireplace and chimney requirements, including clearances, flues, and seismic reinforcement. Section R1006 specifies that fireplaces must be equipped with an exterior air supply that brings air from outside or from a vented attic or crawlspace directly to the firebox for combustion, unless the room is mechanically ventilated in a way that maintains neutral or positive air pressure in the room.

[2015 IECC](#)

[2015 IRC](#)

[Fireplaces, Proper Ventilation for New Wood-Burning Fireplaces - Code Compliance Brief](#)

Overview:

The intent of this brief is to provide additional information about fireplaces¹ to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan review and conduct field inspections can help builders or remodelers with proposed designs and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

Over a considerable amount of time, the code provisions for fireplaces have gone from none requirements such as gasketed doors in the 2009 International Energy Conservation Code (IECC), to tight-fitting flue dampers in the 2012 IECC, to tight-fitting flue dampers or doors and testing and listing requirements for the doors in the 2015 IECC. The intent of this brief is to cover the new requirements for new wood-burning fireplaces regarding doors, dampers, and *combustion air*² and proper ventilation.

¹"Fireplace" is defined in the 2015 IRC as an assembly consisting of a hearth and fire chamber of noncombustible material and provided with a chimney, for use with solid fuels. "Factory-built fireplace" is defined as a listed and labeled fireplace and chimney system composed of factory-made components, and assembled in the field in accordance with manufacturer's

instructions and the conditions of the listing. "Masonry-built fireplace" is defined as a field-constructed fireplace composed of solid masonry units, bricks, stones or concrete.

²"Combustion air" is defined, in the context of the code, as referring to rapid oxidation of fuel accompanied by the production of heat or heat and light.

Plan Review:

Per the **2015 IECC/International Residential Code (IRC), Section R103.3/R106.3, Examination of documents**. The code/building official must examine, or cause to be examined, construction documents for code compliance.

This section lists the applicable code requirements followed by details helpful for plan review regarding the provisions to meet the requirements for "new wood-burning fireplaces."

- **2015 IECC/IRC, Section R402.4.2/N1102.4.2 Fireplaces**. New wood-burning *fireplaces* must have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built *fireplaces* listed and labeled in accordance with UL³ 127 (Standard for Factory Built Fireplaces), the doors must be tested and listed for the *fireplace*. Where using tight-fitting doors on masonry *fireplaces*, the doors must be listed and labeled in accordance with UL 907 (Standard for Fireplace Accessories).
- **2015 IRC, Section R1004.5 Gasketed Fireplace Doors**. A gasketed *fireplace* door should not be installed on a factory-built *fireplace* except where the fireplace system has been specifically tested, listed, and labeled for such use in accordance with UL 127.
- **2012 IECC/IRC, Section R402.4.2/1102.4.2 Fireplaces**. This code requires that new wood-burning *fireplaces* must have tight-fitting flue dampers and outdoor combustion air.
- **2009 IECC/IRC, Section 402.4.3/N1102.4.3 Fireplaces**. This code requires that new wood-burning fireplaces must have gasketed doors and outdoor combustion air.
- **Construction Documentation**. Review the construction documents for the details describing the *fireplace* construction design including exterior air supply.
 - **2015 IECC/IRC, Section R103.2/N1101.5 Information on Construction Documents**. Construction documents should include:
 - *Fireplace* door specifications
 - Exterior air supply specifications

Combustion Air

New wood-burning *fireplaces* must be directly vented to the outside regardless of whether the *fireplace* is masonry or factory built. Review and confirm that the construction documents and/or manufacturer's specifications have a dedicated *combustion* air inlet. Ensure that a *fireplace* located in conditioned space is vented to the outdoors and supplied with adequate combustion and ventilation air according to the manufacturer's installation instructions.

