Guidelines for Home Energy Professionals

Standard Work Specifications for Manufactured Housing Energy Upgrades
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Overview

The U.S. Department of Energy’s (DOE) Weatherization Assistance Program (WAP) and the National Renewable Energy Laboratory (NREL) developed the Guidelines for Home Energy Professionals project (hereafter Guidelines) to support and promote high-quality work within the WAP. NREL is a national laboratory of the DOE, Office of Energy Efficiency & Renewable Energy (EERE), operated by the Alliance for Sustainable Energy, LLC. EERE sponsored, funded, and provided oversight of the Guidelines project. The Guidelines are also a resource for workers, contractors, training providers, homeowners, and program administrators involved in the broader home performance industry where a comprehensive, whole-house approach to building science is required.

The Guidelines project is about achieving quality in any given home energy upgrade task. To do that, the Guidelines take a three-pronged approach:

1. **Define the Work through Standard Work Specifications.**
   The Standard Work Specifications (SWS) for Single-Family, Multifamily, and Manufactured Housing Energy Upgrades define the minimum acceptable outcomes for any weatherization or home performance task to be effective, durable, and safe.

2. **Validate the Training through Job Task Analyses.**
   Job Task Analyses (JTAs) for the four major energy upgrade job classifications define what a worker needs to know and do to be successful. These JTAs cover job tasks for retrofit installer/technician, crew leader, energy auditor, and quality control inspector. The accreditation of energy efficiency training programs verifies that organizations training workers in the industry are qualified to teach to the JTAs.

3. **Certify the Worker through the Certification Blueprints.**
   The certification blueprints synthesize SWS content and the JTAs to lay out a roadmap for developing robust worker certifications. The four Home Energy Professional worker certifications are part of and are aligned with the Guidelines efforts and target a worker’s capacity to demonstrate practical ability to perform the work of the industry.

The Guidelines project allows industry to leverage these three components to develop SWS-based training resources, quality assurance protocols, accredited training programs, and professional certifications. These tools will facilitate the development of a highly qualified work force, demonstrate worker qualifications to employers and homeowners, and enable the industry to validate the quality of its work.
Background

The Guidelines project is supported by the WAP’s National Training and Technical Assistance Plan, which supports the high-quality work performed in the WAP through the development of technical tools and resources built upon the WAP’s 30+ years of leadership in home energy upgrade work. The SWS were developed in response to a need identified by WAP technicians and program administrators for a document that would define the technical requirements of the work performed by the program.

The Guidelines development process is a historic collaboration between WAP technicians and trainers, home performance contractors, building scientists, organized labor, and other professionals throughout the home energy upgrade industry. In addition to the involvement of residential energy efficiency professionals, staff from the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the National Institute for Occupational Safety and Health (NIOSH) participated in writing and reviewing the Guidelines to cover worker and occupant health and safety. The Department of Housing and Urban Development (HUD), Department of Agriculture (USDA), and the Department of Labor (DOL) have also been key partners in the development of the Guidelines.

This document is being disseminated by DOE. As such, the document was prepared in compliance with Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554) and information quality guidelines issued by DOE. Should this document constitute “influential” information, as that term is defined in DOE’s information quality guidelines or the Office of Management and Budget’s Information Quality Bulletin for Peer Review (Bulletin), the document meets the prior peer review pursuant to Section II.2 of the Bulletin. Additionally, the document was reviewed both internally and externally prior to publication. For purposes of external review, the document benefited from review through the public comment process.
Glossary

AARST  American Association of Radon Scientists and Technologists, www.aarst.org
AB  Air barrier
ACCA  Air Conditioning Contractors of America, www.acca.org
ACM  Asbestos-containing material
ADA  Americans with Disabilities Act
ADC  Air Diffusion Council, www.flexibleduct.org
AFUE  Annual fuel utilization efficiency
AGA  American Gas Association, www.aga.org
AHJ  Authority having jurisdiction
AHRI  Air Conditioning, Heating, and Refrigeration Institute, www.ahrinet.org
Air barrier  The separation between the interior and exterior environments of a building that slows air flow to the point that no smoke movement is visible at 50 pascals of pressure difference across the boundary
AL  Action level
ANSI  American National Standards Institute, www.ansi.org
Backdraft damper  A damper that allows air to flow in only one direction
Beaded collar  A round fitting with a ridge or lip part way down its length that prevents a flexible duct mechanically attached with a draw band from sliding off
Bonus room  A livable room that is often over a garage or in an attic area; the room commonly contains slanted ceilings and knee walls
BPI  Building Performance Institute, www.bpi.org
BTU  British thermal unit
Can light  A light fixture (or can) that is recessed into the ceiling
Cathedral ceiling  A condition in which the ceiling has the same slope as the roof
Cathedralized attic  An attic that contains insulation located at the roof deck rather than the attic floor, bringing the attic space into the thermal boundary of the house
CAZ  Combustion appliance zone
CFL  Compact fluorescent lamp
CFM  Cubic feet per minute
CGSB  Canadian General Standard Board
Closed crawlspace  A foundation without wall vents that uses air-sealed walls, ground and foundation moisture control, and mechanical drying methods to control crawlspace moisture. Insulation may be located at the conditioned floor level or on the exterior walls. Return pathways are not allowed from the crawlspace to the living space
CO  Carbon monoxide
Conditioned basement  A below- or partially below-grade livable space with concrete or finished floor that is intentionally heated or cooled
Conditioned crawlspace  A foundation without wall vents that encloses an intentionally heated and/or cooled space. Insulation is located on the exterior walls
CPSC  Consumer Product Safety Commission
CSA  Canadian Standards Association
DACUM  Developing a curriculum
dBA  A-weighted decibels
Dense pack  The process of installing loose-fill insulation to reduce air flow and perform to a stated R-value
DHW  Domestic hot water
Dielectric union  A plumbing connection that separates two different materials and does not allow them to chemically react and break down
Draft regulator  A device that functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value. Source: National Fire Protection Association 54, 2012
Dual-Cooling Up-Duct  Piece of duct located between the living space and attic to allow air flow in pressurized homes having evaporative coolers
Efflorescence  Deposits of crystals or salts left attached to masonry materials after moisture has evaporated off of the surface
Egress window  A window that people can escape through in an emergency
EIFS  Exterior insulation and finish systems
EIMA  EIFS Industry Members Association
Energy factor  Measure of overall efficiency for a variety of appliances. For water heaters, the energy factor is based on three factors: 1) the recovery efficiency, or how efficiently the heat from the energy source is transferred to the water; 2) standby losses, or the percentage of heat lost per hour from the stored water compared to the content of the water; and 3) cycling losses. For dishwashers, the energy factor is defined as the number of cycles per kWh of input power. For clothes washers, the energy factor is defined as the cubic foot capacity per kWh of input power per cycle. For clothes dryers, the energy factor is defined as the number of pounds of clothes dried per kWh of power consumed.
Envelope  The separation between the interior and exterior environments of a building that includes a combination of air and thermal barrier
EPA  U.S. Environmental Protection Agency, www.epa.gov
ERV  Energy recovery ventilator
ESP  External static pressure
Exfiltration  The uncontrolled passage of inside air out of a building through unintended leaks in the building envelope
Exterior storm window  An additional window assembly installed on the exterior of the main window
Finished attic  An attic space that has been converted into an additional living space of the house
GFCI  Ground-fault circuit interrupter
GPM  Gallons per minute
Hi-limit switch  A protective electronic switch that keeps a burner from continuing to operate and damage the appliance
HRV  Heat recovery ventilator
HVAC  Heating, ventilation, and air conditioning
HVI  Home Ventilation Institute
Hydrophobic  Lacking affinity for water; tending to repel and not absorb water; tending not to dissolve in, mix with, or be wetted by water
I-P  Inch-pound
IAQ  Indoor air quality
IBC  International Building Code
IBR  Institute of Boiler and Radiator Manufacturers
IC  Insulation contact
ICC | International Code Council
---|---
IECC | International Energy Conservation Code
IFGC | International Fuel Gas Code
Ignition barrier | Any layer of material that protects another from catching fire due to heat or spark
IMC | International Mechanical Code
Infiltration | The uncontrolled passage of outside air into a building through unintended leaks in the building envelope
Interior storm window | An additional window assembly installed on the interior of the main window
IPM | Integrated Pest Management
IRC | International Residential Code
IWC | Inches of water column
JTA | Job task analysis
Knee wall | Any wall between the conditioned space and the attic
KSA | Knowledge, skills, and abilities
LED | Light-emitting diode
MERV | Minimum efficiency reporting value
Modulating systems | Heating systems with the ability to adjust the heating capacity and output based on the heating demand
MSDS | Material Safety Data Sheet
NEBB | National Environmental Balancing Bureau, www.nebb.org
NEC | National Electrical Code
NIOSH | National Institute for Occupational Safety and Health, www.cdc.gov/niosh
Orphaned equipment | Condition when one smaller combustion appliance exists after being commonly vented with a larger appliance. What remains is a larger exhaust flue or chimney than is necessary for the remaining smaller appliance
Orphaned water heater | Condition when one smaller combustion appliance (e.g., water heater) exists after being commonly vented with a larger appliance. What remains is a larger exhaust flue or chimney than is necessary for the water heater
OSHA | U.S. Occupational Safety and Health Administration, www.osha.gov
PEL | Permissible exposure limit
Perm rating | The measurement of a material's ability to allow the transfer of water vapor through the material
PPE | Personal protective equipment
Programmable thermostat | A thermostat designed to adjust the temperature according to a series of programmed settings that take effect at different times of the day
Psi | Pounds per square inch
Psig | Pound per square inch gauge
Reverse or upslope lapping technique | Upper course laps under a lower course to keep the moisture under the barrier
Rigid material | Drywall, oriented strand board, duct board, cardboard, or any other stiff product that may support the load of insulation while serving as a durable air barrier
RPA | Radiant Professional Alliance
Renovation, repair, and painting

Sealant foam
One- or two-component polyurethane foam typically applied as a bead and used to control air leakage as part of an air barrier system within the building envelope.

Service switch
An electrical switch that controls the complete flow of electricity to a mechanical device.

SHGC
Solar heat gain coefficient

SI
Système International

SMACNA
Sheet Metal and Air Conditioning Contractors’ National Association, www.smacna.org

SPF
Spray polyurethane foam

SPFA
Spray Polyurethane Foam Alliance

SSE
Steady state efficiency

Standby loss
Heat loss through the outer part of a water heater. Energy that is used even when a device is turned off.

Storm door
An additional door assembly that is installed on the exterior of the main door.

Strip heat
A function of a heat pump that uses energy-intensive resistance heat to warm conditioned space when the heat pump is unable to satisfy the heating demand; also provides emergency heat backup for heat pumps.

Support material
Typically, wooden strips that provide support over holes greater than 24" in size for less rigid air barrier materials.

T&TA
Training and Technical Assistance

TABB
Testing and Balancing Bureau, www.tabbcertified.org

TDC
Transverse duct connector

TDF
Transverse duct flange

Thermal boundary
The separation between the interior and exterior environments of a building that slows heat flow.

Thermal resistance
The insulation or other building material that offers the primary barrier to thermal transmittance. R-value is a measurement of thermal resistance.

Tie band
A strap, often made of nylon, that mechanically squeezes a flexible duct to a fitting. Must have a minimum performance temperature rating of 165° (per UL 181A-type test) and a minimum tensile strength rating of 50 pounds.

U.S.
United States

UL
Underwriters Laboratories

Unconditioned basement
A below- or partially below-grade livable space with concrete or finished floor without intentional heating or cooling.

UV
Ultraviolet

Vapor barrier
A material that retards the passage of water vapor and contains a perm rating of less than 1.

Vapor retarder
A material that slows the passage of water vapor and contains a perm rating above 1.

Vaulted ceiling
A condition where a non-horizontal ceiling has a different slope than the roof.

Vented crawl space
A foundation that uses wall vents as a primary means to control moisture. Insulation is located at the conditioned floor level above the crawl space.

VOC
Volatile organic compound

WAP
DOE Weatherization Assistance Program

WDMA
Window and Door Manufacturers Association, www.wdma.com

Wg
Water gauge

Wind intrusion
A condition where air from outside of a structure can pass through insulation and reduce its performance.

Wood/materials shrinkage
A loss of dimension and weight as a result of drying the structure and operating the building at lower relative humidity.
Section 1: Using the Standard Work Specifications for Home Energy Upgrades

The SWS synthesize more than 30 years of building science expertise within the WAP program and the greater industry by identifying the desired outcomes of the individual measures performed during a whole-building energy upgrade. They combine original content with references to relevant codes and/or technical standards that currently exist as independent, stand-alone documents.

Definition of Multifamily Housing
The definition of multifamily housing used for the SWS is: any dwelling that contains five or more living units, which share one or more building systems and has three categories:

Low-rise: 1-3 stories with any shared building system

Mid-rise: 4-5 stories with any shared building system

High-rise: 6 stories or greater

Definition of Manufactured Housing
The definition for manufactured housing as used in the Manufactured Housing SWS document is: a single-family home that contains a permanently affixed chassis, allowing the dwelling to be transported by road. Traditionally, these homes have been called mobile homes and, in essence, the Manufactured Housing SWS document is using the term “manufactured housing” synonymously with “mobile homes.”

The Whole-House/Building Assessment
The whole-house/building assessment or energy audit is a vital component of the home energy retrofit process. It is imperative that an assessment of the whole-house/building is performed by a qualified auditor who is following a high-quality audit procedure recognized by the WAP or other program sponsor. Once the auditor has conducted a whole-house/building assessment and has developed a list of recommended measures, the SWS can be used to identify the desired outcomes of those measures and to assess the quality of the completed work. The SWS document is not meant to replace existing engineering and design specifications, but rather to be complimentary.

The Components of the SWS
The SWS identify the desired outcomes of a particular energy efficiency measure. They define the outcomes, stated as objectives, and then list the minimum specifications that are necessary for a properly installed measure to meet those outcomes (see sample specification).

Sample Specification
SWS Numbering Scheme

The details within the SWS have been indexed and numbered in a way that provides readers with suggestions as to what is contained in a specific detail, and allows for additions as the document expands without disrupting the numbering sequence. The SWS are organized into four layers. From general to specific, those layers are section, topic, subtopic, and detail. Each section contains multiple topics, each topic may be further divided into subtopics, and each subtopic contains one or more details.

Dissecting a Detail Number

There are seven sections in the SWS:

1. Using the Standard Work Specifications
2. Health and Safety
3. Air Sealing
4. Insulation
5. Heating and Cooling
6. Ventilation

7. Baseload

The section number is the first digit of a given detail. As illustrated above, any detail number beginning with 3 is from Section 3—Air Sealing.

Within each section, another set of numbers has been assigned to topics. These are represented in the first two digits in the second number in the detail titles. Some numbers are not yet in use but are reserved for future expansion of the SWS. In the example shown above, .10XX indicates that the detail is in the topic “Attics.” A detail related to insulating attics would be 4.10XX.X. For example, 4.1001.4 Vented Eave or Soffit Baffles.

Here is a full list of topic designations:

.0100 - .0900 – Health and Safety Issues
   .0100 Safe Work Practices
   .0200 Combustion Safety
   .0300 Safety Devices
   .0400 Moisture
   .0500 Radon
   .0600 Electrical
   .0700 Occupant Education and Access
   .0800 and .0900 Reserved for Future Additions

.1000 - .2900 – Parts of the Building
   .1000 Attics
   .1100 Walls
   .1200 Windows and Doors
   .1300 Floors
   .1400 Basements and Crawl Spaces
   .1500 Attached Garages
   .1600 Ducts
   .1700+ Reserved for Future Additions

.3000 - .5900 – Heating and Cooling Systems
   .3000 Forced Air
   .3100 Hydronic Heating
   .3200 Shading
   .3300+ Reserved for Future Additions

.6000 - .7900 – Ventilation
   .6000 Exhaust
   .6100 Supply
   .6200 Whole Building
   .6300+ Reserved for Future Additions

.8000 - .9800 – Baseload
   .8000 Plug Load
   .8100 Water Heating
   .8200+ Reserved for Future Additions

These topic numbers align across sections.
Additionally, these number pairs have been reserved to align across sections and topics.

.88 Special Considerations
.99 Additional Resources

Used at the topic level, it looks like this:

6.9901.1 Supplemental Ventilation Information - ASHRAE 62.2

This is the first detail in Section 6—Ventilation, topic .99 Additional Resources, subtopic 01 Codes and Standards Resources.

Used at the subtopic level, it looks like this:

6.6288.1 Sound Rating Limits

This is the first detail in Section 6—Ventilation, topic .62 Whole Building, subtopic 88 Special Considerations.

Codes and Standards

While the SWS will help identify the desired outcomes of energy efficiency measures in a weatherization or home energy upgrade project, they are not a replacement for the codes and/or technical standards mandated by a particular jurisdiction or a replacement for the manufacturer’s stated installation requirements. State, local, or municipal code or ordinance has legal precedence and users should obtain copies of the applicable codes and standards for their jurisdiction before performing the work.

Numerous national standards bodies have provided significant insight and input on the SWS. The following serve as the primary referenced codes and standards. In order to limit redundancy, additional standards that are already referenced in the following codes are not restated within the Guidelines. However, when a standard is not addressed by the following codes, it is referenced within the Guide to Referenced Standards section as an additional resource. It is important to note that references to codes and standards within the SWS documents do not constitute an endorsement by the WAP.

- IBC (International Building Code)
- IECC (International Energy Conservation Code)
- IFGC (International Fuel Gas Code)
- IMC (International Mechanical Code)
- IPC (International Plumbing Code)
- IRC (International Residence Code)
- NFPA 54 (National Fuel Gas Code)
- NFPA 70 (National Electrical Code)
- NPFA 31 (Standard for the Installation of Oil-Burning Equipment)
- UMC (Uniform Mechanical Code)
- UPC (Uniform Plumbing Code)

When codes and standards are referenced in the SWS, the year of the reference is not included. The reader should refer to the most recent version of the reference that is currently published.

Standards are referenced in two ways:
1. Embedded in the specification in either the objective or specification column. This indicates that the referenced standard is a representative approach to meet the specification.

2. Listed in the Guide to Referenced Standards.

The Role of the U.S. Environmental Protection Agency Healthy Indoor Environment Protocols for Home Energy Upgrades in the SWS

DOE and the EPA have collaborated closely throughout the production of the Guidelines and EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades. In particular, the two agencies have strived to ensure that the majority of the EPA minimum actions are fundamentally integrated and referenced as appropriate in the Standard Work Specifications. The intent is that upgrade workers following the DOE document will inherently achieve most of the EPA minimum recommendations.

The EPA protocols can be located at: [www.epa.gov/iaq/homes/retrofits.html](http://www.epa.gov/iaq/homes/retrofits.html) and should be referenced and utilized by energy upgrade workers.

The EPA protocols also provide additional detailed information on healthy retrofit practices and address some situations not specifically covered in the SWS including below-ground contaminants from sewer gases and soil or groundwater contamination, building products/materials emissions, and removal of fluorescent light ballasts containing polychlorinated biphenyls (PCBs). Additionally, both DOE and the EPA fully support the upgrade industry going above and beyond the minimum requirements by adopting the EPA-recommended expanded actions. Both agencies also understand that financial or programmatic constraints may impede this in certain cases.[1]

The EPA Healthy Indoor Environment Protocols for Home Energy Upgrades focus primarily on the health and safety of the building occupants. The EPA document includes recommended assessment protocols to identify indoor environmental quality issues, recommended minimum actions, and opportunities for expanded actions to promote improved occupant health through home energy upgrades. Each of these is described below.

- **Assessment protocols** provide EPA-recommended protocols for evaluating both existing conditions of concern and the potential for additional health concerns that may arise as a result of upgrade activities.

- **Minimum actions** include actions that weatherization and home energy upgrade contractors should take to help ensure that the work they perform in a home does not introduce new health concerns or make existing conditions worse. These often reference existing national standards; however, work should be conducted in compliance with state and local requirements as well.

- **Expanded actions** include recommended further indoor environment improvements that can be made during many home energy upgrade projects. The expanded actions are improvements that can be performed by home energy upgrade workers with proper training and sufficient resources. National standards and guidance are referenced; however, work should be conducted in compliance with state and local requirements as well.

**The Importance of Qualified Professionals**

It is important for the user to understand the necessity of ensuring that all contractors undertaking the work outlined in the SWS are properly qualified. There are a number of certification bodies and industry groups that provide verification of an individual's qualifications to perform certain types of work. This is particularly important in tasks related to heating, ventilating, and air conditioning (HVAC), electrical systems, and plumbing. Professional contractors who are credentialed through well-established national organizations can help ensure that this work is performed safely and correctly. There are often licensure requirements at the state or local level.
Within the SWS, there is a note placed in each detail in which a licensed or credentialed professional may be required to perform certain tasks. The reader is encouraged to ensure that all work is carried out in accordance with requirements set forth by the authority having jurisdiction.

The WAP requires its contractors to adhere to all codes, licensing, and certification requirements in the jurisdiction in which they operate.

[1] Weatherization Program Notice 11-6 provides information related to the implementation and installation of health and safety measures as part of the WAP. This guidance makes available recommendations to WAP Grantees as they develop their Health and Safety (H&S) Plans and procedures. The guidance also provides clarity to grantees on H&S measures and costs that are allowed as part of this energy program. WPN 11-6 (Program Year 2011, the “dash 6” will be the reference for subsequent H&S guidance in future program years) is available at www.waptac.org under rules and guidance.
## Section 2: Health and Safety

### 2.0100.2 Global Worker Safety

**Topic:** Safe Work Practices  
**Subtopic:** Safe Work Practices  
**Desired Outcome:** Work completed safely without injury or hazardous exposure

> Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</table>
| 2.0100.2a Prevention through design | Design will be incorporated to eliminate or minimize hazards (e.g., material selection, access to equipment for installation and maintenance, placement of equipment, ductwork and condensate lines) | Prevent worker injury  
Reduce risk of exposure to toxic substances and physical hazards |
| 2.0100.2b Hand protection | Durable and wrist-protecting gloves will be worn that can withstand work activity | Minimize skin contact with contaminants  
Protect hands from sharp objects |
| 2.0100.2c Respiratory protection | If the risk of airborne contaminants cannot be prevented, proper respiratory protection will be provided and worn (e.g., N-95 or equivalent face mask)  
When applying low pressure 2-component spray polyurethane foam, air purifying masks with an organic vapor cartridge and P-100 particulate filter will be used | Minimize exposure to airborne contaminants (e.g., insulation materials, mold spores, feces, bacteria, chemicals) |
| 2.0100.2d Personal protective equipment (PPE) | If contaminants are present (e.g., insulation materials), removable protective clothing will be worn  
Eye protection will always be worn (e.g., safety glasses, goggles if not using full-face respirator) | Protect worker from skin contact with contaminants  
Minimize spread of contaminants  
Provide eye protection |
| 2.0100.2e Confined space safety | Spaces with limited ingress and egress and restricted work area will be considered confined space  
Access and egress points will be located before beginning work  
Inspection will be conducted for hazards, such as damaged or exposed electrical conductors, mold, sewage effluent, friable asbestos or fiberglass, pests, and other potential hazards  
Adequate ventilation will be provided  
Use of toxic material will be reduced | Provide adequate access and egress points  
Reduce risk to the workers in the confined space  
Prevent buildup of toxic or flammable contaminants  
Prevent electrical shock |
| 2.0100.2f Power tool safety | Power tools will be inspected and used in accordance with manufacturer specifications to eliminate hazards associated with missing ground prongs, ungrounded circuits, misuse of power tools, noise, and improper or defective cords or extension cords  
All devices used will be verified as GFCI protected or double insulated  
Exhaust gases from compressors and generators will be prevented from entering interior space | Prevent power tool injuries  
Prevent buildup of toxic or flammable contaminants |
| 2.0100.2g Chemical safety | The least toxic suitable material will be chosen  
Hazardous materials will be handled in accordance with manufacturer specifications or MSDS standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers  
Appropriate personal protective equipment (PPE) will be provided  
Workers will be trained on how to use PPE  
Workers will be expected to always use appropriate PPE during work | Prevent worker exposure to toxic substances |
| 2.0100.2h Ergonomic safety | Appropriate PPE will be used (e.g., knee pads, bump caps, additional padding)  
Proper equipment will be used for work  
Proper lifting techniques will be used | Prevent injuries from awkward postures, repetitive motions, and improper lifting |
<p>| 2.0100.2i Hand tool safety | Hand tools will be used for intended purpose | Prevent injuries |</p>
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
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<tbody>
<tr>
<td>2.0100.2</td>
<td>Slips, trips, and falls</td>
<td>Caution will be used around power cords, hoses, tarps, and plastic sheeting</td>
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<td>Precautions will be taken when ladders are used, when working at heights, or when balancing on joists</td>
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<td>Walk boards will be used when practical</td>
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<td>When scaffolding is used, manufacturer set-up procedures will be followed</td>
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<td>Appropriate footwear and clothing will be worn</td>
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<tr>
<td>2.0100.2k</td>
<td>Heat and thermal stress</td>
<td>Ensure staff is aware of risks during summer months, including the symptoms of heat stroke and heat exhaustion</td>
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<td>Appropriate ventilation, hydration, rest breaks, and cooling equipment will be provided</td>
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<td>911 will be dialed when necessary</td>
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<tr>
<td>2.0100.2l</td>
<td>Fire safety</td>
<td>The source of all contaminants (e.g., sewage, dead animals, needles) will be corrected, repaired, or removed before performing inspections that require complete access to the crawl space</td>
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<td>If appropriate, the contaminant will be neutralized and/or a protective barrier will be installed in the area</td>
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<tr>
<td>2.0104.1</td>
<td>Insulation Worker Safety</td>
<td>OSHA asbestos abatement protocol 29 CFR 1926.1101 will be followed if vermiculite insulation is present</td>
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<td>If unsure whether material contains asbestos, a qualified asbestos professional will be contacted to assess the material and to sample and test as needed</td>
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<td>When working around asbestos-containing material (ACM), the following will not be done:</td>
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<td>- Dust, sweep, or vacuum debris</td>
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<td>- Saw, sand, scrape, or drill holes in the material</td>
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<td>- Use abrasive pads or brushes to strip materials</td>
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<td>Attic insulation that looks like vermiculite (as opposed to fiberglass, cellulose, or urethane foams) will not be removed or disturbed</td>
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</tbody>
</table>
### 2.0104 Respiratory Protection

- **Objective:** Protect workers from toxic exposure

- **Comment:** All materials will be handled in accordance with manufacturer specifications or Material Safety Data Sheet (MSDS) standards to eliminate hazards associated with incorrect, defective, or improperly used respirator and personal protective equipment (PPE).

- **Subtopic:** Presence of lead based paint in pre-1978 homes will be assumed unless testing confirms otherwise.

- **Comment:** The Environmental Protection Agency (EPA) Renovation, Repair, and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards.

### 2.0105 Combustion Worker Safety

**Topic:** Safe Work Practices

**Subtopic:** Heating and Cooling Equipment

**Desired Outcome:** Work completed safely without injury or hazardous exposure

#### 2.0105.3 Worker Safety

- **Objective:** Prevent injury
- **Objective:** Minimize exposure to health and safety hazards

#### 2.0105.4 Heating and Cooling Worker Safety

**Topic:** Safe Work Practices

**Subtopic:** Heating and Cooling Equipment

**Desired Outcome:** Work completed safely without injury or hazardous exposure

#### 2.0105.4a Worker Safety

- **Objective:** Prevent injury
- **Objective:** Minimize exposure to health and safety hazards

#### 2.0105.4b Mercury

- **Objective:** Protect worker and occupant from mercury exposure

#### 2.0105.4c Asbestos

- **Objective:** Protect worker and occupant from asbestos exposure

#### 2.0105.4d Personal Protective Equipment (PPE)

- **Objective:** Protect worker from exposure to hazards
- **Objective:** Protect worker from skin contact with liquid nitrogen

#### 2.0105.4e Combustible Gas Detection

- **Objective:** Protect worker and occupant from exposure to hazards

#### 2.0105.4f Carbon Monoxide (CO)

- **Objective:** Protect worker and occupant from exposure to hazards

#### 2.0105.4g Sealant

- **Objective:** Install gas lines with no leaks

---

**Note:** The table entries are formatted to represent the document content accurately.
## 2.0106.1 Ventilation Worker Safety

**Topic:** Safe Work Practices  
**Subtopic:** Ventilation Equipment  
**Desired Outcome:** Work completed safely without injury or hazardous exposure

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 2.0106.1a Worker safety | Follow all worker safety specifications in Global Worker Safety section | Prevent injury  
Minimize exposure to health and safety hazards |

## 2.0110.1 Material Selection, Labeling, and Material Safety Data Sheets (MSDSs)

**Topic:** Safe Work Practices  
**Subtopic:** Material Safety  
**Desired Outcome:** Occupant and worker risk from hazardous materials minimized

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0110.1a Material selection</td>
<td>Materials that do not create long-term health risks for occupants and workers will be used</td>
<td>Improve indoor air quality in the living space</td>
</tr>
</tbody>
</table>
| 2.0110.1b Material labeling | Manufacturer specifications will be followed | Reduce risk of exposure to harmful substances  
Follow safety procedures |
| 2.0110.1c Material Safety Data Sheets (MSDSs) | MSDSs will be provided onsite and available during all work | Assess exposure risk  
Prepare a response in case of emergency |

## 2.0111.5 Prework Qualifications (Home Installation)

**Topic:** Safe Work Practices  
**Subtopic:** Basements and Crawl Spaces  
**Desired Outcome:** Manufactured home is properly installed

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0111.5a Installation deficiencies</td>
<td>Any installation deficiencies that may affect worker safety or integrity or installed measures will be repaired before starting work</td>
<td>Ensure site is safe and ready for upgrade</td>
</tr>
</tbody>
</table>
| 2.0111.5b Stabilization | Home must be stabilized in accordance with manufacturer specifications or local authority having jurisdiction | Ensure the home is secured properly  
Prevent injury  
Minimize exposure to health and safety hazards |

## 2.0201.2 Combustion Safety

**Topic:** Combustion Safety  
**Subtopic:** Combustion Safety Testing-General  
**Desired Outcome:** Buildup of dangerous combustion byproducts in the living space prevented

**Note:** The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0201.2a Outside combustion makeup air</td>
<td>Combustion air will be provided from the outside and, where applicable, in accordance with the 2012 IRC for the type of appliance installed</td>
<td>Prevent combustion byproducts from entering the house</td>
</tr>
<tr>
<td>TITLE</td>
<td>SPECIFICATION(S)</td>
<td>OBJECTIVE(S)</td>
</tr>
<tr>
<td>-------</td>
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<td>--------------</td>
</tr>
<tr>
<td>2.0201.2b New appliances</td>
<td>If replacing appliances, a sealed-combustion, direct-vent appliance will be installed in accordance with manufacturer specifications, 2012 IRC G2427.8, and additional applicable codes. Replacement equipment venting will be assessed to ensure other existing equipment is not adversely affected.</td>
<td>Prevent combustion byproducts from entering the house</td>
</tr>
<tr>
<td>2.0201.2c CO detection and warning equipment</td>
<td>CO detection or warning equipment will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in accordance with ASHRAE 62.2 and authority having local jurisdiction. Installation will be accomplished by a licensed electrician when required by local code.</td>
<td>Alert occupant to CO exposure</td>
</tr>
<tr>
<td>2.0201.2d Gas ovens</td>
<td>Gas ovens will be tested for CO. A clean and tune will be conducted if measured CO in the undiluted flue gases of the oven vent at steady state exceeds 200 ppm or 800 ppm by air-free measurement.</td>
<td>Ensure clean burn of gas ovens</td>
</tr>
<tr>
<td>2.0201.2e Gas range burners</td>
<td>Specify clean and tune if the flame has any discoloration, flame impingement, an irregular pattern, or if burners are visibly dirty, corroded, or bent.</td>
<td>Ensure clean burn and operation of gas range burners</td>
</tr>
<tr>
<td>2.0201.2f Solid fuel-burning appliances</td>
<td>Replacement of solid fuel-burning appliance with UL-listed and EPA-certified appliances if the existing appliance is not UL-listed or has signs of structural failure.</td>
<td>Ensure safe operations of solid fuel-burning appliances</td>
</tr>
</tbody>
</table>

**2.0201.3 Combustion Appliance Zone (CAZ) Testing**  
**Topic:** Combustion Safety  
**Subtopic:** Combustion Safety Testing-General  
**Desired Outcome:** Accurate information about appliance safe operation is gathered

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0201.3a Assessment</td>
<td>Emergency problems (e.g., gas leak, ambient CO levels that exceed 35 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested.</td>
<td>Ensure system does not have fatal problems</td>
</tr>
</tbody>
</table>
| 2.0201.3b Fuel leak detection | Inspect and test for gas or oil leakage at connections of natural gas, propane piping, or oil systems. If leaks are found, immediate action will be taken to notify occupant to help ensure leaks are repaired. The report will specify repair for leaks and replacement for hazardous or damaged gas or oil connectors and pipes. | Detect fuel gas leaks  
Determine and report need for repair |
| 2.0201.3c Venting | The presence and operability of a draft regulator will be verified and tested. Combustion venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards. | Determine if a regulator is present and working  
Determine whether vent system is in good condition and installed properly |
| 2.0201.3d Base pressure test | Baseline pressure will be measured in Combustion Appliance Zone (CAZ) with reference to outdoors. | Measure pressure difference between combustion zone and the outside under natural conditions |
| 2.0201.3e Depressurization test | CAZ depressurization testing will be administered on all natural draft equipment. | Measure combined effect of mechanical system fans on combustion zone  
Removed to align single-family and manufactured housing details |
| 2.0201.3f Spillage test | Appliance spillage testing will be administered on natural draft appliances and shall not exceed 2 minutes. | Detect excessive spillage of combustion gases |
### 2.0201.3g Carbon monoxide (CO) test in appliance vent

**Comment**

See redline change(s)

**SPECIFICATION(S)**
- CO will be tested for in undiluted flue gases of combustion appliances
- If the outlet of the exhaust is accessible, include a CO test on all sealed-combustion and power-vented appliances (without atmospheric chimneys)

**OBJECTIVE(S)**
- Measure CO and report excessive levels

Entire detail (2.0201.3) combined with detail 2.0201.1.

### 2.0202.1 Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters

**Topic:** Combustion Safety  
**Subtopic:** Unvented Space Heaters  
**Desired Outcome:** Elimination of combustion byproducts

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</thead>
</table>
| 2.0202.1a Removal | With the occupant's permission, unvented heaters will be removed, except when used as a secondary heat source and when it can be confirmed that the unit is listed to ANSI Z21.11.2  
- Units that are not being operated in compliance with ANSI Z21.11.2 should be removed before the retrofit but may remain until a replacement heating system is in place  
- Failure to remove unvented space heaters serving as primary heat sources has the potential to create hazardous conditions, and thus any further weatherization services will be reevaluated in the context of potential indoor air quality risks | Eliminate sources of combustion byproduct within a living space |
| 2.0202.1b Occupant education | Occupant will be educated on potential hazards of unvented combustion appliances (primary or secondary) within a living space | Inform occupant about possible hazards associated with combustion byproducts and moisture |

### 2.0203.4 Combustion Air for Natural Draft Appliances

**Topic:** Combustion Safety  
**Subtopic:** Vented Gas Appliances  
**Desired Outcome:** Sufficient air provided in the Combustion Appliance Zone (CAZ)

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</thead>
<tbody>
<tr>
<td>2.0203.4a Required combustion air</td>
<td>The required volume of indoor air will be determined in accordance with Section G2407.5.1 or G2407.5.2 and authority having jurisdiction, except where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), at which time Section G2407.5.2 will be used</td>
<td>Determine if existing conditions meet the combustion air calculation</td>
</tr>
<tr>
<td>2.0203.4b Additional combustion air (if action is required)</td>
<td>Additional combustion air will be provided in accordance with 2012 IRC G2407 and authority having jurisdiction</td>
<td>Ensure adequate combustion air for operation of the appliance</td>
</tr>
<tr>
<td>2.0203.4c Spillage testing</td>
<td>If a combustion appliance spillage exceeds 2 minutes during pressure testing, specify measures to mitigate</td>
<td>Ensure appliance is not spilling longer than 2 minutes</td>
</tr>
</tbody>
</table>
| 2.0203.4d Occupant health and safety | All homes will have a functioning CO alarm  
If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weatherstripping; or conduct air sealing between the garage or crawl space and the home) | Ensure occupant health and safety  
Ensure indoor CO levels do not exceed outdoor CO levels |
<table>
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<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</thead>
</table>
| 2.0203.4e Occupant education | Occupants will be educated on the operation and maintenance of the CO alarm | Ensure occupant can operate and maintain installations  
Completely work on combustion appliances and recommended maintenance will be reviewed with occupant  
Occupant will be provided information regarding the health effects and risks of high CO concentrations | 3988 |

### 2.0203.5 Combustion Flue Gas—Orphaned Water Heaters

**Topic:** Combustion Safety  
**Subtopic:** Vented Gas Appliances  
**Desired Outcome:** Flue gasses successfully removed from the house

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</thead>
<tbody>
<tr>
<td>2.0203.5a Spillage testing</td>
<td>If a combustion appliance spillage exceeds 2 minutes during pressure testing, specify measures to mitigate</td>
<td>Ensure appliance is not spilling longer than 2 minutes</td>
</tr>
<tr>
<td>2.0203.5b Retesting spillage</td>
<td>If a combustion appliance spillage exceeds 2 minutes during pressure testing, specify measures to mitigate</td>
<td>Ensure appliance is not spilling longer than 2 minutes</td>
</tr>
<tr>
<td>2.0203.5c Required combustion air</td>
<td>The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with 2012 IRC G2407.5.1 or local authority having jurisdiction</td>
<td>Determine if existing conditions meet the combustion air calculation</td>
</tr>
<tr>
<td>2.0203.5d Additional combustion air (if action is required)</td>
<td>Additional combustion air will be provided in accordance with 2012 IRC G2407 or local authority having jurisdiction</td>
<td>Ensure adequate combustion air for operation of the appliance</td>
</tr>
</tbody>
</table>
| 2.0203.5e Occupant health and safety | All homes will have a functioning CO alarm (EPA offers expanded actions)  
If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weatherstripping; or conduct air sealing between the garage or crawl space and the home) | Ensure occupant health and safety  
Ensure indoor CO levels do not exceed outdoor CO levels | 3993 |
| 2.0203.5f Occupant education | Occupants will be educated on the operation and maintenance of the CO alarm  
Completed work on combustion appliances and recommended maintenance will be reviewed with occupant  
Occupant will be provided information regarding the health effects and risks of high CO concentrations | Ensure occupant can operate and maintain installations  
Inform occupant regarding possible CO hazards | 3994 |

### 2.0203.6 Draft Regulation—Category I Appliance

**Topic:** Combustion Safety  
**Subtopic:** Vented Gas Appliances  
**Desired Outcome:** Buildup of flue gasses prevented with proper drafting

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 2.0203.6a Assessment | The presence of an operable draft regulator will be verified  
Combustion venting systems will be inspected for damage, leaks, disconnections, and other safety hazards | Determine if a regulator is present and working and if vent system is in good condition and installed properly | 3995 |
| 2.0203.6b Installation (if action is required) | A draft regulator will be installed if necessary  
Manufacturer specifications for installation will be followed (e.g., size, type, location) | Install regulator in accordance with manufacturer specifications | 3996 |
| 2.0203.6c Retesting spillage | If a combustion appliance spillage exceeds 2 minutes during pressure testing, specify measures to mitigate | Ensure appliance is not spilling longer than 2 minutes | 3997 |
### 2.0203.6d Occupant health and safety

**Objective(s):**
- Ensure occupant health and safety
- Ensure indoor CO levels do not exceed outdoor CO levels

#### Comment

All homes will have a functioning CO alarm; EPA offers expanded actions if CO levels in interior living spaces exceed outdoor levels, potential sources will be investigated and appropriate action taken to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weatherstripping; conduct air sealing between the garage or crawl space and the home).

### 2.0203.6e Occupant education

**Objective(s):**
- Ensure occupant health and safety
- Ensure indoor CO levels do not exceed outdoor CO levels

#### Comment

Occupants will be educated on the operation and maintenance of the CO alarm.

Completed work on combustion appliances and recommended maintenance will be reviewed with occupant.

Occupant will be provided information regarding the health effects and risks of high CO concentrations.

### 2.0204.1 Isolating Combustion Water Heater Closet

**Topic:** Combustion Safety  
**Subtopic:** Isolation  
**Desired Outcome:** Isolate combustion water heater closet from conditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 2.0204.1a Work assessment | Installer prework assessment will be conducted to determine:  
- Combustion safety  
- Proper venting  
- Structural integrity  
- Roof leaks  
- Insect infestation  
- Accessibility  
- Number, type, size, and location of penetrations | Ensure combustion appliance is functioning safely  
Ensure work space is safe and ready for air sealing  
Verify scope of work |
| 2.0204.1b Air seal closet | When the water heater closet contains a heater that is not sealed combustion or power vented, the closet will be isolated/separated from the rest of the home through air sealing with fire-rated materials, if feasible. Avoiding frozen pipes must be considered without creating an additional utility burden (e.g., heat tape). | Prevent combustion gases from entering living area and minimize extension of interior pressures caused by exhaust fan, dryers, and interior door closure into the water heater closet |
| 2.0204.1c Materials | Only noncombustible materials will be used in contact with chimneys, vents, and flues. | Prevent a fire hazard |
| 2.0204.1d Post-work testing/verification | Blower door assisted zonal pressure diagnostics will be used to verify isolation has been achieved. | Prevent combustion gases from entering living area |

### 2.0299.1 Combustion Appliance Depressurization Limits Table

**Topic:** Combustion Safety  
**Subtopic:** Additional Resources  
**Desired Outcome:** Ensure appliances meet manufacturer's certified negative pressure tolerance rating

#### Comment

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 2.0299.1a Atmospheric water heater only (Category I, natural draft), open-combustion appliances | Manufacturer's certified negative pressure tolerance rating:  
- Limit: -2 pascals | Ensure appliances meet manufacturer's certified negative pressure tolerance rating |
### 2.0299.1b
Atmospheric water heater (Category I, natural draft) and atmospheric furnace (Category I, natural draft), common-vented, open-combustion appliances

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -3 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

**Note:**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1c
Gas furnace or boiler, Category I or Category I fan-assisted, open-combustion appliances

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -5 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1d
Oil or gas unit with power burner, low- or high-static pressure burner, open combustion appliances

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -5 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1e
Closed, controlled wood-burning appliances

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -7 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1f
Induced-draft appliances (fan at point of exit at wall), Category I with induced draft, open-combustion appliances

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -15 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1g
Pellet stoves with exhaust fan and sealed vent

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -15 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1h
Gas appliances, Category III vented through the wall, forced draft, open-combustion appliances

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -15 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0299.1i
Direct-vent, sealed combustion appliances with forced draft

<table>
<thead>
<tr>
<th>Manufacturer's certified negative pressure tolerance rating:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit -25 pascals</td>
</tr>
</tbody>
</table>

**Objective(s):**

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

### 2.0301.1 Smoke Alarm

**Topic:** Safety Devices  
**Subtopic:** Combustion Safety Devices  
**Desired Outcome:** Properly installed smoke alarms

**Note:** The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.
### 2.0301.2 Carbon Monoxide Alarm or Monitor

**Topic:** Safety Devices  
**Subtopic:** Combustion Safety Devices  
**Desired Outcome:** Properly installed CO alarms or monitors

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

#### 2.0301.2a Hardwired CO detection and warning equipment

- **Comment:** Hardwired CO detection or warning equipment will be installed in accordance with the ASHRAE 62.2 as required by the authority having jurisdiction. Installation will be accomplished by a licensed electrician when required by the authority having jurisdiction.

- **Objective:** Ensure proper installation

#### 2.0301.2b Battery-operated CO detection and warning equipment

- **Comment:** Battery-operated CO detection or warning equipment will be installed in accordance with the ASHRAE 62.2 and manufacturer specifications as required by the authority having jurisdiction.

- **Objective:** Ensure proper installation

### 2.0401.1 Air Sealing Moisture Precautions

**Topic:** Moisture  
**Subtopic:** Air Sealing  
**Desired Outcome:** Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

#### 2.0401.1a Moisture precautions for attics

- **Comment:** Roof leaks will be repaired before performing attic air sealing or insulation. Moisture sources in the house that can generate moisture into the attic will be identified and removed or reduced. Water-resistant sealants and/or closed cell foams (use a minimum of 2" to reach water barrier requirement) will be used in all attic sealing details in cold climates. Plastic, foil, or any other Class 1 vapor barrier will not be used in hot humid climates. In marine climates, vapor permeable materials will be used to block and seal penetrations in attic.

- **Objective:** Ensure durability of repairs, Reduce potential for occupant exposure to mold and other moisture-related hazards, Prevent moisture from communicating from within the conditioned space into unconditioned attic space when economically feasible. Increase durability of seal, Avoid moisture-related damage to the home

#### 2.0401.1b Moisture precautions for crawl spaces

- **Comment:** Exposed earth will be covered with a continuous, durable, sealed Class 1 vapor retarder a minimum of 6 mils in thickness. Plastic, foil, or any other Class 1 vapor barrier/retarder will not be used in hot-humid climates. All accessible penetrations between the crawl space or basement and outside will be sealed. Holes between the crawl space or basement and the living space will be sealed.

- **Objective:** Ensure durability of repairs, Reduce potential for occupant exposure to mold and other moisture-related hazards

#### 2.0401.1c Moisture precautions for the living space

- **Comment:** Moisture sources in the home will be identified and removed or reduced. Local ventilation will be installed where appropriate (e.g., baths, kitchens) and vented to outside according to ASHRAE 62.2-2010. Unvented combustion appliances that are not listed to ANSI Z21.11.2 will be removed.