- **2015 IRC, Section R1006.1 Exterior Air**. Factory-built or masonry fireplaces should be equipped with an exterior air supply to assure proper fuel combustion unless the room is mechanically ventilated and controlled so that the indoor pressure is neutral or positive.
 - **R1006.1.1 Factory-built fireplaces**. Exterior combustion air ducts for factory-built fireplaces should be a listed component of the fireplace and should be installed according to the fireplace manufacturer's instructions.
 - **R1006.1.2 Masonry fireplaces**. Listed combustion air ducts for masonry fireplaces should be installed according to the terms of their listing and the manufacturer's instructions.
- **2015 IRC, Section R1006.2 Exterior air intake**. The exterior air intake should be capable of supplying all combustion air from the exterior of the dwelling or from spaces within the dwelling ventilated with outside air such as non-mechanically ventilated crawl or attic spaces. The exterior air intake should not be located within the garage or basement of the dwelling nor should the air intake be located at an elevation higher than the firebox. The exterior air intake should be covered with a corrosion-resistant screen of ¼-inch (6-millimeter) mesh.
- **2015 IRC, Section R1006.3 Clearance**. Unlisted combustion air ducts should be installed with a minimum 1-inch (25-millimeter) clearance to combustibles for all parts of the duct within 5 feet (1524 millimeters) of the duct outlet.
- **2015 IRC, Section R1006.4 Passageway**. The combustion air passageway should be a minimum of 6 square inches (3870 square millimeters) and not more than 55 square inches (0.035 square meters), except that combustion air systems for listed fireplaces be constructed according to the fireplace manufacturer's instructions.
- **2015 IRC, Section R1006.5 Outlet**. Locating the exterior air outlet in the back or sides of the firebox chamber or within 24 inches (610 millimeters) of the firebox opening on or near the floor is permitted. The outlet should be closable and designed to prevent burning material from dropping into concealed combustible spaces.

³UL (Underwriters Laboratory) is a global independent safety science company that certifies, validates, tests, inspects, audits, advises, and trains.

Field Inspection:

Per the **2015 IECC, Section R104, Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footing and foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **2015 IRC, Section R109, Inspections**, the wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for "*new wood-burning fireplaces*" where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance.

- Confirm that the *fireplace* is installed per manufacturer's installation instructions and/or approved construction documents.
- Confirm that the *fireplace* door has been installed properly per the approved construction documents and/or manufacturer's installation instructions and is tight-fitting.
- Confirm that *combustion air* duct(s) have been installed per approved manufacturer's installation instructions or, for unlisted ducts, confirm that ducts are installed with a minimum 1-inch clearance to combustibles for all parts of the duct within 5 feet (1524 millimeters) of the duct outlet per the approved construction documents.
- Confirm that the air passageway is constructed per the approved manufacturer's installation instructions or, for unlisted fireplaces, a minimum of 6 square inches (3870 square millimeters) and not more than 55 square inches (0.035 square meters) per the approved construction documents.
- Confirm that the exterior air intake is installed per the approved manufacturer's installation instructions and/or construction documents and covered with a corrosion-resistant screen of ¼-inch (6-millimeter) mesh.
- Confirm that the location of the exterior air outlet is either on the back or sides of the firebox chamber or within 24 inches (610 millimeters) of the firebox opening on or near the floor and is closable per the approved construction documents.

Technical Validation(s):

Underwriter Laboratories, UL 127, Standard for Factory-Built Fireplaces, <http://ulstandards.ul.com/standard/?id=127>

Underwriter Laboratories, UL 907, Standard for Fireplace Accessories, <http://ulstandards.ul.com/standard/?id=907>

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

1. [Technology Solutions Case Study: Combustion Safety for Appliances Using Indoor Air](#)

Author(s): NSTAR, PARR

Organization(s): NSTAR, PARR

Publication Date: May, 2014

Case study describing a method for evaluating safe installation and operation of combustion appliances in homes undergoing energy efficiency upgrades where indoor air is used for combustion and venting.

References and Resources*

1. [DOE Zero Energy Ready Home National Program Requirements](#)

Author(s): DOE

Organization(s): DOE

Publication Date: August, 2015

Standard requirements for DOE's Zero Energy Ready Home national program certification.

2. [ENERGY STAR Certified Homes, Version 3 \(Rev. 08\) National Program Requirements](#)

Author(s): EPA

Organization(s): EPA

Publication Date: September, 2015

Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 08).

3. [Indoor airPLUS Construction Specifications Version 1 \(Rev. 03\)](#)

Author(s): EPA

Organization(s): EPA

Publication Date: October, 2015

Document outlining specifications that were developed by the U.S. Environmental Protection Agency (EPA) to recognize new homes equipped with a comprehensive set of indoor air quality (IAQ) features.

4. [International Mechanical Code](#)

Author(s): ICC

Organization(s): ICC

Publication Date: January, 2009

Code containing 2009 ICC language for mechanical draft systems.

5. [NFPA 211: Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, 2013 Edition](#)

Author(s): National Fire Protection Association

Organization(s): National Fire Protection Association

Publication Date: August, 2013

Standard providing guidelines for construction projects involving chimneys, fireplaces, venting systems, and solid fuel-burning appliances.

6. [Wood Stoves, Fireplaces, Pellet Stoves, and Masonry Heaters](#)

Author(s): Washington State Department of Ecology

Organization(s): Washington State Department of Ecology

Publication Date: August, 2015

This web site has information about burn bans, which wood burning devices are legal in Washington, why wood smoke is harmful to health, and how to reduce the smoke from your wood burning device.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

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