- **Objective:** Ensure durability of repairs, Reduce potential for occupant exposure to mold and other moisture-related hazards
2.0401.1d Moisture precautions for exterior water

**Comment**

Before air sealing basement or crawl space walls near wet areas, surface water pooling near the foundation will be addressed by:

- Repairing, modifying, or replacing gutters and downspouts
- Grading and subsurface drainage at critical locations (e.g., localized drain and grading beneath valleys) in accordance with EPA) Indoor airPLUS Construction Specifications Section 1.1
- Possible mitigation by waterproofing or installing draining plane with construction adhesive

Reduce potential for occupant exposure to mold and other moisture-related hazards

### 2.0402.2 Site Improvements/Conditions (e.g., Leveling, Drainage, Vegetation)

**Topic:** Moisture  
**Subtopic:** Drainage  
**Desired Outcome:** Move water away from home

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</thead>
</table>
| 2.0402.2a Work assessment | Installer prework assessment will be conducted to determine:  
- Standing water  
- Positive grade/drainage  
- Conditions of gutter system  
- Vegetation/shrubbery  
- Settling of home  
- Leveling of home  
Ensure no organic material is under the supports, including topsoil and roots | Verify scope of work  
Ensure that work space is ready for work | 4021 |
| 2.0402.2b Corrective action | Ground will be properly graded to provide positive slope (1" per foot) away from home  
Gutter and downspouts will be installed or repaired  
Vegetation within 36" and encroaching on home will be cleared or trimmed if occupant approves  
Home will be leveled to compensate for settling or improper installation | Ensure positive drainage  
Maintain ventilation around home | 4022 |
| 2.0402.2c Occupant education | Occupant will be educated on the benefit of trees and shrubs to reduce heat gain and provide wind breaks in high wind locations  
Occupant will be educated on the need to maintain positive drainage (e.g., gutters, down spouts, grading) and maintain ventilation | Maintain durability  
Ensure water is moved down and away from home | 4023 |

### 2.0403.4 Pier and Skirting Foundations—Ground Moisture Barriers

**Topic:** Moisture  
**Subtopic:** Vapor Barriers  
**Desired Outcome:** Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

<table>
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<th>SPECIFICATION(S)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2.0403.4a Coverage</td>
<td>If existing conditions of the ground and skirting mandates, a moisture barrier that covers the crawl space ground will be installed with allowances for structural supports (piers) and accessibility</td>
<td>Reduce ground moisture entering crawl space</td>
</tr>
</tbody>
</table>
| 2.0403.4b Material specification | A ground moisture barrier with a rating of no more than 0.1 perm will be used  
A ground moisture barrier will be used that meets tear and puncture resistance standard ASTM E1745  
Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home (5 years), and it will need replacing to remain effective | Ensure crawl space is accessible for service and maintenance without damaging the integrity of the ground moisture barrier | 4025 |
2.0403.4c Overlap seams

**Comment:** When seams exist, they will be overlapped a minimum of 12” using reverse or upslope lapping technique

- Keep water under the liner
- Reduce likelihood of damage at seams

2.0403.4d Fastening

**Comment:** Ground moisture barrier may be fastened to ground with durable fasteners

- Prevent movement of the ground moisture barrier

### 2.0404.1 Stand-Alone Dehumidifiers

**Topic:** Moisture  
**Subtopic:** Space Conditioning  
**Desired Outcome:** Energy used to control humidity in conditioned spaces reduced

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</tr>
</thead>
</table>
| 2.0404.1a Selection | Equipment will have a minimum efficiency level of ENERGY STAR® or better  
- Equipment will have a fan-off option  
- Equipment will retain settings after power-off  
- Equipment will have features that reduce both peak electric use (e.g., internal and external timers) and absolute energy use  
- Equipment will have standby losses of 1 watt or less  
- Controls will be labeled so they are understandable, readable, and accurate for occupant needs  
- Systems located in a basement or crawl space will be rated for cold temperature operation  
- Operating environment will be determined and appropriate equipment will be selected for that environment (e.g., low temperature and high relative humidity) | Reduce energy use  
Provide durable equipment  
Control moisture  
Provide equipment appropriate for occupant use |

| 2.0404.1b Installation | Installation will proceed only when the following applicable steps have been taken to control moisture:  
- Downspouts are redirected away from foundation  
- Moisture from drying clothes is vented to the outside  
- Sump pit is covered and sealed  
- Dirt in crawl space is covered with a vapor barrier  
- Plumbing leaks are eliminated  
- Equipment will be installed according to manufacturer specifications and meet all applicable codes  
- Equipment will be installed to permit adequate air flow  
- Equipment will have a timer for off-peak operation if time-of-use program is available and if the equipment can handle power interruptions  
- Any penetrations to the exterior of the home created by the installation of the appliance will be sealed  
- Initial relative humidity and temperature settings will be set by the installer to ensure the space does not reach dew point  
- Operation of controls and needed maintenance will be reviewed with occupant  
- A user guide for dehumidifier settings in different climate conditions will be created by the installer and provided to the occupant  
- Installer will commission the equipment to ensure it is functioning properly  
- An independent measurement will be made to verify relative humidity  
- System will be connected directly to condensate line that drains to a plumbing drain or the exterior, away from the home’s foundation and in compliance with the plumbing code or the authority having jurisdiction  
- Specific information on the proper maintenance of the equipment will be provided to the occupant  
- Warranty information, operation manuals, and installer contact information will be provided to the occupant | Reduce or retire dehumidifiers  
Reduce allergens and asthma triggers  
Improve health and reduce irritants  
Improve building durability  
Improve comfort  
Reduce pest populations  
Reduce risk of mold issues  
Educate occupant on how to operate and maintain equipment |
### 2.0404.2 Crawl Spaces—Preliminary Dehumidification

**Topic:** Moisture  
**Subtopic:** Space Conditioning  
**Desired Outcome:** A dry and moisture controlled space ensured

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>2.0404.2a Close vents</td>
<td>Vents and other openings will be closed after ensuring sufficient combustion air for fuel burning appliances in accordance with 2012 IRC G2407.5.1</td>
<td>Reduce moisture load coming from outside of the crawl space</td>
</tr>
</tbody>
</table>
| 2.0404.2b Drying | If liquid moisture is present, the area will be dried until any liquid moisture is eliminated | Reduce moisture in the crawl space  
Improve work environment |
| 2.0404.2c Drying time | Space will be dehumidified until wood moisture content in solid, untreated lumber is less than 20% | Reduce moisture content of wood |

### 2.0404.4 Basements—Dehumidification

**Topic:** Moisture  
**Subtopic:** Space Conditioning  
**Desired Outcome:** Basement humidity controlled with supplemental dehumidification

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
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</table>
| 2.0404.4a Dehumidifier | A permanent, low-temperature, auto-restart, minimum ENERGY STAR® rated dehumidifier will be installed  
Manufacturer specifications will be followed for size and use  
Condensate will be drained to daylight or a condensation pump | Maintain a dry basement  
Reduce conditions conducive to mold growth, wood rot, and pests |
| 2.0404.4b Dehumidification for divided spaces | Drying will be provided to all basement areas | Maintain a dry basement  
Reduce conditions conducive to mold growth, wood rot, and pests |
| 2.0404.4c Relative humidity | All basement spaces will be maintained at a relative humidity that ensures condensation will not occur on cool surfaces | Maintain a dry basement  
Reduce conditions conducive to mold growth, wood rot, and pests |
| 2.0404.4d Condensing surfaces (e.g., cold water pipes) | Condensing surfaces in basement will be insulated and sealed | Maintain a dry basement  
Reduce conditions conducive to mold growth, wood rot, and pests |
| 2.0404.4e Dehumidification (option for dry climates and heating-dominated climates seasonally) | Ventilation in the basement will be controlled to maintain relative humidity that ensures condensation will not occur on cool surfaces | Maintain a dry basement  
Reduce conditions conducive to mold growth, wood rot, and pests |
| 2.0404.4f Occupant education | Occupant will be educated on how and when to change filter and clean condensate drain of the dehumidifier in accordance with manufacturer specifications | Ensure occupant health  
Preserve integrity of system |

### 2.0501.4 Pier and Skirting Foundation—Venting

**Topic:** Radon  
**Subtopic:** Air Sealing  
**Desired Outcome:** Pollutants are effectively vented
### 2.0602.1 Static Electric Shock

**Topic:** Electrical

**Subtopic:** Electric Hazards

**Desired Outcome:** Prevention of static electric shock to the insulation installer when using rigid tubing

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>2.0602.1a</td>
<td>Rigid fill tube grounding</td>
<td>Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded</td>
</tr>
<tr>
<td>2.0602.1b</td>
<td>Metal coupler grounding</td>
<td>For an additional level of protection, the metal coupler on the hose will be connected to the grounding wire, grounding wire will be connected to the grounding rod, and the grounding rod will be driven into the ground a minimum of 8' when possible; grounding wire will be connected in compliance with local code and authority having jurisdiction</td>
</tr>
</tbody>
</table>

### 2.0602.2 House Current Electric Hazard

**Topic:** Electrical

**Subtopic:** Electric Hazards

**Desired Outcome:** Prevention of injury to the installer and occupant, and prevent damage to the structure, if required by authority having jurisdiction

**Note:** The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

<table>
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<tr>
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<tbody>
<tr>
<td>2.0602.2a</td>
<td>Metal skin and frame grounding</td>
<td>Metal skin and frame will be grounded through the panel box to avoid electrical shock</td>
</tr>
<tr>
<td>2.0602.2b</td>
<td>Metal fill tube grounding</td>
<td>For an additional level of protection, metal fill tube will be connected to the grounding wire, grounding wire will be connected to the copper grounding rod that is driven into the ground a minimum of 8' when possible and required by code or authority having jurisdiction</td>
</tr>
<tr>
<td>2.0602.2c</td>
<td>Electrical tool safety</td>
<td>An electrical safety assessment will be performed, all electric tools will be protected by ground-fault circuit interrupters (GFCI), three-wire type extension cords will be used with portable electric tools, worn or frayed electric cords will not be used, water sources (e.g., condensate pans) and electrical sources will be kept separate, metal ladders will be avoided, aluminum foil products will be kept away from live wires, and for arc flash hazards, NFPA 70E will be consulted</td>
</tr>
<tr>
<td>2.0602.2d</td>
<td>Aluminum wiring</td>
<td>If aluminum wiring is present, work on the home will be stopped until the suspect wiring is inspected and determined to be safe by a licensed electrician, after energy retrofit is completed, wiring will be reinspected by a licensed electrician</td>
</tr>
</tbody>
</table>
### Section 3: Air Sealing

**3.1001.4 General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)**

**Topic:** Attics  
**Subtopic:** Penetrations and Chases  
**Desired Outcome:** Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space.

<table>
<thead>
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</table>
| 3.1001.4a  
Work assessment | Installer prework assessment will be conducted to determine:  
- Structural integrity  
- Roof leaks  
- Insect infestation  
- Accessibility  
- Number, type, size, and location of penetrations | Ensure work space is safe and ready for air sealing  
Verify scope of work | 4048 |
| 3.1001.4b  
Air sealing penetrations | Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the penetration or hole  
The infill or backing will not bend, sag, or move once installed  
All accessible damaged vapor barrier will be repaired  
Penetration through the air barrier will be repaired | Ensure closure is permanent and supports any load (e.g., wind, insulation, mechanical pressures)  
Ensure sealant is effective and durable | 4049 |
| 3.1001.4c  
Sealant selection | Sealants will be used to fill holes no larger than recommended by manufacturer specifications  
Sealants will be compatible with all adjoining surfaces  
Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction | Create a permanent seal  
Ensure sealant meets or exceeds the performance characteristics of the surrounding materials  
Create a continuous seal | 4050 |
| 3.1001.4d  
Ceiling hole repair | Ceiling repair material must meet or exceed strength of existing ceiling material  
Ceiling repair must span from truss to truss or add blocking as needed for support  
The backing or infill will not bend, sag, or move once installed  
All accessible damaged vapor barriers will be repaired  
Penetrations through the air barrier must be repaired | Ensure ceiling is structurally sound  
Minimize air leakage  
Ensure closure is permanent and supports expected wind and mechanical pressure loads  
Ensure sealant does not fall out | 4051 |
| 3.1001.4e  
Materials | Materials will be used or installed in accordance with product manufacturer specifications | Select materials to ensure durable and permanent repair | 4052 |
| 3.1001.4f  
High temperature application | Only noncombustible materials will be used in contact with chimneys, vents, and flues  
Local codes will be referenced | Prevent a fire hazard | 4053 |

### 3.1101.1 Exterior Holes and Penetrations

**Topic:** Walls  
**Subtopic:** Manufactured Housing Walls  
**Desired Outcome:** Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space; all repairs will maintain structural integrity.

<table>
<thead>
<tr>
<th>TITLE</th>
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</tr>
</thead>
</table>
### 3.1101.1a Work assessment

**Comment**

Installer prework assessment will be conducted to determine:

- Structural integrity
- Size of wall stud
- Insect infestation
- Accessibility
- Number, type, size, and location of penetrations

Ensure work space is safe and ready for air sealing
Verify scope of work

---

### 3.1101.1b Materials

**Comment**

Like material and/or compatible materials will be used for repairs

Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute)

Select materials to ensure durable and permanent repair

---

### 3.1101.1c Exterior wall air sealing

**Comment**

All holes and penetrations on exterior surface of exterior walls will be sealed to ensure resistance to outdoor elements

Intentionally ventilated walls will not be sealed at vent locations (e.g., weep holes)

All holes and penetrations on the interior surface of exterior walls will be repaired

Backimg or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration

Minimize air leakage
Maintain durability
Ensure resulting closure is permanent and supports expected load
Ensure sealant is effective and durable

---

### 3.1101.2 Interior Holes and Penetrations

**Topic:** Walls

**Subtopic:** Manufactured Housing Walls

**Desired Outcome:** Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space; all repairs will maintain structural integrity

#### TITLE | SPECIFICATION(S) | OBJECTIVE(S)
--- | --- | ---

#### 3.1101.2a Work assessment

**Comment**

Installer prework assessment will be conducted to determine:

- Structural integrity
- Size of wall stud
- Insect infestation
- Accessibility
- Number, type, size, and location of penetrations

Ensure work space is safe and ready for air sealing
Verify scope of work

---

#### 3.1101.2b Interior wall air sealing

**Comment**

All accessible holes and penetrations in top and bottom plates will be sealed

Backimg or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration

Minimize air leakage
Maintain durability
Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads
Ensure sealant is effective and durable

---

#### 3.1101.2c Materials

**Comment**

Like material and/or compatible materials will be used for repairs

Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute)

Select materials to ensure durable and permanent repair

---

### 3.1101.3 Holes, Penetrations, and Marriage Line

**Topic:** Walls

**Subtopic:** Manufactured Housing Walls

**Desired Outcome:** Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space; all repairs to maintain structural integrity

#### TITLE | SPECIFICATION(S) | OBJECTIVE(S)
--- | --- | ---

---
### 3.1101.3a Work assessment

**Comment**

Installer prework assessment will be conducted to determine:

- Structural integrity
- Insect infestation
- Accessibility
- Number, type, size, and location of penetrations
- Identify marriage walls and lines

Ensure work space is safe and ready for air sealing
Verify scope of work

### 3.1101.3b Marriage wall air sealing of holes and penetrations

**Comment**

All accessible holes and penetrations in top and bottom plates will be sealed

Minimize air leakage
Maintain durability
Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads
Ensure sealant is effective and durable

### 3.1101.3c Marriage line air sealing

**Comment**

All accessible holes and penetrations at marriage lines will be sealed continuously at end walls, floors, and ceiling

Minimize air leakage
Maintain durability
Ensure sealant is effective and durable

### 3.1101.3d Materials

**Comment**

Materials will be used or installed in accordance with product manufacturer specifications

Select materials to ensure durable and permanent repair

---

### 3.1201.5 Manufactured Housing Windows and Doors

**Topic:** Windows and Doors
**Subtopic:** Maintenance, Repair, and Sealing
**Desired Outcome:** Windows and doors are operable, sealed, and weathertight

<table>
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<tr>
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<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</thead>
</table>
| 3.1201.5a Work assessment | Installer prework assessment will be conducted to determine:  
- Number  
- Type  
- Operating condition  
- Wall construction | Ensure work space is safe and ready for air sealing  
Verify scope of work |
| 3.1201.5b Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file  
EPA’s Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | Protect worker and occupant from potential lead hazards |
| 3.1201.5c Operable windows and doors | All egress windows will be operable as required by local codes  
All egress doors will be operable as required by local codes | Maintain operability of egress windows and doors |
| 3.1201.5d Air infiltration | Details that reduce air infiltration will be repaired, replaced, sealed, or installed (e.g., plastic gliders, weatherstripping, cranks, latches, locks, knobs, thresholds) | Reduce air infiltration |
| 3.1201.5e Water infiltration | Details that reduce water infiltration will be repaired, replaced, or installed (e.g., replace missing glazing on sash, exterior caulking, exterior storm windows, storm doors, drip cap, J-channel, flashing) | Reduce water infiltration |
| 3.1201.5f Materials | Materials will be used or installed in accordance with product manufacturer specifications | Select materials to ensure durable and permanent repair |
3.1201.6 Interior Storm Windows

Topic: Windows and Doors
Subtopic: Maintenance, Repair, and Sealing

Desired Outcome: Minimize air infiltration through existing leaky windows while maintaining safe egress for occupants

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</table>
| 3.1201.6a Work assessment | Installer prework assessment will be conducted to determine:  
- Number  
- Type  
- Size  
- Condition of opening | Verify scope of work |
| 3.1201.6b Fixed storm window | Fixed interior storm windows will not be installed in egress locations | Safety |
| 3.1201.6c Installing operable storm window | Operable interior storm windows will be installed in accordance with manufacturer specifications | Minimize air leakage  
Provide safe egress for occupants |
| 3.1201.6d Health and safety | Interior storm windows will be operable and egress rated in egress locations | Provide safe egress for occupants |
| 3.1201.6e Occupant education | Occupants will be educated on the proper use and maintenance of storm windows | Ensure weathertightness and safety |

3.1202.3 Replacing Damaged Window Glass in Manufactured Housing

Topic: Windows and Doors
Subtopic: Repairing/Replacing Cracked and Broken Glass

Desired Outcome: Glass complete and intact

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</table>
| 3.1202.3a Work assessment | Installer prework assessment will be conducted to determine:  
- Number  
- Type  
- Location  
- Operating condition  
- Wall construction  
- Size | Ensure that work space is safe and ready for glass replacement  
Verify scope of work |
| 3.1202.3b Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file  
EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | Protect worker and occupant from potential lead hazards |
### 3.1203.3 Replacement of Manufactured Housing Windows and Doors

**Topic:** Windows and Doors  
**Subtopic:** Replacement  
**Desired Outcome:** Smooth operation and an airtight and weathertight fit of replacement windows and doors

<table>
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</tr>
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</table>
| 3.1203.3a Work assessment | Installer prework assessment will be conducted to determine:  
  - Number  
  - Type  
  - Operating condition  
  - Wall construction | Ensure work space is safe and ready for air sealing  
Verify scope of work |
| 3.1203.3b Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file  
EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | Protect worker and occupant from potential lead hazards |
| 3.1203.3c Window or door selection | Window or door units will be designed for manufactured home use and will be ENERGY STAR qualified  
Rough opening will be measured before ordering replacements  
Access to emergency egress points, such as primary windows or exit doors, will be considered during the selection of retrofit window or door units | Ensure proper size, type, and operation of window or door |
| 3.1203.3d Rough opening preparation | Existing units will be removed  
Opening will be cleaned  
Any damaged framing will be replaced  
Opening for installation will be prepared in accordance with manufacturer specifications | Provide a clean opening for replacement unit |
| 3.1203.3e Window and door installation | Window or door units will be installed in accordance with manufacturer specifications | Ensure replacement window or door operates properly  
Ensure replacement window or door has a weathertight fit |
| 3.1203.3f Safety | Egress windows will only be replaced with egress windows | Provide safe egress for occupants |
| 3.1203.3g Maintenance and occupant education | Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window or door | Ensure long-term weathertightness |

### 3.1301.1 Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board Floors

**Topic:** Floors  
**Subtopic:** Penetrations

---

**Topic:** Windows and Doors  
**Subtopic:** Replacement  
**Desired Outcome:** Smooth operation and an airtight and weathertight fit of replacement windows and doors

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<th>Objective(s)</th>
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</thead>
</table>
| 3.1203.3a Work assessment | Installer prework assessment will be conducted to determine:  
  - Number  
  - Type  
  - Operating condition  
  - Wall construction | Ensure work space is safe and ready for air sealing  
Verify scope of work |
| 3.1203.3b Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file  
EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | Protect worker and occupant from potential lead hazards |
| 3.1203.3c Window or door selection | Window or door units will be designed for manufactured home use and will be ENERGY STAR qualified  
Rough opening will be measured before ordering replacements  
Access to emergency egress points, such as primary windows or exit doors, will be considered during the selection of retrofit window or door units | Ensure proper size, type, and operation of window or door |
| 3.1203.3d Rough opening preparation | Existing units will be removed  
Opening will be cleaned  
Any damaged framing will be replaced  
Opening for installation will be prepared in accordance with manufacturer specifications | Provide a clean opening for replacement unit |
| 3.1203.3e Window and door installation | Window or door units will be installed in accordance with manufacturer specifications | Ensure replacement window or door operates properly  
Ensure replacement window or door has a weathertight fit |
| 3.1203.3f Safety | Egress windows will only be replaced with egress windows | Provide safe egress for occupants |
| 3.1203.3g Maintenance and occupant education | Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window or door | Ensure long-term weathertightness |
**Desired Outcome:** Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space

<table>
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<tr>
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</thead>
</table>
| 3.1301.1a Work assessment | Installer prework assessment will be conducted to determine:  
  - Structural integrity  
  - Standing water  
  - Raw sewage  
  - Insect infestation  
  - Pests  
  - Accessibility  
  - Number, type, size, and location of penetrations | Ensure work space is safe and ready for air sealing  
Verify scope of work |

3.1301.1b Soft bottom board repair  
Patching material will be provided as needed to meet the specific characteristics of the bottom board material and the characteristics of the hole  
Patch will have a service life of a minimum of 20 years
| 3.1301.1b Soft bottom board repair | Patching material will be provided as needed to meet the specific characteristics of the bottom board material and the characteristics of the hole  
Patch will have a service life of a minimum of 20 years | Minimize air leakage  
Keep insulation in place  
Ensure repair materials are compatible  
Ensure patch will support insulation |

3.1301.1c Hard bottom board repair  
Patching will be provided as needed to meet both the specific characteristics of the bottom board material and the characteristics of the hole  
Patch will not bend, sag, or move once installed  
Patch will be permanent
| 3.1301.1c Hard bottom board repair | Patching will be provided as needed to meet both the specific characteristics of the bottom board material and the characteristics of the hole  
Patch will not bend, sag, or move once installed  
Patch will be permanent | Minimize air leakage  
Ensure repair materials are compatible  
Minimize hole size to ensure successful use of sealant  
Ensure closure is permanent and supports insulation  
Ensure sealant does not fail out |

3.1301.1d Bottom board penetrations  
Combustion air supplies will be labeled for identification and will not be blocked or sealed  
Penetrations will be sealed to meet both the specific characteristics of the bottom board material and the characteristics of the penetrations (e.g., electrical, PVC, gas line, dryer vent)  
The patch will not bend, sag, or move once installed
| 3.1301.1d Bottom board penetrations | Combustion air supplies will be labeled for identification and will not be blocked or sealed  
Penetrations will be sealed to meet both the specific characteristics of the bottom board material and the characteristics of the penetrations (e.g., electrical, PVC, gas line, dryer vent)  
The patch will not bend, sag, or move once installed | Ensure combustion equipment is not compromised  
Minimize air leakage around penetrations |

3.1301.1e Materials  
Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute)  
Surface preparation and material selected will be used or installed in accordance with product manufacturer specifications
| 3.1301.1e Materials | Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute)  
Surface preparation and material selected will be used or installed in accordance with product manufacturer specifications | Select materials to ensure durable and permanent repair |

### 3.1301.2 Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring

**Topic:** Floors  
**Subtopic:** Penetrations  
**Desired Outcome:** Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space; all repairs will maintain structural integrity

<table>
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<tr>
<th>TITLE</th>
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</tr>
</thead>
</table>
| 3.1301.2a Work assessment | Installer prework assessment will be conducted to determine:  
  - Structural integrity  
  - Insect infestation  
  - Pests  
  - Accessibility  
  - Plumbing leaks  
  - Number, type, size, and location of penetrations | Ensure work space is safe and ready for air sealing  
Verify scope of work |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1301.2b</td>
<td>Floor air sealing (decking, subfloor, floor decking)</td>
<td>Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration. The backing or infill will not bend, sag, or move once installed.</td>
</tr>
<tr>
<td>3.1301.2c</td>
<td>Sealant selection</td>
<td>Sealants will be used to fill holes no larger than recommended by manufacturer specifications. Sealants will be compatible with all adjoining surfaces. Sealants will be continuous and meet fire barrier specifications, if required.</td>
</tr>
<tr>
<td>3.1301.2d</td>
<td>Floor repair</td>
<td>Floor repair material will meet or exceed strength of existing floor material. Repair will span from joist to joist and blocking added as needed to support floor. Patches smaller than 144 square inches will not require repairs from joist to joist. Floor repair material will be glued, fastened, and air sealed.</td>
</tr>
<tr>
<td>3.1301.2e</td>
<td>Structural materials</td>
<td>Materials will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute). Materials will be used or installed in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td>3.1301.2f</td>
<td>High temperature application</td>
<td>Only noncombustible materials will be used in contact with chimneys, combustion exhaust vents, and flues.</td>
</tr>
</tbody>
</table>

### 3.1302.1 Floor Framing—Bay Window

**Topic:** Floors  
**Subtopic:** Floor Framing  
** Desired Outcome:** Floor/framing around bay windows sealed and weathertight

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 3.1302.1a | Work assessment | Installer prework assessment will be conducted to determine:  
- Accessibility  
- Number  
- Type  
- Size  
- Operating condition  
- Condition of opening  
- Wall construction type | Ensure work space is safe and ready for air sealing. Verify scope of work. |
<p>| 3.1302.1b | Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file. EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards. | Protect worker and occupant from potential lead hazards. |</p>
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1302.1c Air infiltration</td>
<td>Details that reduce air infiltration will be repaired, replaced, sealed, or installed Bay window floor framing that connects interior to exterior underpinning and insulation must be removed to seal gaps, cracks, and joints Blocking must be installed on perimeter rail (rim joist) if missing Seal all gaps, cracks, and joints of all framing in bay window assembly Insulation must be replaced or installed in full contact with subfloor Underpinning will be replaced and sealed</td>
<td>Reduce air infiltration</td>
</tr>
<tr>
<td>3.1302.1d Water infiltration</td>
<td>Details that reduce water infiltration will be repaired, replaced, or installed</td>
<td>Reduce water infiltration</td>
</tr>
<tr>
<td>3.1302.1e Materials</td>
<td>Materials will be used or installed in accordance with product manufacturer specifications</td>
<td>Ensure proper use and installation of materials</td>
</tr>
</tbody>
</table>

### 3.1488.2 Skirting Manufactured Homes

**Topic:** Basements and Crawl Spaces  
**Subtopic:** Special Considerations  
** Desired Outcome:** Wind, weather, debris, and pests are excluded from the underside of the home

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(S)</th>
<th>Objective(S)</th>
</tr>
</thead>
</table>
| 3.1488.2a Work assessment | Installer prework assessment will be conducted to determine:  
- Type (ventilated or unventilated, insulated or noninsulated)  
- Extent of repair/replacement  
- Accessibility  
- Moisture and drainage  
- Structural integrity of foundation (e.g., piers and supports)  
- Structural integrity of perimeter rail/rim joist  
- Integrity of existing skirting support material  
- Presence of infestation or pests  
Problems will be corrected before skirting work begins | Ensure work space is safe and ready for repair or installation  
Verify scope of work |
| 3.1488.2b Repair and installation | Manufacturer specifications will be followed when applicable  
No exposed wood will be left unfinished (e.g., wood to be painted, sealed, treated)  
If framing is required for skirting, framing will be structurally sound  
Skirting will be installed to allow for movement (e.g., no screws or nails directly through panels)  
Skirting installation will allow for expansion, contraction, and frost heaving | Match existing skirting  
Provide resistance from outdoor elements  
Limit pest access |
| 3.1488.2c Venting | Venting will be in accordance with local climate conditions or code as required | Achieve and maintain building durability |
| 3.1488.2d Insulated skirting | Insulated skirting may be installed where belly is inaccessible and not repairable | Reduce conductive heat loss through floor assembly |
| 3.1488.2e Flashing | Flashing or proper caulking will be installed between skirting and manufactured home, if required by authority having jurisdiction | Prevent water penetration |
| 3.1488.2f Materials | Like material and/or compatible materials will be used for repairs (e.g., galvanized metal, aluminum, alkaline copper quaternary treated lumber)  
Selected materials will be corrosion resistant | Achieve/increase durability |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1488.2g Fasteners</td>
<td>Like material and/or compatible materials will be used for repairs (e.g., galvanized metal, aluminum, alkaline copper quaternary treated lumber) Fasteners will be corrosion resistant</td>
<td>Achieve/increase durability</td>
</tr>
<tr>
<td>3.1488.2h Structural</td>
<td>Existing skirting support material will be structurally sound and completely intact; any damaged framing will be replaced</td>
<td>Provide adequate support</td>
</tr>
<tr>
<td>3.1488.i Skirting stiffener/high wind support</td>
<td>Skirting support (e.g., vinyl blowout rods, horizontal bracing for other types) will be placed in high-wind locations</td>
<td>Increase strength to resist wind loading</td>
</tr>
<tr>
<td>3.1488.j Occupant education</td>
<td>Occupants will be educated on maintenance of skirting (e.g., floating panels are not tightly screwed to framing, string trimmers may damage skirting)</td>
<td>Increase durability</td>
</tr>
</tbody>
</table>

### 3.1601.2 Duct Preparation for SPF Application

**Topic:** Ducts  
**Subtopic:** Duct Preparation  
**Desired Outcome:** Condition of ductwork identified and necessary repairs made in preparation for spray polyurethane foam (SPF) application

For supporting material, see Referenced Standards, General Information on Spray Polyurethane Foam (SPF) and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</thead>
</table>
| 3.1601.2a Inspection | All exposed ductwork in unconditioned spaces (e.g., attics, basements, crawl spaces) will be inspected  
Broken joints or large cracks, gaps, or holes will be identified  
Type of ductwork (e.g., metal, duct board, flex duct) will be identified  
Type and R-value of existing duct insulation (e.g., fiberglass, stone wool, asbestos) will be identified as will the location of vapor retarders, if any  
If asbestos insulation was used, it will not be disturbed; consult with an asbestos abatement expert for removal  
Loose fitting or damaged fiberglass or stone wool insulation will be removed using proper safety equipment  
Necessary clearances for installation of SPF will be ensured | Identify damaged ductwork in need of repair  
Identify type and R-value of existing insulation |
| 3.1601.2b Repair | Broken or missing ductwork will be repaired or replaced  
All cracks, gaps, or holes greater than ¼” will be taped or sealed as feasible  
Dust, dirt, and grease will be removed from exterior surfaces of ducts | Cover openings in ducts to prevent SPF from entering the interior of the duct  
Ensure surfaces of duct are clean to promote proper adhesion of SPF |

### 3.1601.4 Support for Horizontal, Suspended Ducts

**Topic:** Ducts  
**Subtopic:** Duct Preparation  
**Desired Outcome:** Ducts and plenums properly supported

<table>
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<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</thead>
</table>
| 3.1601.4a Support | Flexible and duct board ducts and plenums will be supported where feasible in accordance with flex duct manufacturer specifications and local codes  
Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping)  
Metal ducts will be supported by metal strapping, rods, or other materials, where feasible | Eliminate falling and sagging |

### 3.1601.5 Preparation and Mechanical Fastening

**Topic:** Ducts  
**Subtopic:** Duct Preparation  
**Desired Outcome:** Ducts and plenums properly fastened to prevent leakage
3.1601.5a Preparation
Comment

Surrounding insulation will be cleared to expose joints being sealed; salvage for reuse if possible
Duct surface to receive sealant will be cleaned

Gain access while maintaining insulation value
Achieve proper adhesion for airtight seal when needed to ensure a tight fit to the framing structure and ensure the register can be removed and reinstalled by the dwelling occupant

3.1601.5b Metal to metal
Comment

Ducts will be fastened with a minimum of three equally spaced screws

Ensure durable joints

3.1601.5c Flex to metal
Comment

Joints will be fastened with tie bands using a tie band tensioning tool
For oval flexible duct to metal connections, tie bands cannot be used; appropriate mechanical fastener will be used
All connections, regardless of fastener, will be sealed

Ensure durable joints

3.1601.5d Duct board to duct board
Comment

Joints will be fastened with outward clinching (stitch) staples and c-channels if possible

Ensure durable joints

3.1601.5e Duct board to flexible duct
Comment

Metal take-off collar specifically designed for the thickness of the duct board will be used
All finger tabs will be bent down securely
Finger tabs will be longer than the thickness of the duct board and the shank will not extend beyond the thickness of the duct board
There will be an internal metal backer inside the duct board through which three evenly spaced screws can be secured; the metal backer will not interfere with air flow

Ensure durable joints
Prevent the collar from moving into or out of the duct board or slipping

3.1601.5f Duct board plenum to air handler cabinet
Comment

Flange/c-channel will be fastened with screws with the duct board installed between c-channel flanges
Duct board plenum will be connected to air handler plenum with flexible duct in upflow units

Ensure durable joints

3.1601.5g Boot to wood
Comment

Predrill for screws or use ring shanked nails to fasten boot to wood

Ensure durable joints

3.1601.5h Boot to gypsum
Comment

If accessible, boot hanger will be fastened to adjacent framing with screws or nails
Boot will be connected to boot hanger with screws
If inaccessible, boot will be fastened to gypsum with a durable, adhesive sealant

Ensure durable joints

3.1601.5i Duct board to flex
Comment

Metal take-off collar with a hip and an internal metal backer will be used
Take-offs will be in accordance code requirements

Ensure durable joints

3.1602.10 Hard and Flex Branch Ducts
Topic: Ducts
Subtopic: Duct Sealing
Desired Outcome: Deliver air from trunk to termination (register/diffuser) without leakage

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
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</thead>
</table>
| 3.1602.10a Work assessment | Installer prework assessment will be conducted to determine:
  - Location
  - Connection types
  - Leakage points
Access holes will be created for the work done at each location | Verify scope of work
Gain access to duct connections |
| 3.1602.10b Reduce excess flex duct length | Excess flex duct will be removed between the takeoff at trunk and floor register boot | Improve air flow |
### 3.1602.11 Air Sealing System
**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** Ducts and plenums sealed to prevent leakage

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1602.11a New component to new component sealant selection</td>
<td>Any closure system used will meet or exceed applicable standards</td>
<td>Ensure effectiveness of air sealing system</td>
</tr>
</tbody>
</table>
| 3.1602.11b New component to existing component | Duct surface to receive sealant will be cleaned  
Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic  
Mastic alone will be acceptable for holes less than ½" that are more than 10' from air handler  
Holes greater than ¼" will be patched with metal or joint will be rebuilt to reduce the gap size  
Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:  
  - They will be backed using temporary tape (e.g., foil tape) as a support before sealing  
  - They will be sealed using fiberglass mesh and mastic | Eliminate air leakage into or out of ducts and plenums  
Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct  
Reinforce seal  
Support mastic and fiberglass mesh during curing | 4150 |
| 3.1602.11c Existing component to existing component | Duct surface to receive sealant will be cleaned  
Fiberglass mesh and mastic will overlap temporary tape by at least 1" on all sides  
Seams, cracks, joints, holes, and penetrations larger than ¼" will be repaired using rigid duct material  
Fiberglass mesh and mastic will overlap repair joint by at least 1" on all sides  
Fiberglass mesh and mastic will be the primary seal | Eliminate air leakage into or out of ducts and plenums  
Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct  
Reinforce seal  
Support mastic and fiberglass mesh during curing | 4151 |
| 3.1602.11d Performance testing | Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program | Document post-retrofit duct leakage test has been performed | 4148 |

---

### 3.1602.12 Air Sealing System Components
**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** Ducts and plenums sealed to prevent leakage

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1602.12a New component to new component sealant selection</td>
<td>Any closure system used will meet or exceed applicable standards</td>
<td>Ensure effectiveness of air sealing system</td>
</tr>
</tbody>
</table>
| 3.1602.12b New component to existing component | Duct surface to receive sealant will be cleaned  
Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic  
Mastic alone will be acceptable for holes less than ½" that are more than 10' from air handler  
Holes greater than ¼" will be patched with metal or joint will be rebuilt to reduce the gap size  
Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:  
  - They will be backed using temporary tape (e.g., foil tape) as a support before sealing  
  - They will be sealed using fiberglass mesh and mastic | Eliminate air leakage into or out of ducts and plenums  
Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct  
Reinforce seal  
Support mastic and fiberglass mesh during curing | 4150 |
| 3.1602.12c Existing component to existing component | Duct surface to receive sealant will be cleaned  
Fiberglass mesh and mastic will overlap temporary tape by at least 1" on all sides  
Seams, cracks, joints, holes, and penetrations larger than ¼" will be repaired using rigid duct material  
Fiberglass mesh and mastic will overlap repair joint by at least 1" on all sides  
Fiberglass mesh and mastic will be the primary seal | Eliminate air leakage into or out of ducts and plenums  
Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct  
Reinforce seal  
Support mastic and fiberglass mesh during curing | 4151 |
| 3.1602.12d Performance testing | Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program | Document post-retrofit duct leakage performed | 4152 |
3.1602.13 Return—Framed Platform  
**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** The return duct is installed to prevent air leakage

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1602.13a Preparation</td>
<td>Debris and dirt will be cleaned out of the return platform</td>
<td>Allow for the application of rigid materials and sealants</td>
</tr>
</tbody>
</table>
| 3.1602.13b Infill and backing | Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space  
Backings or infill will not bend, sag, or move once installed  
Material will be rated for use in return duct systems | Minimize hole size to ensure successful use of sealant  
Ensure closure is permanent and supports all loads (e.g., return air pressure)  
Ensure sealant does not fall out |
| 3.1602.13c Sealant selection | Sealants will be compatible with their intended surfaces  
Sealants will be continuous and meet fire barrier specifications | Select permanent sealant  
Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |

3.1602.2 Duct Spray Polyurethane Foam (SPF) Installation  
**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** Exposed ductwork in unconditioned spaces insulated and sealed

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</tr>
</thead>
</table>
| 3.1602.2a Installation | Insulation will be installed according to manufacturer specifications and all provisions of the 2012 IRC  
SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer  
Sufficient insulation will be applied to all joints and around all penetrations to the conditioned space through walls, floors, and ceilings  
SPF will be covered with proper fire protective coverings or coatings appropriate for location of ductwork and type of foam used, and provisions of the 2012 IRC and local codes  
If ducts are used for air-conditioning, an appropriate vapor retarder will be applied on the SPF if open-cell SPF used  
If 2” or more of closed-cell SPF is used, follow manufacturer specification to determine if additional vapor retarder is needed  
The flame spread index will not be greater than 25 and the smoke-developed index will not be greater than 450 at the specified installed thickness  
The foam plastic will be protected with an ignition barrier | Insulate and seal all exposed ductwork in unconditioned spaces  
Manage moisture condensation on ductwork that carries cooled air in warm, moist climates  
Provide adequate fire protection for exposed SPF |

3.1602.3 Proprietary Spray Application  
**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** Ducts and plenums sealed to prevent leakage

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.
3.1602.8 Supply Plenum (Furnace to Trunk Duct Connection) in Both Upflow and Downflow Air Handler Configurations

**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** Deliver all air from air handler to the trunk duct without leakage or restriction

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1602.8a Internal or external application</td>
<td>Sealant will be applied in accordance with manufacturer specifications, as well as UL 181M, NFPA 90A, and NFPA 90B</td>
<td>Reduce duct leakage</td>
</tr>
</tbody>
</table>
| 3.1602.8a Work assessment | Installer prework assessment will be conducted to determine:  
  - Size of plenum  
  - Alignment  
  - Connection method  
  - Existing sealing | Ensure an efficient and effective way to accomplish work  
Verify scope of work |
| 3.1602.8b Preparation | Debris will be removed  
Surface will be prepared for work (e.g., remove tape, oil)  
Floor will be prepared to receive the appropriately sized plenum | Provide unobstructed path for work access and air flow  
Ensure adhesion of materials to be installed  
Provide a properly sized plenum to maximize distribution of air flow (equal to the furnace discharge) |
| 3.1602.8c Plenum rebuild or repair | Plenum will be rebuilt or repaired using compatible materials and will be:  
  - Mechanically fastened  
  - Sealed  
  - Durable  
  - Structurally sound  
  - Insulated  
  - Equipped with a vapor retarder where climate appropriate  
  If possible, flow diverter or turning vanes will be installed for air flow and/or balancing (e.g., bullhead Ts, offset air handler) | Minimize restrictions  
Maximize air flow and air distribution  
Minimize moisture issues  
Prevent condensation on plenum |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1602.8d</td>
<td>Repair work access</td>
<td>Repair work access &lt;br&gt; Prevent condensation &lt;br&gt; Minimize heat loss and heat gain from plenum</td>
</tr>
<tr>
<td></td>
<td>Point of access options include:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 1: Through the trunk duct</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Repair and seal access hole in the trunk duct</td>
<td></td>
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<tr>
<td></td>
<td>• Install insulation</td>
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<tr>
<td></td>
<td>• Repair belly/bottom liner</td>
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<tr>
<td></td>
<td>Option 2: Remove crossover duct</td>
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</tr>
<tr>
<td></td>
<td>• Reattach crossover duct</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Seal and insulate crossover duct</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Repair belly/bottom liner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 3: Remove air handler</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Install new gasket, if necessary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Mechanically attach furnace to the structure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reconnect utilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Replace and seal panels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 4: Through the furnace panel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Replace and seal panels</td>
<td></td>
</tr>
<tr>
<td>3.1602.8e</td>
<td>Safety testing</td>
<td>Verify operation &lt;br&gt; Identify unsafe equipment operating conditions</td>
</tr>
<tr>
<td></td>
<td>Equipment will be cycled</td>
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<tr>
<td></td>
<td>Combustion Appliance Zone (CAZ) test will be performed where combustion appliances are utilized</td>
<td></td>
</tr>
<tr>
<td>3.1602.8f</td>
<td>Performance testing</td>
<td>Document post-retrofit duct leakage test has been performed</td>
</tr>
<tr>
<td></td>
<td>Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program</td>
<td></td>
</tr>
</tbody>
</table>

### 3.1602.9 Crossover Ducts

**Topic:** Ducts  
**Subtopic:** Duct Sealing  
**Desired Outcome:** Deliver all air from trunk to trunk without leakage or restriction

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1602.9a</td>
<td>Work assessment</td>
<td>Verify scope of work</td>
</tr>
<tr>
<td></td>
<td>Installer prework assessment will be conducted to determine:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Location</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Types</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Leakage points</td>
<td></td>
</tr>
</tbody>
</table>
### 3.1602.9b Flexible crossover duct connections

**Comment:** Flexible crossover duct connections will be added, rebuilt, or repaired using compatible materials and will be:
- Mechanically fastened at both inner and outer liner
- Sealed using UL-listed sealant that is durable, structurally sound, insulated
- Equipped with a vapor retarder

- Whenever possible, rigid elbow or equivalent will be installed in crawl space crossover ducts
- Floor insulation will be in contact with the outer liner of the crossover duct
- Crossover duct vapor retarder will be sealed to the bottom liner (e.g., belly fabric)
- New flex duct installation will be insulated to a minimum of R-8
- When feasible, 26-gauge hard duct should be installed
- If a new crossover is required, it must be insulated to at least R-8 and be air sealed

**Objective:**
- Ensure lasting durable connections
- Minimize air leakage and heat transfer
- Maintain duct diameter around the turns
- Maximize air flow and distribution

### 3.1602.9d Through-the-rim crossover duct

**Comment:** Through-the-rim crossover ducts will be located and accessed through the bottom liner and branch duct; all branch crossover duct connections and end caps will be located and accessed
- Hole size (air pathway) will be maximized between branch crossover and trunk
- All connections will be mechanically fastened and sealed inside duct
- End caps will be sealed

**Objective:**
- Ensure all connections are identified
- Maximize air flow and distribution
- Ensure lasting durable connections
- Minimize air leakage

### 3.1602.9f Attic crossover

**Comment:** Access to the attic will be created for all attic areas that contain crossover ducts, where feasible
- Plenum boxes and crossover duct connections will be rebuilt, mechanically fastened, and sealed
- Access holes will be repaired

**Objective:**
- Ensure lasting durable connections
- Minimize air leakage
- Maximize air flow and distribution
- Repair work access

### 3.1602.9g Combustion Appliance Zone (CAZ) testing

**Comment:** CAZ testing will be performed where combustion appliances are utilized

**Objective:**
- Identify unsafe equipment operating conditions

### 3.1602.9h Performance testing

**Comment:** Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program

**Objective:**
- Document post-retrofit duct leakage test has been performed

---

### 3.1701.1 Holes, Penetrations, and Connection Seam

**Topic:** Additions

**Subtopic:** Attached Additions

**Desired Outcome:** The exterior of the seam is weathertight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between unconditioned and conditioned space
3.1701.1a  Installer prework assessment will be conducted to determine:
- Structural integrity
- Roof leaks
- Insect infestation
- Accessibility
- Mechanical attachment
- Location of marriage wall seams
- Number, type, size, and location of penetrations

Ensure work space is safe and ready for air sealing
Verify scope of work

3.1701.1b  Marryage wall seams will be sealed continuously at walls, floors, and ceiling connection
All accessible holes and penetrations in the addition envelope will be sealed
Backing or infill will be provided as needed, when accessible

Minimize air leakage
Maintain durability and/or flexibility
Ensure sealant is effective and durable

3.1701.1c  Materials will be used or installed in accordance with product manufacturer specifications

Select materials to ensure durable and permanent repair

3.1701.1d  All holes and penetrations on exterior surface of exterior walls will be sealed to ensure resistance to outdoor elements
Intentionally ventilated walls will not be sealed at vent locations (e.g., weep holes)
All holes and penetrations on the interior surface of exterior walls will be repaired
Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration

Minimize air leakage
Maintain durability
Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads
Ensure sealant is effective and durable

3.1701.1e  All accessible holes and penetrations in top and bottom plates will be sealed
Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration

Minimize air leakage
Maintain durability
Ensure resulting closure is permanent and supports expected load
Ensure sealant is effective and durable

3.1701.1f  Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration
The backing or infill will not bend, sag, or move once installed

Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads
Ensure sealant is effective and durable

3.1701.1g  Sealants will be used to fill holes no larger than recommended by manufacturer specifications
Sealants will be compatible with all adjoining surfaces
Sealants will be continuous and meet fire barrier specifications, if required

Create a permanent seal
Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

3.1701.1h  Floor repair material will meet or exceed strength of existing floor material
Repair will span from joist to joist and blocking added as needed to support floor
Patches smaller than 144 square inches will not require repairs from joist to joist
Floor repair material will be glued, fastened, and air sealed

Ensure floor is structurally sound
Minimize air leakage

3.1701.1i  Materials will be used or installed in accordance with product manufacturer specifications

Select materials to ensure durable and permanent repair
<table>
<thead>
<tr>
<th>Section</th>
<th>Comment</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1701.1j</td>
<td>Ceiling hole repair</td>
<td>Ceiling repair material must meet or exceed strength of existing ceiling material. Ceiling repair must span from truss to truss or add blocking as needed for support. The backing or infill will not bend, sag, or move once installed. All accessible damaged vapor barriers will be repaired. Penetrations through the air barrier must be repaired. Ensure ceiling is structurally sound. Minimize air leakage. Ensure closure is permanent and supports expected wind and mechanical pressure loads. Ensure sealant does not fall out.</td>
</tr>
<tr>
<td>3.1701.1k</td>
<td>High temperature application</td>
<td>Only noncombustible materials will be used in contact with chimneys, vents, and flues. Prevent a fire hazard.</td>
</tr>
</tbody>
</table>
### 4.1002.1 Above Roof Deck Insulation: Preparation
**Topic:** Attics  
**Subtopic:** Above Roof Deck Insulation  
**Desired Outcome:** Roof covering removed and replaced to expose roof deck for installation of above roof deck insulation

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1002.1a Roof covering replacement | New roof covering will be installed in accordance with manufacturer specifications and local building code requirements after installation of above roof deck insulation | Install roof covering correctly  
Meet local code requirements |

### 4.1002.2 Above Deck Roof Deck Insulation: Installation
**Topic:** Attics  
**Subtopic:** Above Roof Deck Insulation  
**Desired Outcome:** Properly installed roof deck insulation

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1002.2a Sealing</td>
<td>Holes, gaps, and penetrations in existing roof deck will be sealed</td>
<td>Prevent air leaks</td>
</tr>
</tbody>
</table>
| 4.1002.2b Installation | Insulation will be installed according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions  
Insulation will be installed to prescribed R-value | Install insulation properly |
| 4.1002.2c Occupant education | A dated receipt signed by the installer will be provided that includes:  
- Insulation type  
- Coverage area  
- R-value  
- Installed thickness and settled thickness (settled thickness required for loose-fill only)  
- Number of bags installed in accordance with manufacturer specifications (for loose-fill only) | Document job completion to contract specifications  
Confirm amount of insulation installed  
Comply with 16 CFR 460.17 |

### 4.1003.10 Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)
**Topic:** Attics  
**Subtopic:** Attic Ceilings  
**Desired Outcome:** Consistent, uniform *thermal boundary* and *air barrier* between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>

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*thermal boundary*  
*air barrier*
<table>
<thead>
<tr>
<th>Section</th>
<th>Comment</th>
</tr>
</thead>
</table>
| **4.1003.10a** | Attic, ceiling, and roof verification: 
- All combustion appliance flues will be terminated to the exterior of the house and terminations will maintain proper clearance above snow loads.
- A distance no less than 2” will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place.
- All ventilation systems will maintain a continuous connection and terminate to the outdoors.
- All broken mushroom vents will be replaced or removed and sealed.
- All plumbing stacks will be terminated to the outdoors.
- Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures, if feasible and only when installed measures will compromise the fire rating of the fixture.
- All recessed lights will be labeled as having an air leakage rate no more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential.
- All obvious ceiling penetrations will be sealed.
- The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials.
- All roof, attic, and ceiling assemblies will be structurally sound: 
  - Loose ceiling panels will be secured.
  - Temporary ceiling bracing will be recommended while installing installation.
- Dishing and pooling issues that allow standing water will be addressed.
- All known roof water leaks will be repaired before installing installation. |
| **4.1003.10b** | Special precautions will be taken to limit fiberglass and construction dust exposure to the occupant and occupant belongings. |
| **4.1003.10c** | Attic access: 
- Equidistant holes will be drilled in a straight row parallel to the longitudinal exterior wall of the ceiling.
- If a longitudinal ceiling trim piece exists, trim piece will be removed and holes will be drilled behind the trim.
- Hole location and size will be placed to provide access to allow for consistent and uniform coverage of installed insulation throughout the attic assembly.
- There will be, at a minimum, one hole between each roof truss.
- Holes will be large enough to accommodate the chosen fill tube without damaging the ceiling material during installation.
- If a vapor barrier or ceiling-mounted insulation is present, access will be gained through them.
- Attic will be visually inspected for the location of existing insulation, obstructions, hazards, and construction type. |
| **4.1003.10d** | Blowing machine set up: 
- Blowing machine pressure test will be performed with air on full, feed off, and gate closed.
- Hose outlet pressure will be set in accordance with manufacturer specifications. |

**4182**

Ensure occupant and worker safety
- Verify attic space is ready to insulate
- Ensure structural integrity of the roof and ceiling assembly
- Prevent intrusion of bulk moisture
- Prevent damage while installing insulation

**4183**

Protect occupant health and safety
- Protect occupant belongings

**4184**

Create access to the full attic cavity
- Determine insulation installation technique
- Prevent damage to ceiling
- Create a professionally finished ceiling

**4185**

Ensure machine is capable of delivering uniform insulation density and coverage
**4.1003.10e Fiberglass blown insulation installation**

Comment

- Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot
- Using fill tube, 100% of each cavity will be filled to a consistent density
- Fill tube will be inserted within 6” of the end of each attic cavity
- Insulation will be installed into the void of the attic cavity:
  - If existing insulation is roof-mounted, insulation will be blown below
  - If existing insulation is ceiling-mounted, insulation will be blown above
  - If existing insulation is mounted at both locations, insulation will be blown in between

Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84

**4.1003.10f Patching and sealing holes**

Comment

- Holes will be plugged or covered and sealed to be aesthetically pleasing
- If existing trim was removed, it will be reinstalled

Create an airtight seal
Create a visually acceptable ceiling finish

**4.1003.10g Verification of details**

Comment

- Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process

Verify the integrity of the house has been maintained

**4.1003.10h Onsite Documentation**

Comment

- A dated receipt signed by the installer will be provided that includes:
  - Insulation type
  - Coverage area
  - R-value
  - Installed thickness and minimum settled thickness
  - Number of bags installed in accordance with manufacturer specifications

Document job completion to contract specifications
Confirm amount of insulation installed
Ensure ability to match bags required for total area completed
Comply with 16 CFR 460.17

---

**4.1003.11 Installing Fiberglass Blown Insulation in Roof-Over Constructions**

**Topic:** Attics  
**Subtopic:** Attic Ceilings  
**Desired Outcome:** Consistent, uniform thermal boundary and air barrier between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| **4.1003.11a Roof-over overview** | If occupant will allow access from interior, installation through the ceiling is preferred  
Attic space created by the roof-over will be accessed in accordance with the Single-Family Attic Access SWS  
If the roof-over does not allow physical access to the roof-over attic, access to the original attic will be gained through roof venting  
If existing insulation height in the attic is less than the height of the heel plate (original attic), access will be made through the original roof and the original attic cavities will be filled before blowing insulation over the original roof  
At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage  
If existing insulation height is equal to or greater than the height of the heel plate (original attic), the insulation will be installed in the end cavities before blowing on top of the original roof  
Access to the end cavities will be gained and insulation will be installed  
At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage  
Insulation will not be installed on top of the original roof until the end cavities are insulated and air sealed in original attic  
If insulation is installed on top of the original roof, it will be installed in accordance with the Single-Family SWS Loose Fill Blown Fiberglass Insulation Installation | Gain access to the combined attic spaces  
Address thermal bridging  
Correctly insulate the combined attic spaces |

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| **4.1003.11b Verification of details** | If occupant will allow access from interior, installation through the ceiling is preferred  
Attic space created by the roof-over will be accessed in accordance with the Single-Family Attic Access SWS  
If the roof-over does not allow physical access to the roof-over attic, access to the original attic will be gained through roof venting  
If existing insulation height in the attic is less than the height of the heel plate (original attic), access will be made through the original roof and the original attic cavities will be filled before blowing insulation over the original roof  
At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage  
If existing insulation height is equal to or greater than the height of the heel plate (original attic), the insulation will be installed in the end cavities before blowing on top of the original roof  
Access to the end cavities will be gained and insulation will be installed  
At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage  
Insulation will not be installed on top of the original roof until the end cavities are insulated and air sealed in original attic  
If insulation is installed on top of the original roof, it will be installed in accordance with the Single-Family SWS Loose Fill Blown Fiberglass Insulation Installation | Gain access to the combined attic spaces  
Address thermal bridging  
Correctly insulate the combined attic spaces |

<table>
<thead>
<tr>
<th>TITLE</th>
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</tr>
</thead>
</table>
| **4.1003.11c Onsite Documentation** | If occupant will allow access from interior, installation through the ceiling is preferred  
Attic space created by the roof-over will be accessed in accordance with the Single-Family Attic Access SWS  
If the roof-over does not allow physical access to the roof-over attic, access to the original attic will be gained through roof venting  
If existing insulation height in the attic is less than the height of the heel plate (original attic), access will be made through the original roof and the original attic cavities will be filled before blowing insulation over the original roof  
At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage  
If existing insulation height is equal to or greater than the height of the heel plate (original attic), the insulation will be installed in the end cavities before blowing on top of the original roof  
Access to the end cavities will be gained and insulation will be installed  
At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage  
Insulation will not be installed on top of the original roof until the end cavities are insulated and air sealed in original attic  
If insulation is installed on top of the original roof, it will be installed in accordance with the Single-Family SWS Loose Fill Blown Fiberglass Insulation Installation | Gain access to the combined attic spaces  
Address thermal bridging  
Correctly insulate the combined attic spaces |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1003.11b Onsite documentation | A dated receipt signed by the installer will be provided that includes:  
- Insulation type  
- Coverage area  
- R-value  
- Installed thickness and minimum settled thickness  
- Number of bags installed in accordance with manufacturer specifications | Document job completion to contract specifications  
Confirm amount of insulation installed  
Ensure ability to match bags required for total area completed  
Comply with 16 CFR 460.17 |

#### 4.1003.8 Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Roof Side Lift)

**Topic:** Attics  
**Subtopic:** Attic Ceilings  
**Desired Outcome:** Consistent, uniform thermal boundary and air barrier between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1003.8a Attic, ceiling, and roof verification | All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads  
A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place  
All ventilation systems will maintain a continuous connection and terminate to the outdoors  
All broken mushroom vents will be replaced or removed and sealed  
All plumbing stacks will be terminated to the outdoors  
Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures  
All recessed lights will be labeled as having an air leakage rate no more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential  
All obvious ceiling penetrations will be sealed  
The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials  
All roof, attic, and ceiling assemblies will be structurally sound; loose ceiling panels will be secured  
Temporary ceiling bracing will be recommended during the insulation installation process  
Dishing and pooling issues that allow standing water will be addressed  
All known roof water leaks will be repaired before insulation installation | Ensure occupant and worker safety  
Verify attic space is ready to insulate  
Ensure structural integrity of the roof and ceiling assembly  
Prevent intrusion of bulk moisture  
Prevent damage during the insulation installation process |
| 4.1003.8b Attic access | Fasteners will be removed from the J channel and the roof edge on the most easily accessible side of the house  
Roof will be separated from the heel plate and siding roof will be lifted and propped to accommodate fill tube  
Length of opening will be enough to allow ease of access and reattachment while minimizing potential damage from high winds  
If subsheathing is present, access will be gained through subsheathing  
Attic will be visually inspected for the location of existing insulation, obstructions, hazards, and construction type | Create access to the full attic cavity  
Protect roof from wind damage during installation  
Ensure ease of roof reattachment  
Determine insulation installation technique |
| 4.1003.8c Blowing machine setup | Blowing machine pressure test will be performed with air on full, feed off, and gate closed  
Hose outlet pressure will be set in accordance with manufacturer specifications | Ensure machine is capable of delivering uniform insulation density and coverage |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1003.8d Fiberglass blown insulation installation | Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot. Using fill tube, 100% of each cavity will be filled to a consistent density. Fill tube will be inserted within 6" of the end of each attic cavity. Insulation will be installed into the void of the attic cavity:  
  - If existing insulation is roof-mounted, insulation will be blown below  
  - If existing insulation is ceiling-mounted, insulation will be blown above  
  - If existing insulation is mounted at both locations, insulation will be blown in between  
  Avoid overfilling of roof edges and above attic trusses. Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84. | Fill entire attic cavity to the prescribed R-value to reduce air infiltration.  
Avoid clogging of the cavity and the fill tube.  
Prevent damage to the ceiling.  
Allow roof to be returned to original position.  
Fire safety will be maintained. |
| 4.1003.8e Roof reattachment | If existing J channel is damaged, it will be replaced. Existing sealant will be removed from the roof edge and J channel. At a minimum, new sealant will be reinstalled at the original location. Roof and J channel will be fastened to the original location with new screws. All seams, edges, and penetrations will be sealed as necessary. | Prepare roof edge and J channel for reattachment.  
Reattach roof edge and J channel without leaks. |
| 4.1003.8f Verification of details | Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process. | Verify the integrity of the house has been maintained. |
| 4.1003.8g Onsite documentation | A dated receipt signed by the installer will be provided that includes:  
  - Insulation type  
  - Coverage area  
  - R-value  
  - Installed thickness and minimum settled thickness  
  - Number of bags installed in accordance with manufacturer specifications. | Document job completion to contract specifications.  
Confirm amount of insulation installed.  
Ensure ability to match bags required for total area completed.  
Comply with 16 CFR 460.17. |

### 4.1003.9 Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Exterior Access from Top of Roof)

**Topic:** Attics  
**Subtopic:** Attic Ceilings  
**Desired Outcome:** Consistent, uniform *thermal boundary* and *air barrier* between the conditioned space and unconditioned space
### 4.1003.9a Attic, ceiling, and roof verification

<table>
<thead>
<tr>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads.</td>
</tr>
<tr>
<td>A distance no less than 2” will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place.</td>
</tr>
<tr>
<td>All ventilation systems will maintain a continuous connection and terminate to the outdoors.</td>
</tr>
<tr>
<td>All broken mushroom vents will be replaced or removed and sealed.</td>
</tr>
<tr>
<td>All plumbing stacks will be terminated to the outdoors.</td>
</tr>
<tr>
<td>Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures.</td>
</tr>
<tr>
<td>All recessed lights will be labeled as having an air leakage rate not more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential.</td>
</tr>
<tr>
<td>All obvious ceiling penetrations will be sealed.</td>
</tr>
<tr>
<td>The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials.</td>
</tr>
<tr>
<td>All roof, attic, and ceiling assemblies will be structurally sound:</td>
</tr>
<tr>
<td>- Loose ceiling panels will be secured.</td>
</tr>
<tr>
<td>- Temporary ceiling bracing will be recommended during the insulation installation process.</td>
</tr>
<tr>
<td>Dishing and pooling issues that allow standing water will be addressed.</td>
</tr>
<tr>
<td>All known roof water leaks will be repaired before installing insulation.</td>
</tr>
<tr>
<td>Ensure occupant and worker safety.</td>
</tr>
<tr>
<td>Verify attic space is ready to insulate.</td>
</tr>
<tr>
<td>Ensure structural integrity of the roof and ceiling assembly.</td>
</tr>
<tr>
<td>Prevent intrusion of bulk moisture.</td>
</tr>
<tr>
<td>Prevent damage while installing insulation.</td>
</tr>
</tbody>
</table>

### 4.1003.9b Attic access

<table>
<thead>
<tr>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to the attic cavity will be created using one of these methods:</td>
</tr>
<tr>
<td>- Drilling</td>
</tr>
<tr>
<td>- Cutting</td>
</tr>
<tr>
<td>- Continuous slicing along the center line (at the highest point of the roof)</td>
</tr>
<tr>
<td>Access location will be placed to allow for consistent and uniform coverage of installed insulation throughout the attic assembly.</td>
</tr>
<tr>
<td>There will be, at a minimum, one opening between each roof truss.</td>
</tr>
<tr>
<td>Openings will be large enough to accommodate the chosen fill tube.</td>
</tr>
<tr>
<td>If subsheathing is present, access will be gained through subsheathing.</td>
</tr>
<tr>
<td>Attic will be visually inspected for the location of existing insulation, wiring, flues, obstructions, hazards, and construction type.</td>
</tr>
<tr>
<td>Create access to the full attic cavity.</td>
</tr>
<tr>
<td>Maintain the integrity of the roof truss.</td>
</tr>
<tr>
<td>Protect roof from wind damage during installation.</td>
</tr>
<tr>
<td>Determine technique for installing insulation.</td>
</tr>
</tbody>
</table>

### 4.1003.9c Blowing machine set up

<table>
<thead>
<tr>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowing machine pressure test will be performed with air on full, feed off, and gate closed.</td>
</tr>
<tr>
<td>Hose outlet pressure will be set in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td>Ensure machine is capable of delivering uniform insulation density and coverage.</td>
</tr>
<tr>
<td>4176</td>
</tr>
<tr>
<td>4177</td>
</tr>
<tr>
<td>4178</td>
</tr>
</tbody>
</table>
Fiberglass blown insulation installation

<table>
<thead>
<tr>
<th>Comment</th>
<th>4179</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.</td>
<td>Fill entire attic cavity to the prescribed R-value to reduce air infiltration.</td>
</tr>
<tr>
<td>Using fill tube, 100% of each cavity will be filled to a consistent density.</td>
<td>Avoid clogging of the cavity and the fill tube.</td>
</tr>
<tr>
<td>Fill tube will be inserted within 6&quot; of the end of each attic cavity.</td>
<td>Prevent damage to the ceiling.</td>
</tr>
<tr>
<td>Insulation will be installed into the void of the attic cavity:</td>
<td>Allow roof to be returned to original position.</td>
</tr>
<tr>
<td>- If existing insulation is roof-mounted, insulation will be blown below.</td>
<td>Fire safety will be maintained.</td>
</tr>
<tr>
<td>- If existing insulation is ceiling-mounted, insulation will be blown above.</td>
<td></td>
</tr>
<tr>
<td>- If existing insulation is mounted at both locations, insulation will be blown in between.</td>
<td></td>
</tr>
<tr>
<td>Insulation will be filled no higher than the top of the truss.</td>
<td></td>
</tr>
<tr>
<td>Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84.</td>
<td></td>
</tr>
</tbody>
</table>
If the roof is sliced:

- A solid metal ridge cap will be centered over the slice
- A flexible and durable sealant will be sandwiched between the roof and the ridge cap
- Screws will be installed to prevent wrinkles and create a permanent seal
- Screws will not go into any wood framing
- A durable and flexible final coating will be applied over the screws and edge of the ridge cap to create a continuous seal between the roof and the perimeter of the ridge cap

For holes that are drilled or cut, the initial patch will be applied using the following procedure:

- At least 6" of surface surrounding the opening will be cleaned before patch is installed
- Sealant will be continuous and applied in between the patch and the roof
- Sealant will be an all-weather adhesive that is flexible and durable

If a metal patch is used:

- Patch will overlap the opening by 2" on all sides
- Gauge will be equal to or greater than the roof material
- Fasteners will be installed to prevent wrinkles and create a permanent seal
- If a plug is used, it will be flanged and have a tight fit
- Screws will not go into any wood framing

A durable and flexible 45 mil adhesive patch will be applied in accordance to manufacturer specifications over the initial patch and will have at a minimum:

- Tear strength of 640g
- Elongation of 380%
- Application temperature no lower than 55°F and no greater than 110°F
- Services temperature no less than -25°F and no greater than 150°F
- Adhesive patch will overlap the initial patch by 2" on all sides
- A durable and flexible final coating will be applied over the adhesive patch to create a continuous seal between the roof and the perimeter of the patch
- All remaining seams, edges, and penetrations will be sealed as necessary

Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process.

Verify the integrity of the house has been maintained.
### 4.1003.9g

**Onsite documentation**

- A dated receipt signed by the installer will be provided that includes:
  - Insulation type
  - Coverage area
  - R-value
  - Installed thickness and minimum settled thickness
  - Number of bags installed in accordance with manufacturer specifications

- Document job completion to contract specifications

- Confirm amount of insulation installed

- Ensure ability to match bags required for total area complete

- Comply with 16 CFR 460.17

---

### 4.1088.6 Installing Insulation at Flat and Cathedral Ceiling Transition Wall

**Topic:** Attics

**Subtopic:** Special Considerations

**Desired Outcome:** Consistent, uniform *thermal boundary and air barrier* between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1088.6a Insulation installation verification</td>
<td>A visual inspection of the highest point of the transition wall will be completed Access points will be determined from the gable end, roof, ceiling, or interior paneling</td>
<td>Verify the height and the accessibility of the attic</td>
</tr>
<tr>
<td>4.1088.6b Access attic</td>
<td>Attic will be accessed through the location that allows the most efficient and effective insulation coverage</td>
<td>Gain access to the flat and cathedral ceiling transition wall</td>
</tr>
<tr>
<td>4.1088.6c Blowing</td>
<td>Blowing machine pressure test will be performed with air on full, feed off, and gate closed Insulation will be blown against the transition wall until the wall is covered</td>
<td>Ensure machine is capable of delivering uniform insulation density and coverage to meet manufacturer specifications for loose blown insulation Create a thermal barrier at the transition wall</td>
</tr>
<tr>
<td>4.1088.6d Spray two-part foam</td>
<td>Insulation will be installed to prescribed R-value in accordance with manufacturer specifications Spray polyurethane foam (SPF) will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer</td>
<td>Insulate and seal transition wall</td>
</tr>
<tr>
<td>4.1088.6e Batt</td>
<td>Batt insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions Insulation will be installed to the prescribed R-value Vapor barrier will be installed based on regional considerations</td>
<td>Insulate to prescribed R-value</td>
</tr>
<tr>
<td>4.1088.6f Patching and sealing access points</td>
<td>Created access points will be covered and sealed in an aesthetically pleasing manner Existing access points (e.g., gable vent) will be returned to the original condition If existing trim was removed, it will be reinstalled</td>
<td>Create an airtight seal Create an aesthetically pleasing finish</td>
</tr>
<tr>
<td>4.1088.6g Verification of details</td>
<td>Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process</td>
<td>Verify the integrity of the house has been maintained</td>
</tr>
</tbody>
</table>
### Onsite Documentation

A dated receipt signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Installed thickness and settled thickness (settled thickness required for loose-fill only)
- Number of bags installed in accordance with manufacturer specifications (for loose-fill only)


### Exterior Wall Dense Packing

**Topic:** Walls  
**Subtopic:** Preparation  
**Desired Outcome:** Walls properly prepared to receive dense pack insulation

#### Preparation

- Lead safety procedures will be followed  
- Cavities will be free of hazards, intact, and able to support dense pack pressures  
- Drilling hazards (e.g., wiring, venting, fuel piping) will be located  
- Blocking will be installed around:  
  - All openings to inside of the crawl space and basement for fibrous material  
  - High temperature fire-rated materials  
  - Wiring and electrical hazards  
  - Heat sources  

Access to exterior wall cavities will be gained, sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers.

When accessing wall cavities, the interior will be masked to control dust during drilling.

Electricity supply will be confirmed and will support blowing machine power demand.

Blowing machine pressure test will be performed with air on highest level, feed off, and gate closed.

Hose outlet pressure will be at least 80 IWC or 2.9 psi for cellulose insulation; for other types of dense pack insulation, check manufacturer specification for blowing machine set up.

Prevent damage to the house  
Provide a clean work space  
Provide thorough access to allow 100% coverage  
Ensure proper equipment and process results in consistent density  
Prevent settling and retard air flow through cavities  
Protect worker and occupant health
### 4.1104.1 Stuffing Wall Cavities with Fiberglass Batts

**Topic:** Walls  
**Subtopic:** Manufactured Housing Wall Insulation  
**Desired Outcome:** Consistent thermal boundary and air barrier between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| **4.1104.1a**  
Access wall cavities | If skirting overlaps siding, skirting will be detached to allow access to the wall cavity  
Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6" without damaging the siding  
Temporary fasteners will be installed near the bottom of the siding panels at the seams to prevent separation  
If a subsheathing is present under the siding, access through the subsheathing will be required | Gain access to the wall cavity without damaging or separating the siding | 4199 |
| **4.1104.1b**  
Exterior wall cavity inspection | Wall cavities will be inspected for moisture damage, pest locations, and integrity of the wiring, and holes to the interior  
Siding will be repaired as necessary  
Location of belt rails, obstructions, and existing insulation will be identified  
All interior surfaces of exterior walls will be inspected for loose paneling joints, occupant wall hangings, location of switches and outlets, and other wall obstructions  
Objects will be removed from the interior surfaces of the walls being insulated  
Interior paneling will be repaired as necessary | Prevent wall cavity for insulation  
Prevent water leaks from occurring | 4200 |
| **4.1104.1c**  
Fiberglass batt installation tool (stuffer) | A sheet of polycarbonate, such as Lexan, will be cut to the following specifications to create a stuffer tool:  
- Approximately 1' x 8' x ¼" with a 5 degree bend 7' ½" from the bottom  
- All corners of the Lexan (polycarbonate) will be rounded and all edges will be sanded  
Other clear sheet plastics will not be used due to a tendency to shatter under stress | Create a tool to install a fiberglass batt into the cavity  
Ensure worker safety | 4201 |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1104.1d Fiberglass batt installation | Thickness of the batt will fill the void without deforming siding or damaging structure  
Fiberglass batts will fill the cavity (e.g., batt may be cut approximately 1" longer to ensure proper fill and allow for lap at the top)  
Flexible membrane will have an appropriate perm rating for the region  
Flexible membrane will be cut 2" wider than the cavity and approximately 1' longer than the batt  
Stuffer tool, membrane, and fiberglass batt will be aligned for installation  
Stuffer tool will be used to install the fiberglass batt and membrane at the same time  
Excess fiberglass batt and membrane vapor retarder extending below the cavity will be rolled and tucked into the cavity  
A poly-encased fiberglass batt may be used in place of the fiberglass batt and membrane assembly  
The membrane will be installed in contact with the side of the wall that is compatible with the local climate zone | Maintain integrity of the batt  
Aid in the installation process |
| 4.1104.1e Sub-sheathing patch and repair | Subsheathing will be patched or repaired as necessary | Ensure the integrity of the drainage plane |
| 4.1104.1f Reattachment | If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting  
Siding will be reattached with new fasteners  
Siding will be reattached without bulges or wrinkles | Ensure the integrity of the drainage plane  
Return siding to existing conditions without damage |
| 4.1104.1g Onsite documentation | A dated receipt signed by the installer will be provided that includes:  
- Coverage area  
- Thickness  
- R-value | Document job completion to contract specifications  
Confirm amount of insulation installed  
Comply with 16 CFR 460.17 |

### 4.1104.2 Fiberglass Blown Insulation Installation (Lifting Siding)

**Topic:** Walls  
**Subtopic:** Manufactured Housing Wall Insulation  
**Desired Outcome:** Consistent thermal boundary and air barrier between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1104.2a Access wall cavities | If skirting overlaps siding, skirting will be removed  
Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6" without damaging the siding  
Temporary fasteners will be installed near the bottom of the siding panels at the seams  
If a subsheathing is present under the siding, access through the subsheathing will be required | Gain access to the wall cavity without causing damage or separation of the siding |

---

**Comment:**

- **Thickness of the batt will fill the void without deforming siding or damaging structure.**
- **Flexible membrane will have an appropriate perm rating for the region.**
- **Flexible membrane will be cut 2" wider than the cavity and approximately 1' longer than the batt.**
- **Stuffer tool, membrane, and fiberglass batt will be aligned for installation.**
- **Excess fiberglass batt and membrane vapor retarder extending below the cavity will be rolled and tucked into the cavity.**
- **A poly-encased fiberglass batt may be used in place of the fiberglass batt and membrane assembly.**
- **The membrane will be installed in contact with the side of the wall that is compatible with the local climate zone.**

**Comment:**

- **Subsheathing will be patched or repaired as necessary.**
- **If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting.**
- **Siding will be reattached with new fasteners.**
- **Siding will be reattached without bulges or wrinkles.**

**Comment:**

- **A dated receipt signed by the installer will be provided that includes:**
  - Coverage area
  - Thickness
  - R-value

**Comment:**

- **If skirting overlaps siding, skirting will be removed.**
- **Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6" without damaging the siding.**
- **Temporary fasteners will be installed near the bottom of the siding panels at the seams.**
- **If a subsheathing is present under the siding, access through the subsheathing will be required.**
### 4.1104.2b Exterior wall cavity inspection

**Comment**

Installer prework assessment will be conducted to determine:

- Moisture damage
- Presence of infestation or pests
- Location and integrity of wiring
- Holes to the interior and exterior
- Loose paneling or siding
- Location of belt rails
- Location of wall obstructions (switches, outlets)
- Existing insulation
- Wall hangings for removal during work

Problems will be corrected before work begins

**Objective(s)**

Prepare wall cavity for insulation

Prevent water leaks

---

### 4.1104.2c Blowing machine set up

**Comment**

Blowing machine pressure test will be performed with air on full, feed off, and gate closed

Hose outlet pressure will be set according to manufacturer specifications

**Objective(s)**

Achieve uniform insulation density and coverage

---

### 4.1104.2d Fiberglass blown insulation installation

**Comment**

Insulation will meet a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84

Insulation will be installed to a density of 1.5 to-1.6 pounds per cubic foot

Using fill tube, 100% of each cavity will be filled to a consistent density

Special precaution will be taken not to overfill the bottom of the cavity

Fill tube will be inserted from the bottom of the wall cavity within 6" of the top of the cavity between the interior paneling and any existing insulation

**Objective(s)**

Fire safety maintained

Fill entire wall cavity to the prescribed R-value to reduce air infiltration

Ensure bottom portion of siding will reattach properly

Avoid clogging of the cavity and the fill tube

---

### 4.1104.2e Subsheathing patch and repair

**Comment**

Subsheathing will be patched or repaired as necessary

**Objective(s)**

Ensure the integrity of the drainage plane

---

### 4.1104.2f Reattachment

**Comment**

If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting

Siding will be reattached with new fasteners

Siding will be reattached without bulges or wrinkles

**Objective(s)**

Ensure the integrity of the drainage plane

Reattach siding without damage

---

### 4.1104.2g Onsite documentation

**Comment**

A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

**Objective(s)**

Document job completion to contract specifications

Confirm amount of insulation installed Comply with 16 CFR 460.17

---

### 4.1104.3 Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

**Topic:** Walls

**Subtopic:** Manufactured Housing Wall Insulation

**Desired Outcome:** Consistent, uniform thermal boundary and air barrier between the conditioned space and unconditioned space
<table>
<thead>
<tr>
<th>4.1104.3a</th>
<th>Access wall cavities</th>
<th>With T-111, OSB, or plywood type siding:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comment</td>
<td>• Access to exterior wall cavities will be gained and sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Drilled holes will be large enough to accommodate an appropriately sized fill tube.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Holes will be drilled around the perimeter of the home, parallel to the bottom plate and an equal distance apart.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The line of holes will be located under the lowest window sill when possible.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With lap siding:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Course of siding will be unhooked or removed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Holes sufficiently large for the fill tube will be drilled in every wall cavity.</td>
</tr>
<tr>
<td>4.1104.3b</td>
<td>Exterior wall cavity inspection</td>
<td>Installer prework assessment will be conducted to determine:</td>
</tr>
<tr>
<td></td>
<td>Comment</td>
<td>• Moisture damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Presence of infestation or pests</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Location and integrity of wiring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Holes to the interior and exterior</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Loose paneling or siding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Location of belt rails</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Location of wall obstructions (switches, outlets)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Existing insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wall hangings for removal during work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problems will be corrected before work begins.</td>
</tr>
<tr>
<td>4.1104.3c</td>
<td>Blowing machine set up</td>
<td>Blowing machine pressure test will be performed with air on full, feed off, and gate closed.</td>
</tr>
<tr>
<td></td>
<td>Comment</td>
<td>Hose outlet pressure will be set in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure machine is capable of delivering uniform insulation density and coverage.</td>
</tr>
<tr>
<td>4.1104.3d</td>
<td>Fiberglass blown insulation installation</td>
<td>Flame spread and smoke-developed index for insulation will meet a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84.</td>
</tr>
<tr>
<td></td>
<td>Comment</td>
<td>Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Using fill tube, 100% of each cavity will be filled to a consistent density.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill tube will be inserted within 6&quot; of the top of the cavity between the interior paneling and any existing insulation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill entire wall cavity to the prescribed R-value to reduce air infiltration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid clogging of the cavity and the fill tube.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fire safety will be maintained.</td>
</tr>
<tr>
<td>4.1104.3e</td>
<td>Plug and seal holes</td>
<td>Holes will be plugged and sealed.</td>
</tr>
<tr>
<td></td>
<td>Comment</td>
<td>Ensure the integrity of the drainage plane.</td>
</tr>
</tbody>
</table>
For T-111 and equivalent siding:

- A preprimed trim will be centered and installed over the holes
- Height of the trim will span from 1" above to 1" below the hole
- A continuous caulk seal will be applied between the trim and siding
- Caulk seal will be above the holes
- Top edge of the trim will be sealed to the siding with a continuous caulk seal

For lap siding:

- Siding will be reattached without bulges or wrinkles
- Siding will be hooked into the original position

A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

A color-corresponding sealant will be applied to the access hole

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1104.3f</td>
<td>Final wall assembly</td>
<td>Ensure the integrity of the drainage plane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return siding to existing conditions without damage</td>
</tr>
</tbody>
</table>

**4.1104.4 Spray Foam Insulation Installation in Cavities above Doors and Windows**

**Topic:** Walls  
**Subtopic:** Manufactured Housing Wall Insulation  
**Desired Outcome:** Consistent, uniform thermal boundary and air barrier between the conditioned space and unconditioned space

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1104.4a</td>
<td>Access wall cavities above doors and windows</td>
<td>Prepare wall cavity for insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prevent damage from overspray to occupant possessions</td>
</tr>
<tr>
<td></td>
<td>All interior surfaces of the cavities planned to be insulated will be inspected for loose paneling joints, occupant wall hangings, and other wall obstructions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Objects will be removed from the interior surfaces of the exterior walls as needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interior paneling will be repaired and secured as necessary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Holes will be drilled from the interior of the house</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A hole no larger than the spray nozzle will be drilled in each cavity above the door or window</td>
<td></td>
</tr>
<tr>
<td></td>
<td>When possible, the hole will be drilled in the panel groove</td>
<td></td>
</tr>
</tbody>
</table>

| 4.1104.4b | Cavity inspection | Determine the approximate amount of foam to be installed in the cavity |
| | Cavity will be probed to assess conditions and volume of cavity |

| 4.1104.4c | Insulation installation | Fill entire wall cavity to the prescribed R-value to reduce air infiltration |
| | Fire safety will be maintained |
| | Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 or UL 723 |
| | Foam insulation will be separated from the interior of the building by an approved thermal barrier at a minimum of 1/2" gypsum wallboard or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275 |
| | Two-part foam selection will be based on regional considerations |
| | 100% of each cavity will be filled to a consistent density without bulging of panels or siding |

| 4.1104.4d | Final wall assembly | Ensure wall is aesthetically pleasing |
| | A color-corresponding sealant will be applied to the access hole |

| 4.1104.3g | Onsite documentation | Document job completion to contract specifications |
| | | Confirm amount of insulation installed |
| | | Comply with 16 CFR 460.17 |
### 4.1104.4e
Onsite documentation

A dated receipt signed by the installer will be provided that includes:
- Coverage area
- Thickness
- R-value

Document job completion to contract specifications
Confirm amount of insulation installed
Comply with 16 CFR 460.17

### 4.1302.1 Prepare Belly Floor Cavity for Insulation

**Topic:** Floors  
**Subtopic:** Manufactured Housing Belly Preparation  
**Desired Outcome:** Belly floor cavity ready for insulation

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1302.1a</td>
<td>Gas, water, waste, and electrical lines will be checked for:</td>
<td>Ensure that floor space is safe and ready for work</td>
</tr>
<tr>
<td></td>
<td>- Plumbing leaks</td>
<td>Verify scope of work</td>
</tr>
<tr>
<td></td>
<td>- Gas/oil leaks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Attachment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Standing water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Raw sewage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Pests</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1302.1b</td>
<td>Where bottom board/rodent barrier is missing or damaged and accessible, the following will be ensured:</td>
<td>Ensure problems are corrected before floor cavity insulation work begins</td>
</tr>
<tr>
<td></td>
<td>- Duct sealing completed</td>
<td>Keep pipes from freezing</td>
</tr>
<tr>
<td></td>
<td>- Gas, water, and electrical lines secured at least every 4’ to a floor joist or framing member</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Water line will be located on the warm side of the insulation; if not, the water lines will be insulated appropriately</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- No water or gas leaks are present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Waste lines are sloped to ½” per foot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Bottom board/rodent barrier is sound/strong enough to support insulation</td>
<td></td>
</tr>
</tbody>
</table>

When bottom board is intact, the following will be ensured:
- Holes and penetrations in the bottom board and decking sealed
- Duct sealing completed
- No water or gas leaks present
- Bottom board is sound/strong enough to support insulation
- Water lines are secured to the floor joists/warm side of the insulation; if not, the water lines will be insulated appropriately

Problems will be corrected before floor cavity insulation work begins

### 4.1303.1 Insulation of Floor Cavity with Blown Material

**Topic:** Floors  
**Subtopic:** Manufactured Housing Floor Cavity Insulation  
**Desired Outcome:** Consistent thermal boundary between conditioned and unconditioned space that reduces heat flow
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1303.1a R-value Comment</td>
<td>Insulation will be installed in accordance with recommended R-value and density</td>
<td>Insulate to prescribed R-value for the climate zone</td>
</tr>
<tr>
<td>4.1303.1b Work assessment Comment</td>
<td>Road and rodent barrier must be intact and free from holes and capable of supporting the insulation</td>
<td>Ensure bottom board is intact&lt;br&gt;Ensure insulation is supported&lt;br&gt;Protect cavity from infestation</td>
</tr>
<tr>
<td>4.1303.1c Insulate floors Comment</td>
<td>Each cavity will be insulated to specified R-value and density&lt;br&gt;The number of bags installed will be confirmed and will match the number required on the coverage chart</td>
<td>Eliminate voids and settling</td>
</tr>
<tr>
<td>4.1303.1d Materials Comment</td>
<td>Flame spread index of selected materials will not exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E84 or UL 723&lt;br&gt;Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 or UL 723&lt;br&gt;Foam insulation will be separated from the interior of the building by an approved thermal barrier at a minimum of 1/2&quot; gypsum or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275&lt;br&gt;Selected material will be of minimal water absorbency&lt;br&gt;Selected material will be noncorrosive</td>
<td>Ensure durability&lt;br&gt;Prevent moisture damage&lt;br&gt;Fire safety will be maintained</td>
</tr>
<tr>
<td>4.1303.1e Occupant education Comment</td>
<td>A dated receipt signed by the installer will be provided that includes:&lt;br&gt;- Insulation type&lt;br&gt;- Coverage area&lt;br&gt;- R-value&lt;br&gt;- Installed thickness and minimum settled thickness&lt;br&gt;- Number of bags installed in accordance with manufacturer specifications</td>
<td>Document job completion to contract specifications&lt;br&gt;Confirm amount of insulation installed&lt;br&gt;Ensure ability to match bags required for total area completed&lt;br&gt;Comply with 16 CFR 460.17</td>
</tr>
</tbody>
</table>

4.1303.2 Insulation of Floor Cavity with Batt Material

**Topic:** Floors  
**Subtopic:** Manufactured Housing Floor Cavity Insulation  
** Desired Outcome: Consistent *thermal boundary* between conditioned and unconditioned space that reduces heat flow**

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1303.2a R-value Comment</td>
<td>Insulation will be installed in accordance with recommended R-value and density</td>
<td>Insulate to prescribed R-value for the climate zone</td>
</tr>
<tr>
<td>4.1303.2b Work assessment Comment</td>
<td>Ensure complete accessibility of floor cavity&lt;br&gt;Clean floor cavities&lt;br&gt;Remove all remnants of previous insulation and bottom board</td>
<td>Ensure work area is clean, safe, and ready to accept insulation</td>
</tr>
<tr>
<td>Title</td>
<td>Specification(s)</td>
<td>Objective(s)</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>4.1303.2c Insulate floors</td>
<td>Each cavity will be insulated to specified R-value and density</td>
<td>Eliminate voids</td>
</tr>
<tr>
<td>  Comment</td>
<td>If insulation has facing, facing will be in contact with the heated side</td>
<td>Minimize conductive heat transfer across the floor system</td>
</tr>
<tr>
<td> </td>
<td>Insulation will be in contact with subfloor</td>
<td>Ensure durability</td>
</tr>
<tr>
<td> </td>
<td>Insulation will not have gaps, voids, or be compressed</td>
<td>Minimize convective heat transfer</td>
</tr>
<tr>
<td> </td>
<td>Insulation will be supported (e.g., metal insulation supports) to maintain a permanent contact with subfloor</td>
<td>Keep pipes from freezing</td>
</tr>
<tr>
<td> </td>
<td>Insulation will be notched around all wires, pipes, and blocks</td>
<td></td>
</tr>
<tr>
<td> </td>
<td>Ducts and water lines will be insulated for climate conditions</td>
<td></td>
</tr>
<tr>
<td> </td>
<td>Water lines will be located above the warm side of the insulation (toward the conditioned space), when feasible</td>
<td></td>
</tr>
<tr>
<td> </td>
<td>A rigid air barrier will be installed in contact with the bottom of the joists, when feasible</td>
<td></td>
</tr>
<tr>
<td> </td>
<td>Rigid air barrier will be fastened as to not sag, bend, or fall off</td>
<td></td>
</tr>
<tr>
<td> </td>
<td>Seams, holes, and joints in the air barrier will be sealed</td>
<td></td>
</tr>
<tr>
<td> </td>
<td>In cases where HVAC ducts hang below the level of the rigid air barrier and insulation, the ducts will be insulated and air barrier provided that is sealed to the rigid air barrier</td>
<td></td>
</tr>
<tr>
<td>4.1303.2d Materials</td>
<td>Insulation materials will be of minimal water absorbency and flame spread, and smoke-developed index for insulation will be in accordance with 2012 IRC 2012, Sections R302.10.1 through R302.10.5</td>
<td>Ensure durability</td>
</tr>
<tr>
<td>  Comment</td>
<td>Foam plastic insulation will comply with 2012 IRC 2012, Section R316</td>
<td>Prevent moisture damage</td>
</tr>
<tr>
<td> </td>
<td>Fasteners will be corrosion resistant</td>
<td></td>
</tr>
<tr>
<td>4.1303.2e</td>
<td>A dated receipt signed by the installer will be provided that includes:</td>
<td>Document job completion to contract specifications</td>
</tr>
<tr>
<td>  Comment</td>
<td>  Coverage area</td>
<td>Confirm amount of insulation installed</td>
</tr>
<tr>
<td> </td>
<td>  Thickness</td>
<td>Comply with 16 CFR 460.17</td>
</tr>
<tr>
<td> </td>
<td>  R-value</td>
<td></td>
</tr>
</tbody>
</table>

### 4.1303.3 Insulation of Floor Cavity with Spray Foam Material

**Topic:** Floors  
**Subtopic:** Manufactured Housing Floor Cavity Insulation  
**Desired Outcome:** Installation of a consistent thermal boundary between conditioned and unconditioned space that reduces heat flow

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(s)</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1303.3a Insulate R-value</td>
<td>Insulation will be installed in accordance with recommended R-value</td>
<td>Insulate to prescribed R-value for the climate zone</td>
</tr>
<tr>
<td>  Comment</td>
<td>Insulate to prescribed R-value for the climate zone</td>
<td></td>
</tr>
<tr>
<td>4.1303.3b Work assessment</td>
<td>Ensure complete accessibility of floor cavity</td>
<td>Ensure work area is clean, safe, and ready to accept insulation</td>
</tr>
<tr>
<td>  Comment</td>
<td>Ensure work area is clean, safe, and ready to accept insulation</td>
<td></td>
</tr>
<tr>
<td>4.1303.3c Preparation</td>
<td>All floor areas will be open and accessible for spray foam application</td>
<td>Prepare all substrate surfaces for the application of spray foam</td>
</tr>
<tr>
<td>  Comment</td>
<td>Prepare all substrate surfaces for the application of spray foam</td>
<td></td>
</tr>
</tbody>
</table>

**Specifications:**
- Insulation will be installed in accordance with recommended R-value.
- Insulation materials will be of minimal water absorbency and flame spread, and smoke-developed index for insulation will be in accordance with 2012 IRC 2012, Sections R302.10.1 through R302.10.5.
- Foam plastic insulation will comply with 2012 IRC 2012, Section R316.
- Fasteners will be corrosion resistant.
- A dated receipt signed by the installer will be provided that includes coverage area, thickness, and R-value.
- Prepare all substrate surfaces for the application of spray foam.
- Insulation will be installed in accordance with recommended R-value and density.
- Insulation will be in contact with subfloor.
- Insulation will not have gaps, voids, or be compressed.
- Insulation will be notched around all wires, pipes, and blocks.
- Ducts and water lines will be insulated for climate conditions.
- Water lines will be located above the warm side of the insulation (toward the conditioned space), when feasible.
- A rigid air barrier will be installed in contact with the bottom of the joists, when feasible.
- Rigid air barrier will be fastened as to not sag, bend, or fall off.
- Seams, holes, and joints in the air barrier will be sealed.
- In cases where HVAC ducts hang below the level of the rigid air barrier and insulation, the ducts will be insulated and air barrier provided that is sealed to the rigid air barrier.
- Insulation materials will be of minimal water absorbency and flame spread, and smoke-developed index for insulation will be in accordance with 2012 IRC 2012, Sections R302.10.1 through R302.10.5.
- Foam plastic insulation will comply with 2012 IRC 2012, Section R316.
- Fasteners will be corrosion resistant.
- A dated receipt signed by the installer will be provided that includes coverage area, thickness, and R-value.
- Document job completion to contract specifications.
- Insulation will be installed in accordance with recommended R-value.
4.1303.3d Installation  
Insulation will be installed to prescribed R-value in accordance with manufacturer specifications.  
In accordance with manufacturer specifications, spray foam will be applied to desired thickness using the maximum pass thickness onto subfloor between floor joists and all rim/band joists.  
Rim/band joist will be sealed.  
When desired, underside of joists will be covered with spray foam to provide a layer of continuous insulation.  
Each cavity will be insulated to specified R-value.  
Insulation must be in contact with subfloor.  
Insulation will not have gaps or voids.  
Ducts and water lines will be insulated for climate conditions.

4.1303.3e Materials  
Insulation will be installed in accordance with manufacturer specifications.  
Flame spread index of selected materials will not exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E 84 or UL 723.  
Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E 84 or UL 723.  
Foam insulation will be separated from the interior of the building by an approved thermal barrier at minimum 1/2" gypsum or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

4.1303.3f Fire protection  
Spray foam will be separated from the occupied space of the building with a 15-minute thermal barrier (typically 15/32” sheathing, 1/2” gypsum board, or approved thermal barrier coating) or as approved by ASTM E84 requirements.  
Spray foam designed to be used as a fire block does not require a thermal barrier installed prior to application.

4.1303.3g Occupant education  
A dated receipt signed by the installer will be provided that includes:  
- Coverage area  
- Thickness  
- R-value.

### Title: No Groundwater Leakage
#### Topic: Basements and Crawl Spaces
#### Subtopic: Basements and Crawl Space Walls
#### Desired Outcome: Basement insulation improves thermal performance and ensures sufficient drying potential

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1402.2a R-value</td>
<td>Regional IECC will be followed for required R-values</td>
<td>Improve thermal performance of the basement and living space</td>
</tr>
<tr>
<td>4.1402.2b Air barrier</td>
<td>A continuous air barrier will be installed on the warm side of the insulation</td>
<td>Prevent condensation on the basement wall</td>
</tr>
<tr>
<td>4.1402.2c Vapor permeability</td>
<td>When absorbent insulation materials are installed, assembly will remain vapor permeable to the interior in all climate zones except Zone 7 <a href="http://energycode.pnl.gov/EnergyCodeReqs">http://energycode.pnl.gov/EnergyCodeReqs</a></td>
<td>Provide drying potential to the basement</td>
</tr>
</tbody>
</table>

See redline change(s)
### 4.1402.3 Basement Wall Insulation—Groundwater Leakage

**Topic:** Basements and Crawl Spaces  
**Subtopic:** Basements and Crawl Space Walls  
**Desired Outcome:** Basement insulation improves thermal performance and ensures sufficient drying potential

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</tr>
</thead>
</table>
| 4.1402.3a Drainage | A continuous drainage plane at the interior surface of the exterior basement wall will be created from the top of the wall to a drainage field at the bottom of the wall or sub-slab  
Drainage field will be run to daylight or pumped to the outside | Remove moisture on the surface of the exterior basement wall |
| 4.1402.3b Rough finish walls | Drainage plane will be replaced with a waterproof membrane  
Only a nonabsorbent insulation that complies with ASTM C665-06 will be applied  
Insulation will adhere to the waterproof membrane without voids  
Drainage field will be run to daylight or pumped to the outside | Create an air and moisture barrier on the interior side of the exterior basement wall and allow the insulation to conform to the irregularity of the surface  
Improve thermal performance of the basement and the living space |
| 4.1402.3c Thermal barrier, insulation | A nonabsorbent insulation will be used with a minimum expected service life of 10 years  
A fire-rated material will be used if the insulation is left exposed | Improve thermal performance of the basement and the living space |
| 4.1402.3d Location | Insulation will be installed continuously from the top of the band joist to the top of the slab | Maintain a continuous thermal boundary on the interior side of the exterior basement wall |
| 4.1402.3e Termite protection | Where termite pressure exists, if subslab drainage is installed, termite treatment will be performed before reinstalling the slab | Provide termite protection |
| 4.1402.3f Insulation attachment | Insulation will be attached with a durable connection equal to or better than the manufacturer specifications, whichever is more durable  
A minimum expected service life of 10 years will be ensured | Secure thermal boundary without compromising the insulation |
| 4.1402.3g R-value | Regional IECC will be followed for required R-value | Improve thermal performance of the basement and living space |
| 4.1402.3h Sealing | A continuous air barrier on the warm side of the thermal boundary will be installed, including floor-to-wall and wall-to-ceiling connections | Prevent convective air leakage from the basement, through the drainage plane, and back into the basement |
| 4.1402.3i Finish wall requirements | International Residential Code (2012 IRC) will be followed for finished wall details in basements | Install a durable, finished wall |
| 4.1402.3j Onsite documentation | A dated receipt signed by the installer will be provided that includes:  
• Coverage area  
• Thickness  
• R-value | Document job completion to contract specifications  
Confirm amount of insulation installed  
Comply with 16 CFR 460.17 |

### 4.1488.1 Climate Considerations for Insulating Water Lines Located Between Bottom Board and Ground

**Topic:** Basements and Crawl Spaces  
**Subtopic:** Special Considerations  
**Desired Outcome:** Water supply line does not freeze in cold climates

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1488.1a Work assessment | Installer prework assessment will be conducted to determine:  
• Water leaks do not exist  
• Accessibility  
Water leaks will be repaired before installation | Verify scope of work  
Ensure that work space is safe and ready for work |
### 4.1488.1b Installation

- **Objectives:**
  - Ensure fire safety
  - Protect supply pipe from freezing

- **Comment:**
  - Pipe freeze protection system will have thermostatic heat control and circuit protection
  - Insulation will be installed over pipe freeze protection system when necessary
  - Pipe will be protected from wind

- **Insulation and Vapor Barrier**

  **Topic:** Ducts
  **Subtopic:** Insulating Ducts
  **Desired Outcome:** Minimize condensation

- **4.1601.3 Insulation and Vapor Barrier**

- **4.1601.4 Insulating Flex Ducts**

  **Topic:** Ducts
  **Subtopic:** Insulating Ducts
  **Desired Outcome:** Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1601.4g Attachment of exterior liner</td>
<td>Liner will be pulled up onto the metal duct as far as possible before securing</td>
<td>Create a strong, durable attachment</td>
</tr>
<tr>
<td>4.1601.4h Sealing of all accessible ducts</td>
<td>All accessible joints, seams, and connections will be sealed with UL 181 approved mastics</td>
<td>Minimize duct leakage</td>
</tr>
<tr>
<td>4.1601.4i Insulation of all fittings</td>
<td>All metal fittings, including boots, elbows, and takeoffs, will be insulated separately using a minimum of R-8 duct wrap with a vapor barrier mechanically fastened (e.g., stitch staples, tie bands) and sealed with no exposed metal</td>
<td>Minimize thermal conductance of the duct system</td>
</tr>
<tr>
<td>4.1601.4j Completeness of vapor barrier</td>
<td>Vapor barrier of all duct insulation will be taped to the flex duct using the taping system required by the manufacturer of the duct insulation</td>
<td>Ensure a complete vapor barrier</td>
</tr>
<tr>
<td>4.1601.4k Vermin proofing</td>
<td>Vermin access points will be identified and treated appropriately (e.g., seal access holes)</td>
<td>Ensure long-term durability of the building materials</td>
</tr>
<tr>
<td>4.1601.4l CAZ testing</td>
<td>CAZ testing will be performed where combustion appliances are utilized</td>
<td>Identify unsafe equipment operating conditions</td>
</tr>
</tbody>
</table>

### 4.1601.5 Insulating Metal Ducts

**Topic:** Ducts  
**Subtopic:** Insulating Ducts  
**Desired Outcome:** Lowered thermal conductance of duct system and minimized condensation on the duct system

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 4.1601.5a Selection of duct insulation material | Duct insulation will be a minimum of R-8, in accordance with local code or buried under attic insulation, whichever is a greater R-value, and have an attached and continuous vapor barrier  
Hot humid and warm coastal regions will not bury ducts | Decrease heat loss and condensation problems |
| 4.1601.5b Duct sealing | All accessible ducts will be sealed with a UL-181 mastic before insulation is applied | Minimize duct leakage |
| 4.1601.5c Attachment of duct insulation | Duct insulation will be mechanically fastened (e.g., stitch staples, tie bands) and sealed with no exposed metal  
Duct insulation will be secured to the duct system using metal wire or rot-proof nylon twine  
Pattern of the wire or twine will be sufficient to securely hold the duct insulation tight to the duct  
Mechanical fastening will be sufficient to securely hold the duct insulation in place and tight to the duct | Ensure a secure connection between the duct system and the duct insulation  
Ensure performance of the installed material  
Minimize condensation |
| 4.1601.5d Taping of the vapor barrier | Using a tape approved by the manufacturer, all seams and connection of the vapor barrier will be taped so that no metal is exposed  
No gaps will exist between pieces of duct insulation | Prevent gaps in the vapor barrier of the insulation |
| 4.1601.5e Vermin proofing | Vermin access points will be identified and treated appropriately (e.g., seal access holes) | Ensure long-term durability of the building materials |

### 4.9901.1 General Information on Spray Polyurethane Foam (SPF)

**Topic:** Insulation—Additional Resources  
**Subtopic:** Materials  
**Desired Outcome:** To provide general information on spray polyurethane foam

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.9901.1a</td>
<td>Low-Pressure SPF Comment</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Low-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in pressurized canisters (~250 psi), dispensed through unheated hoses through a disposable mixing nozzle system, and applied as a froth-like material to substrate. This type of SPF product is typically used for large sealing and small-scale insulation products.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.9901.1b</th>
<th>High-Pressure SPF Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in unpressurized drums or totes, and dispensed by a proportioner pump where heat and pressure are added. These chemicals travel through heated hoses to a spray gun where the material is aerosolized during application. This type of SPF product is typically used for larger insulation applications.</strong> Once installed, there is essentially no difference in product performance between low- and high-pressure foams. It should be noted that the main differences between the delivery methods are in capital equipment investment, application rate, and PPE requirements. Applicators should obtain training from the suppliers of SPF to help assure installation quality and use of all equipment as well as safe handling, use, and disposal of all chemicals used in the process. Spray Polyurethane Foam Alliance (SPFA) also offers additional training and accreditation for high-pressure SPF applicators.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.9901.1c</th>
<th>Manufacturer Installation Instructions Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In addition to the guidelines above, SPF applicators should follow all manufacturer installation instructions for the product being used. These instructions include product-specific documents, such as application instructions, MSDSs, and evaluation reports.</strong></td>
<td></td>
</tr>
</tbody>
</table>

| 4.9901.1d | To provide general information on spray polyurethane foam | 4275 |
| 4.9901.1e | To provide general information on spray polyurethane foam | 4276 |
| 4.9901.1f | To provide general information on spray polyurethane foam | 4277 |
## Section 5: Heating and Cooling

### 5.3001.3 Replace Return Air Systems that Incorporate Floor Cavity (Belly) and/or Attic as the Return Air Pathway

**Topic:** Forced Air  
**Subtopic:** Design  
** Desired Outcome:** Effective, efficient, safe, and durable return air system

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
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</table>
| 5.3001.3a Close return air openings | Existing return air openings will be closed off and sealed with a durable material equivalent in strength to the surrounding material  
Disturbed materials suspected to contain asbestos or lead content will be assessed and removed in accordance with EPA regulations | Minimize air leakage  
Improve indoor environmental quality  
Ensure safe and legal renovation |
| 5.3001.3b Alternate return air system | Alternate return air opening will be provided to the furnace closet (e.g., replace louvered door or install grilles); whenever possible, follow manufacturer specifications for amount needed  
Return duct design will be in accordance with ANSI/ACCA 1 Manual D Residential Duct Systems  
A continuous and adequate return air pathway to the air handler will be installed | Ensure sufficient return air is provided to the system |
| 5.3001.3c Zone pressure test | Pressures will be measured with the furnace fan operating across interior doors that can be closed and have a supply and/or return behind them  
Rooms should not exceed 3 pascals of pressure  
Pressure testing will be performed with all interior doors closed and the air handler running | Ensure sufficient return air is provided to the system  
Minimize moisture intrusion from negative pressures  
Improve indoor air quality |
| 5.3001.3d Combustion Appliance Zone (CAZ) testing | CAZ testing will be performed where combustion appliances are utilized | Identify unsafe equipment operating conditions |
| 5.3001.3e Occupant education | Occupant will be educated on changes, how to operate and maintain the system, and any potential health concerns (e.g., lead, asbestos) | Ensure occupant is educated |

### 5.3003.1 Data Plate Verification

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
** Desired Outcome:** Data for commissioning and future service work is recorded

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
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</table>
| 5.3003.1a Data plate verification | Equipment will be visually inspected  
Information will be recorded from the equipment data plates indoors and outdoors | Ensure technician has equipment data necessary for commissioning and future service work |

### 5.3003.11 Heating and Cooling Controls

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
** Desired Outcome:** Heating and cooling controls installed and set properly

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.11a Removal of mercury-based thermostats | Mercury-based thermostat will be removed safely and disposed of in accordance with EPA regulations | Protect workers and occupants from injury  
Protect environment from damage |
| 5.3003.11b Removal of existing controls | Existing controls will be removed in accordance with EPA lead safe work rules | Protect workers and occupants from injury  
Protect environment from damage |
| 5.3003.11c Penetrations | Penetrations for control wiring will be sealed with a durable sealant (e.g., caulk, silicone, foam) at both the interior (e.g., floor, sheetrock) and exterior air barriers (e.g., bottom liner, side walls) | Ensure controls operate as designed  
Minimize infiltration and exfiltration from house |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.11d</td>
<td>Thermostat location</td>
<td>Thermostats will be installed to reflect the temperature of the zone in which they are installed. Mounting location for air leakage and conductance that would affect the thermostat operation (e.g., marriage walls, exterior walls) will be accessed. Thermostats will not be exposed to extreme temperatures, radiant heat sources, and drafts.</td>
</tr>
<tr>
<td>5.3003.11e</td>
<td>Blower speed</td>
<td>Blower speed will be set for equipment in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td>5.3003.11f</td>
<td>Thermostat selection: heat pump</td>
<td>A thermostat with supplementary heat lockout that can interface with an outdoor temperature sensor will be selected.</td>
</tr>
<tr>
<td>5.3003.11g</td>
<td>Heat pump: supplementary heat</td>
<td>Supplementary heat lockout on air-to-air heat pumps will be set to the economical balance point. ANSI/ACCA 3 Manual S-2004 Residential Equipment Selection will be referenced for set points when using different types of heat pumps.</td>
</tr>
<tr>
<td>5.3003.11h</td>
<td>Heat pump: low ambient compressor lockout</td>
<td>For air-to-air heat pumps, low ambient compressor lockout will be set to 0°F outdoor temperature or ambient compressor lockout will be disabled. ANSI/ACCA 3 Manual S-2004 Residential Equipment Selection will be referenced for low ambient compressor lockout when using different types of heat pumps.</td>
</tr>
<tr>
<td>5.3003.11i</td>
<td>Heat pump: outside temperature sensor</td>
<td>An outdoor temperature sensor will be installed in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td>5.3003.11j</td>
<td>Heat pump: supplementary heat wiring</td>
<td>Supplementary heat will be wired onto second stage heating terminal in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td>5.3003.11k</td>
<td>Thermostat: installer programming</td>
<td>The installer options will be set to match the thermostat to the equipment and control board settings.</td>
</tr>
<tr>
<td>5.3003.11l</td>
<td>Time delay settings</td>
<td>Time delay for equipment will be set in accordance with manufacturer specifications and as appropriate for the climate zone (e.g., no time delay for hot humid climates).</td>
</tr>
<tr>
<td>5.3003.11m</td>
<td>Humidistat: location</td>
<td>Humidistat will be installed to reflect humidity of the zone in which it is installed. Humidistat will be installed in a dry location.</td>
</tr>
<tr>
<td>5.3003.11n</td>
<td>Ventilation control</td>
<td>Ventilation controls will be connected to operational control system, as originally designed in the factory. Powered ventilation system alarm will be set to &quot;on;&quot; controls will be reset to factory settings.</td>
</tr>
</tbody>
</table>
### 5.3003.11o Occupant education

**Comment**

Occupants will be educated on proper use of thermostat, including:

- Proper use of setbacks for air conditioners and heat pumps
- Allowing occupant comfort to determine setback for combustion heating appliances
- Using emergency heat appropriately
- Educate property manager/occupant about fan on/auto or vent/auto operations
- Educate the property manager/occupant about ventilation, as it applies to controls
- Instruct the property manager/occupant to never leave the fan set to "on" or "vent" in humid climates
- Educate property manager/occupant about possible moisture problems when thermostat is set low for extended periods of time during the summer

### 5.3003.12 Package Units—Repair and Service

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
**Desired Outcome:** Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.12a Work assessment | Assessment will be performed to identify problems with air, refrigerant, electrical, load, safety, indoor environmental quality (IEQ), and/or other needed repairs  
If new installation or replacement is necessary, ACCA Manual J, Manual S, and/or Manual D will be referenced to determine if the existing duct system is adequate for the sizing of the furnace, and the procedures outlined in ANSI/ACCA 5 QI-2010 HVAC Quality Installation Specification will be followed | Determine the scope of repair, service, and level of expertise required to perform the work |
| 5.3003.12b Remove existing system components | Nonsalvageable components and waste will be removed and disposed of properly  
Refrigerant will be removed in accordance with EPA requirements | Prepare for installation of new equipment or components  
Ensure environmental and legal compliance |
| 5.3003.12c Repairs | Repairs will be performed by qualified specialist as identified in the assessment  
Maintenance will be done in accordance with ANSI/ACCA 4  
| 5.3003.12d Service existing components | Service will be performed by qualified personnel as identified in the assessment  
Maintenance will be done in accordance with ANSI/ACCA 4  
| 5.3003.12e Commissioning | Equipment will be fully tested for proper operation following procedures outlined in ANSI/ACCA 5 QI-2010  
Property manager/occupant will be educated on how to operate and maintain system, including thermostat operation and system changes | Ensure proper system operation  
Ensure property manager/occupant is educated |

### 5.3003.13 Refrigerant Charge Evaluation

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance

**Desired Outcome:** Ensure proper system operation  
Ensure property manager/occupant is educated
### Desired Outcome: Properly charged system

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.13a Prerequisite</td>
<td>Leak detection, air flow, and refrigerant line inspection will be checked and repaired to determine need for refrigerant charge</td>
<td>Eliminate possible sources of other problems before addressing refrigerant charging</td>
</tr>
<tr>
<td>5.3003.13b Qualified contractor</td>
<td>Charge will be tested and work performed by a qualified contractor</td>
<td>Ensure compliance with codes and environmental regulations</td>
</tr>
<tr>
<td></td>
<td>Refrigerant charge will be in accordance with ANSI/ACCA 5 QI-2010 HVAC Quality Installation Specification refrigerant charging requirements for mixed humid, hot humid, marine, and hot dry climates</td>
<td>Ensure proper equipment charge</td>
</tr>
<tr>
<td>5.3003.13c Documentation</td>
<td>Contractor will provide documentation of work performed</td>
<td>Maintain record of work performed</td>
</tr>
<tr>
<td>5.3003.13d Quality assurance</td>
<td>External static pressure will be measured and documented EPA refrigerant charge log will be provided</td>
<td>Ensure external static pressure is within range in accordance with manufacturer specifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure quality workmanship</td>
</tr>
</tbody>
</table>

### 5.3003.14 Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
**Desired Outcome:** Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.14a Place appliance in operation | Heating equipment will be placed in operation in accordance with applicable NFPA standards and manufacturer specifications when available | Ensure equipment:  
- Operates as designed  
- Operates safely  
- Operates efficiently  
- Is durable |
| 5.3003.14b Gas pressure | Measurement will be verified by a certified professional in accordance with fuel type and manufacturer specifications | Ensure equipment:  
- Operates as designed  
- Operates safely  
- Operates efficiently  
- Is durable |
| 5.3003.14c Carbon dioxide (CO₂) and oxygen (O₂) | Measurement will be verified in accordance with industry manuals (e.g., Testo, Bacharach) | Ensure equipment:  
- Operates as designed  
- Operates safely  
- Operates efficiently  
- Is durable |

*Title: No change  
Specification(s): If fault has been determined in the preceding steps, then measurement will be verified by a certified professional in accordance with fuel type and manufacturer specifications. (Entire specification moved down to a lower number.)  
Objective(s): No change*
5.3003.14d Excess combustion air

Excess combustion air will be calculated and verified in accordance with industry manuals (e.g., Testo, Bacharach)

Ensure equipment:
- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

5.3003.14e Carbon monoxide (CO) in flue gas

CO in the undiluted flue gas will be less than 100 ppm

Ensure equipment:
- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

Title: No change
Specification(s): CO in the undiluted flue gas will be less than 400 ppm air-free
Objective(s): No change

5.3003.14f Testing/inspection holes

All testing and inspection holes will be sealed with manufacturer approved materials

Ensure equipment:
- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

5.3003.15 Combustion Analysis of Oil-Fired Appliances

Topic: Forced Air
Subtopic: System Assessment and Maintenance
Desired Outcome: Analysis of critical components and operations completed to industry and manufacturer specifications

5.3003.15a Oil system: smoke test

Smoke test will be conducted before any combustion testing is completed
Smoke spot reading will be in accordance with burner manufacturer specifications

Ensure equipment:
- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

5.3003.15b Oil system: nozzle

Nozzle size, angle, and spray pattern will be correct for design input and within equipment firing rate of the heating system manufacturer

Ensure equipment:
- Operates as designed
- Operates safely
- Operates efficiently
- Is durable
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.15c Oil filter | Filter will be present, clean, and leak free | Ensure equipment:  
  - Operates as designed  
  - Operates safely  
  - Operates efficiently  
  - Is durable |
| 5.3003.15d Fuel pressure | Measurement will be verified in accordance with manufacturer specifications | Ensure equipment:  
  - Operates as designed  
  - Operates safely  
  - Operates efficiently  
  - Is durable |
| 5.3003.15e Oil system: steady state efficiency (SSE) | Measurement will be verified in accordance with manufacturer specifications | Ensure equipment:  
  - Operates as designed  
  - Operates safely  
  - Operates efficiently  
  - Is durable |
| 5.3003.15f Net stack temperature | Net stack temperature will be measured and verified in accordance with manufacturer specifications | Ensure equipment:  
  - Operates as designed  
  - Operates safely  
  - Operates efficiently  
  - Is durable |
| 5.3003.15g Carbon dioxide (CO2) and oxygen (O2) | Measurement will be verified in accordance with industry manuals (e.g., Testo, Bacharach) | Ensure equipment:  
  - Operates as designed  
  - Operates safely  
  - Operates efficiently  
  - Is durable |
| 5.3003.15h Excess combustion air | Excess combustion air will be calculated and shown to be in accordance with industry manuals (e.g., Testo, Bacharach) | Ensure equipment:  
  - Operates as designed  
  - Operates safely  
  - Operates efficiently  
  - Is durable  

Title: No change  
Specification(s): Excess air will be minimized in accordance with industry best practices  
Objective(s): No change
### 5.3003.15 CO in flue gas

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.15i | CO in the undiluted flue gas will be less than 100 ppm | Ensure equipment:  
- Operates as designed  
- Operates safely  
- Operates efficiently  
- Is durable |

See redline change(s)

### 5.3003.15j Testing/inspection holes

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.15j | All testing and inspection holes will be sealed with approved materials | Ensure equipment:  
- Operates as designed  
- Operates safely  
- Operates efficiently  
- Is durable |

### 5.3003.16 Evaluating Electrical Service

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
**Desired Outcome:** Electrical components properly tested

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.16a</td>
<td>Service entrance</td>
<td>Ensure occupant and worker safety</td>
</tr>
</tbody>
</table>
| 5.3003.16b | Polarity | Ensure equipment:  
- Operates as designed  
- Operates safely |
| 5.3003.16c | Voltage: incoming power | Ensure equipment operates as designed |
| 5.3003.16d | Voltage: contactor | Ensure contactor does not overheat  
Ensure equipment operates as designed |
| 5.3003.16e | Grounding | Ensure equipment:  
- Operates as designed  
- Operates safely  
Ensure ground continuity among sections |
| 5.3003.16f | Blower amperage | Ensure equipment:  
- Operates as designed  
- Operates efficiently  
- Operates safely |
### 5.3003.3 Evaluating Air Flow

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
**Desired Outcome:** Air flow is properly tested

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.3a Total air flow | Total system air flow will be measured by:  
  - Temperature rise  
  - Flow plate  
  - Fan depressurization device (e.g., Duct Blaster, DucTester) | Ensure equipment:  
  - Operates as designed  
  - Operates efficiently  
  - Provides comfort  
  - Operates safely  
  - Is durable | 3879 |
| 5.3003.3b External static pressure | External static pressure will be in accordance with manufacturer specifications | Ensure equipment:  
  - Operates as designed  
  - Operates efficiently  
  - Provides comfort  
  - Operates safely  
  - Is durable | 3880 |
| 5.3003.3c Pressure | Pressure drop across cooling coils will be in accordance with manufacturer specifications | Ensure equipment:  
  - Operates as designed  
  - Operates efficiently  
  - Provides comfort  
  - Operates safely  
  - Is durable | 3881 |
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 5.3003.3d | Pressure drop: filter | Ensure equipment:  
- Operates as designed  
- Operates efficiently  
- Provides comfort  
- Operates safely  
- Is durable |
| 5.3003.3e | Balancing room flow: new ductwork | Ensure equipment:  
- Operates as designed  
- Operates efficiently  
- Provides comfort  
- Operates safely  
- Is durable |
| 5.3003.3f | Supply wet bulb and dry bulb | Ensure equipment:  
- Operates as designed  
- Operates efficiently  
- Provides comfort  
- Operates safely  
- Is durable |
| 5.3003.3g | Return wet bulb and dry bulb | Ensure equipment:  
- Operates as designed  
- Operates efficiently  
- Provides comfort  
- Operates safely  
- Is durable |
| 5.3003.3h | Temperature rise: gas and oil furnaces only | Ensure equipment:  
- Operates as designed  
- Operates efficiently  
- Provides comfort  
- Operates safely  
- Is durable |

### 5.3003.5 Refrigerant Line Inspection

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
**Desired Outcome:** Refrigerant lines properly installed

*Note:* The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.5a</td>
<td>Insulation</td>
<td>All liquid refrigerant lines will be insulated to a minimum of R-4 Vapor or high side lines will not be insulated unless specified by the equipment's manufacturer Suction lines will be insulated to a minimum of R-4 For mixed humid, hot humid, and marine climates, heating and cooling refrigerant lines will be insulated</td>
</tr>
<tr>
<td>5.3003.5b</td>
<td>Ultraviolet (UV) protection of insulation</td>
<td>If exposed to sunlight, refrigerant line insulation will be protected from UV degradation in accordance with manufacturer specifications, 2012 IRC N1103.3.1, or local code</td>
</tr>
<tr>
<td>5.3003.5c</td>
<td>Sizing</td>
<td>Refrigerant lines will be sized to meet manufacturer specifications for the installed equipment</td>
</tr>
<tr>
<td>5.3003.5d</td>
<td>Installation quality</td>
<td>Refrigerant lines will be installed without kinks, crimps, or excessive bends</td>
</tr>
<tr>
<td>5.3003.5e</td>
<td>Support</td>
<td>Refrigerant lines will be routed, supported, and secured to house in a manner that protects the line from damage by workers or occupants</td>
</tr>
</tbody>
</table>

### 5.3003.6 Evaluating Sequence of Operation
**Topic:** Forced Air
**Subtopic:** System Assessment and Maintenance
**Desired Outcome:** Sequence of operation of the system verified

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.6a</td>
<td>Verification</td>
<td>The sequence of operation of the system will be verified in accordance with the manufacturer installation, operation, and maintenance manual</td>
</tr>
</tbody>
</table>

### 5.3003.7 Occupant Education
**Topic:** Forced Air
**Subtopic:** System Assessment and Maintenance
**Desired Outcome:** Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.7a</td>
<td>Basic operation</td>
<td>Basic operation of the equipment will be explained to the occupant (e.g., design conditions, efficiency measures, differences from previous system or situation)</td>
</tr>
<tr>
<td>5.3003.7b</td>
<td>System controls (e.g., thermostat, humidistat)</td>
<td>Proper operation and programming of system controls to achieve temperature and humidity control will be explained to the occupant</td>
</tr>
<tr>
<td>5.3003.7c</td>
<td>System disconnects</td>
<td>Indoor and outdoor electrical disconnects and fuel shut-offs will be demonstrated to occupant</td>
</tr>
<tr>
<td>5.3003.7d</td>
<td>Combustion air inlets</td>
<td>Location of combustion air inlets will be identified for occupant in accordance with NFPA 31, 54, and 58 Importance of not blocking inlets will be explained to occupant</td>
</tr>
<tr>
<td>5.3003.7e</td>
<td>Blocking air flow</td>
<td>Importance of cleaning dust and debris from return grilles will be explained to occupant Proper placement of interior furnishings with respect to registers will be explained to occupant Negative consequences of closing registers will be explained to occupant Importance of leaving interior doors open as much as possible will be explained to occupant</td>
</tr>
</tbody>
</table>
### 5.3003.7 Routine maintenance

**Comment**

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(s)</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.7f</td>
<td>Proper filter selection and how to change the filter will be explained to occupant</td>
<td>Ensure equipment operates as designed</td>
</tr>
<tr>
<td></td>
<td>Importance of keeping outside unit clear of debris, vegetation, decks, and other blockage will be explained to occupant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance and timing of routine professional maintenance will be explained to occupant</td>
<td></td>
</tr>
</tbody>
</table>

### 5.3003.7g Calling heating, ventilation, and air conditioning (HVAC) contractor

**Comment**

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(s)</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.7g</td>
<td>Situations when the occupant should contact the HVAC contractor will be explained, including:</td>
<td>Notify occupant to contact installer when system is not operating as designed</td>
</tr>
<tr>
<td></td>
<td>• Fuel odors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water draining from secondary drain line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Emergency heat indicator always on for a heat pump system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• System blowing cold air during heating season and vice versa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Icing of the evaporator coil during cooling mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Outside unit never defrosts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unusual noises</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unusual odors</td>
<td></td>
</tr>
</tbody>
</table>

### 5.3003.7h Carbon monoxide (CO)

**Comment**

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(s)</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.7h</td>
<td>A carbon monoxide (CO) alarm will be installed</td>
<td>Occupant will be made aware of operation of CO alarm</td>
</tr>
</tbody>
</table>

### 5.3003.7i Warranty and service

**Comment**

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(s)</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.7i</td>
<td>Occupant will be provided with relevant manuals and warranties</td>
<td>Provide manuals and warranties for future servicing</td>
</tr>
<tr>
<td></td>
<td>The labor warranty will be explained and the occupant will be given a phone number to call for warranty service</td>
<td></td>
</tr>
</tbody>
</table>

### 5.3003.8 Evaporative Cooler Maintenance and Repairs

**Topic:** Forced Air  
**Subtopic:** System Assessment and Maintenance  
**Desired Outcome:** Evaporative cooler evaluated and maintained as needed

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>Title</th>
<th>Specification(s)</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3003.8a</td>
<td>The following system elements will be assessed:</td>
<td>Ensure all components function properly</td>
</tr>
<tr>
<td></td>
<td>• Pump</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Spider</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Float</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Damper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Roof jack support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Electrical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Motor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fan</td>
<td></td>
</tr>
</tbody>
</table>

Elements will be repaired or replaced as needed in accordance with manufacturer instructions.
### 5.3003.8 Repair and maintenance

**Comment**
- Calcium deposits will be removed
- Pads will be replaced
- Any additional repairs or replacements will be made as necessary in accordance with manufacturer’s instructions

**OBJECTIVE(S)**
- Protect the potable water supply from cross-contamination
- Ensure evaporative cooler functions properly

### 5.3003.8c Occupant education

**Comment**
- A regular service schedule will be recommended to occupant
- Issues regarding multiple systems running will be discussed with occupant

**OBJECTIVE(S)**
- Ensure the occupant understands basic operation and the importance of regular maintenance

---

### 5.3201.1 Indigenous Shading

**Topic:** Shading  
**Subtopic:** Landscaping  
**Desired Outcome:** Heat gain and loss reduced through use of indigenous plants

**OBJECTIVE(S)**
- Ensure plantings survive in local conditions using a minimum amount of water

### 5.3201.1a Plant selection

**Comment**
- All plants intended for shading will be indigenous and drought resistant

### 5.3201.1b Plant size

**Comment**
- No plant will be chosen that will grow to a height that would cause damage to the home if it or any part of it fell on the home

### 5.3202.1 Reflective Coatings on Metal Roofs

**Topic:** Shading  
**Subtopic:** Reflective Roofs  
**Desired Outcome:** Reduce solar heat gain for manufactured homes

**OBJECTIVE(S)**
- Ensure roof is clean, dry, and structurally sound for proper adhesion of new coating

### 5.3202.1a Assessment

**Comment**
- Existing roof coating will be assessed for hazardous material

### 5.3202.1b Preparation

**Comment**
- Roof will be stripped of all debris, algae, and peeled and loose coating
- Repairs to roof and penetrations will be made before application

### 5.3202.1c Materials selection

**Comment**
- Material will be approved for application to metal and existing roof coating
- Material will be an ENERGY STAR qualified reflective coating
- Roof coating will be durable, flexible, reflective, and meet ASTM D412, ASTM D1737, and UL 790 Class A

### 5.3202.1d Application

**Comment**
- Roof-coating material will be applied in accordance with manufacturer specifications

### 5.3202.1e Occupant education

**Comment**
- Occupant will be educated on the maintenance of reflective coating per manufacturer specifications, including annual inspection and cleaning

---

### 5.3202.1 Reflective Coatings on Metal Roofs

**OBJECTIVE(S)**
- Ensure proper application

---

### 5.3202.1e Occupant education

**Comment**
- Occupant will be educated on the maintenance of reflective coating per manufacturer specifications, including annual inspection and cleaning

**OBJECTIVE(S)**
- Preserve integrity and effectiveness of reflective coating

---

### Section 6: Ventilation
### Section 6: Ventilation

#### 6.6002.3 Exhaust-Only Ventilation—Fan Intake Grille Location

**Topic:** Exhaust  
**Subtopic:** Components  
**Desired Outcome:** Exhaust grille location optimizes either primary or local ventilation

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 6.6002.3a | Primary whole house ventilation | Fan intake grille will be installed in a central location within the main body of the house  
Ensure it is accessible for filter change and cleaning | Provide whole house air exchange |
| 6.6002.3b | Local ventilation | Fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are generated | Remove contaminated air at the source |

#### 6.6002.4 Ducts (Exhaust Fans)

**Topic:** Exhaust  
**Subtopic:** Components  
**Desired Outcome:** Installed ducts effectively move the required volume of air and prevent condensation

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 6.6002.4a | Duct design and configuration | Consideration will be given to:  
- Vent termination location  
- Amount of space for duct run  
- Roof condition, type, and access (e.g., metal, shingle, bow string, flat)  
- Duct insulation  
When applicable, pitch duct to remove condensation to outdoors  
Ducts will be as straight as possible, fully extended, and have the shortest run possible  
Turns will be made so the radius at the centerline is no less than one duct diameter  
Duct diameter will be equal to or greater than the exhaust fan outlet  
Fan flow will be verified by flow measurement to meet ASHRAE Standard 62.2 | Effectively move the required volume of air |
| 6.6002.4b | Duct insulation | Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or in accordance with local codes | Prevent condensation from forming or collecting inside or outside of the ductwork |
| 6.6002.4c | Duct support | Horizontal runs will be supported in accordance with flex duct manufacturer specifications and local codes  
Supports with a width of at least 1 ¼” will be used or adequate metal support | Effectively move the required volume of air  
Preserve the integrity of the duct system |
| 6.6002.4d | Duct connections | Metal-to-metal or metal-to-PVC connections will be fastened with a minimum of three equally spaced screws  
Flexible duct-to-metal or flexible duct-to-PVC connections will be fastened with tie bands using a tie band tensioning tool  
PVC-to-PVC connections will be fastened with approved PVC cement  
Other specialized duct fittings will be fastened in accordance with manufacturer specifications  
In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | Effectively move the required volume of air  
Preserve the integrity of the duct system |
| 6.6002.4e | Duct materials | Flexible materials will be UL 181 listed or Air Diffusion Council approved  
Rigid, smooth metal of 30-gauge wall thickness or thicker will be used  
PVC material may be used | Effectively move the required volume of air  
Preserve the integrity of the duct system |
### 6.6003.1 Surface-Mounted Ducted

**Topic:** Exhaust  
**Subtopic:** Fans  
**Desired Outcome:** Surface-mounted ducted fans installed to specification

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
<th></th>
</tr>
</thead>
</table>
| 6.6003.1a | A hole no greater than a 1/4” greater than the assembly will be cut to accommodate fan assembly                                                                                                                                                                                                                                               | Minimize repair work  
Ensure a secure installation                                                                                                                                                                                                                                  | 2985 |
| 6.6003.1b | Wiring will be installed by a properly licensed contractor, as required by the authority having jurisdiction  
Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes                                                                                                                                                 | Prevent an electrical hazard                                                                                                                                                                                                                                      | 2986 |
| 6.6003.1c | Fan outlet will be oriented toward the final termination location  
Fan will be oriented so the equivalent length of the duct run is as short as possible  
Fan will be mounted securely in accordance with manufacturer specifications                                                                                                                                                                                                  | Ensure short duct run to achieve optimum air flow  
Ensure a secure installation  
Ensure fan housing does not shake, rattle, or hum when operating                                                                                                                                                                                                  | 2987 |
| 6.6003.1d | A backdraft damper will be installed between the outlet side of the fan and the exterior                                                                                                                                                                                                                                                             | Prevent reverse air flow when the fan is off                                                                                                                                                                                                                      | 2988 |
| 6.6003.1e | Duct-to-fan outlet will be connected and sealed as follows:  
- Round metal-to-metal or metal-to-PVC connections will be fastened with a minimum of three equally spaced screws  
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes  
- Flexible duct-to-metal or flexible duct-to-PVC connections will be fastened with tie bands using a tie band tensioning tool  
- PVC-to-PVC connections will be fastened with approved PVC cement  
- Other specialized duct fittings will be fastened according to manufacturer specifications  
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material                                                                                                                                                  | Exhaust to outside                                                                                                                                                                                                                                                | 2989 |
| 6.6003.1f | Gaps and holes in fan housing will be sealed with caulk or other sealants in accordance with manufacturer recommendations  
Sealants will be compatible with their intended surfaces  
Sealants will be continuous and meet fire barrier specifications                                                                                                                                                                                                     | Prevent air leakage through fan housing  
Ensure a permanent seal  
Prevent a fire hazard                                                                                                                                                                                                                                               | 2990 |
| 6.6003.1g | Sealants will be compatible with their intended surfaces  
Sealants will be continuous and meet fire barrier specifications                                                                                                                                                                                                                                                                           | Prevent air leakage between house and fan                                                                                                                                                                                                                           | 2991 |
| 6.6003.1h | Air flows in cubic feet per minute (CFM) will be measured and adjusted to meet the whole house upgrade design requirements                                                                                                                                                                                                                           | Exhaust sufficient air from desired locations to outside                                                                                                                                                                                                          | 2992 |
### 6.6003 Inline

**Topic:** Exhaust  
**Subtopic:** Fans  
**Desired Outcome:** Inline fans installed to specification

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.6003.1</strong> Preventing air leakage caused by exhaust fans</td>
<td>Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics)</td>
<td>Ensure occupant health and safety</td>
</tr>
<tr>
<td><strong>6.6003.1j</strong> Combustion safety</td>
<td>Pressure effects will be assessed and corrected on all combustion appliances</td>
<td>Ensure safe operation of combustion appliances</td>
</tr>
</tbody>
</table>

#### 6.6003.2 Inline

**Subtopic:** Exhaust Fans

Ducts will be connected and sealed to the intake fan and termination fitting as follows:

- Round metal-to-metal or metal-to-PVC connections will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes
- Flexible duct-to-metal or flexible duct-to-PVC connections will be fastened with tie bands using a tie band tensioning tool
- PVC-to-PVC connections will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

- Exhaust from desired location to outside
- Preserve integrity of the duct system and building envelope

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| **6.6003.2a** Wiring | Wiring will be installed by a properly licensed contractor, as required by the authority having jurisdiction  
Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes | Prevent an electrical hazard |
| **6.6003.2b** Access | Fan and service switch will be accessible for maintenance according to NFPA 70 National Electric Code or local authority having jurisdiction | Fan and service switch will be accessible for maintenance |
| **6.6003.2c** Fan mounting | Fan outlet will be oriented toward the final termination location  
Fan will be oriented so the equivalent length of the duct run is as short as possible  
Fan will be mounted securely in accordance with manufacturer specifications  
Fan will be isolated from the building framing unless specifically designed to be directly attached  
Fan will be installed remotely by installing ducting from intake grille | Ensure short duct run to achieve optimum air flow  
Ensure fan is installed securely  
Ensure fan housing or building framing does not shake, rattle, or hum when operating  
Minimize noise |
| **6.6003.2d** Backdraft damper | A backdraft damper will be installed between the outlet side of the fan and the exterior | Prevent reverse air flow when the fan is off |
| **6.6003.2e** Duct connections | Ducts will be connected and sealed to the intake fan and termination fitting as follows:  
- Round metal-to-metal or metal-to-PVC connections will be fastened with a minimum of three equally spaced screws  
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems or tapes  
- Flexible duct-to-metal or flexible duct-to-PVC connections will be fastened with tie bands using a tie band tensioning tool  
- PVC-to-PVC connections will be fastened with approved PVC cement  
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications  
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | Exhaust from desired location to outside  
Preserve integrity of the duct system and building envelope |
| **6.6003.2f** Boot to interior surface seal | Sealants will be compatible with their intended surfaces  
Sealants will be continuous and meet fire barrier specifications | Prevent air leakage around intake housing  
Prevent a fire hazard |
### 6.6003.5 Garage Exhaust Fan

**Topic:** Exhaust  
**Subtopic:** Fans  
**Desired Outcome:** Contaminants properly removed from house

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 6.6003.5a | System selection | Remove contaminants from garage  
Ventilation for garage will be exhaust only and provide a minimum installed capacity of 100 CFM of ventilation per vehicle bay and will vent directly outdoors  
Garage exhaust fan will be wired for continuous operation or installed with automatic controls that activate the fan whenever the garage is occupied and for at least 15 minutes after the garage has been vacated  
If a ducted fan (not through-the-wall) is used, measure and verify the minimum air flow and adjust as necessary | 3004 |
| 6.6003.5b | Air leakage | Ensure occupant health and safety  
Air leakage between the house and garages will be prevented by sealing and weatherstripping | 3005 |
| 6.6003.5c | Combustion safety | Ensure safe operation of combustion appliances  
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards  
Exhaust fans and other exhausting systems shall be provided with makeup air or other pressure relief | 3006 |

### 6.6003.6 Fan Placement (Whole House/Common Space Exhaust Only)

**Topic:** Exhaust  
**Subtopic:** Fans  
**Desired Outcome:** Provide primary ventilation for common spaces

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 6.6003.6a | Clearance | Ensure access for installation, operation, and maintenance  
Clearance for size of the fan recommended will be determined  
Consideration will be given for adequate head clearance | 3007 |
| 6.6003.6b | Power source | Provide accessible and adequate power source  
Power source load will be determined as adequate  
Consideration will be given to power source location | 3008 |
| 6.6003.6c | Location | Allow fresh air distribution to common areas  
No resistance greater than 3 pascals will exist between fan intake location with reference to the common area | 3009 |
### 6.6003.6d Duct/vent

**Consideration will be given to:**
- Vent termination location
- Amount of space for duct run
- Roof condition and type (e.g., metal, shingle, bow string, flat)
- Duct insulation

When applicable, pitch duct to remove condensation to outdoors

Ducts will be as straight as possible, fully extended, and have the shortest run possible

To the extent possible, turns will be made so that the radius at the centerline is no less than one duct diameter

Duct diameter will be equal to or greater than the exhaust fan outlet

Fan flow will be verified by flow measurement to meet ASHRAE standard 62.2

**Objective:**

Effectively move the required volume of air

---

### 6.6003.6e Attachment

**Fan will be secured to a structural component**

Structural integrity of the manufactured home will be maintained (e.g., roof trusses, walls, floor joists)

**Objective:**

Maintain structural integrity

---

### 6.6003.6f Total exhaust airflow

**Total exhaust system airflow will be measured**

**Objective:**

Ensure exhaust airflow is as designed

---

### 6.6005.1 Clothes Dryer

**Topic:** Exhaust

**Subtopic:** Appliance Exhaust Vents

**Desired Outcome:** Dryer air exhausted efficiently and safely

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

---

#### 6.6005.1a Clothes dryer ducting

**Clothes dryers will be ducted to the outdoors, which does not include unconditioned spaces, such as attics and crawl spaces that are ventilated with the outdoors**

As short a run as practical of rigid sheet metal or semi-rigid sheet metal venting material will be used in accordance with manufacturer specifications

Dryer ducts exceeding 35’ in duct equivalent length will have a dryer booster fan installed

Plastic venting material will not be used

Uninsulated clothes dryer duct will not pass through unconditioned spaces, such as attics and crawl spaces

Ducts will be connected and sealed as follows:

- UL-listed foil type or semi-rigid sheet metal to rigid metal will be fastened with clamp
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

In addition,

- Sheet metal screws or other fasteners that will obstruct the exhaust flow will not be used
- Condensing dryers will be plumbed to a drain

**Objective:**

Preserve integrity of building envelope

Effectively move air from clothes dryer to outside

---
### 6.6005.2 Kitchen Range

**Topic:** Exhaust  
**Subtopic:** Appliance Exhaust Vents  
**Desired Outcome:** Kitchen range fan installed to specification

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6005.2a</td>
<td>Wiring</td>
<td>Prevent an electrical hazard</td>
</tr>
</tbody>
</table>
| **Wiring** Comment | Wiring will be installed in accordance with local regulations or the 2012 IRC in the absence of such regulations or where those regulations are not as stringent as the 2012 IRC  
Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes  
Wiring will be installed by a licensed electrician | | |
| 6.6005.2b | Fan venting | Remove cooking contaminants from the house  
Preserve integrity of building envelope | 3019 |
| **Fan venting** Comment | Kitchen range fans will be vented to the outdoors  
Recirculating fans will not be used as a ventilating device | | |
| 6.6005.2c | Fan ducting | Preserve integrity of building envelope  
Effectively move air from range to outside | 3020 |
| **Fan ducting** Comment | Kitchen range fans will be ducted to the outdoors  
As short a run as practical of smooth wall metal duct will be used, following manufacturer specifications  
Ducting will be connected and sealed as follows: | | |
| | • Metal-to-metal connections will be fastened with a minimum of three equally spaced screws  
• Other metal-to-metal connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes  
• For down-draft exhaust systems, PVC-to-PVC connections will be fastened with approved PVC cement  
• Other specialized duct fittings will be fastened in accordance with manufacturer specifications  
• In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | | |
| 6.6005.2d | Termination fitting | Ensure safe operation of combustion appliances  
Ensure occupant health and safety | 3021 |
| **Termination fitting** Comment | Termination fitting will be installed including a backdraft damper, as described in termination fitting detail | | |
6.6005.2e Makeup air

Makeup air will be provided for kitchen range fans exhausting more than 200 CFM

Ensure safe operation of combustion appliances
Ensure occupant health and safety

3022

6.6005.2f Combustion safety

Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Ensure safe operation of combustion appliances
Ensure occupant health and safety

3023

6.6005.2g Occupant education

Occupant will be instructed to keep grease filters and termination fitting clean

Effectively move air from kitchen range to outdoors

3024

6.6102.4 Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

Topic: Supply
Subtopic: Components
Desired Outcome: Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6102.4a Forced air system requirements</td>
<td>Existing forced air system leakage to the outside will be less than 10% of the air handler flow when measured at 25 pascals with reference to the outside. Any portion of the return located inside the Combustion Appliance Zone will be air sealed</td>
<td>Reduce migration of pollutants</td>
</tr>
<tr>
<td>6.6102.4b Wiring</td>
<td>Wiring will be installed by a properly licensed contractor, as required by the authority having jurisdiction. Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes</td>
<td>Prevent an electrical hazard</td>
</tr>
<tr>
<td>6.6102.4c Access</td>
<td>Motorized damper and service switch will be accessible for maintenance in accordance with required code or authority having jurisdiction</td>
<td>Ensure accessibility for maintenance</td>
</tr>
<tr>
<td>6.6102.4d Mounting intake duct</td>
<td>Ventilation duct will be attached as close to the HVAC system’s fan as possible while remaining in compliance with HVAC manufacturer specifications. Filtration of ventilation air will be provided before reaching the thermal conditioning components. Filtration will be accessible and serviceable. Duct will be connected to intake fitting. Connection and seal will be performed in accordance with supply duct detail.</td>
<td>Ensure short duct run to achieve optimum air flow. Preserve integrity of the duct system and building envelope</td>
</tr>
<tr>
<td>6.6102.4e Motorized damper</td>
<td>A motorized damper or equivalent technology will be installed between the intake fitting and the return side of the air handler. Air flow will be provided by sequenced operation of the damper or equivalent technology.</td>
<td>Prevent air flow when none is desired</td>
</tr>
<tr>
<td>6.6102.4f Intake filter</td>
<td>An accessible filter will be installed. Filter will be able to remove contaminants consistent with at least minimum efficiency reporting value (MERV) 8 or better when tested in accordance with ANSI/ASHRAE 52.2-2007. Filter or air cleaning systems that intentionally produce ozone will not be allowed.</td>
<td>Ensure occupant health and safety. Preserve integrity of the building envelope</td>
</tr>
<tr>
<td>6.6102.4g Occupant education</td>
<td>Occupant will be educated on how and when to change filter.</td>
<td>Ensure occupant health and safety. Preserve integrity of the building envelope</td>
</tr>
<tr>
<td>6.6102.4h Intake ventilation airflow</td>
<td>Total intake ventilation airflow will be measured.</td>
<td>Ensure airflow is as designed</td>
</tr>
</tbody>
</table>

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6.6188.2 Removing Supply Vents from Garages

Topic: Supply
Subtopic: Special Considerations
Desired Outcome: Safe removal of garage supply vents
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6188.2a</td>
<td>Removal of supply/return in garage</td>
<td>Supply run feeding the register will be truncated as near to the supply plenum as possible. If directly connected to the plenum, the supply run will be truncated at the plenum. If connected to a Y or T branch system, the supply run will be truncated at the Y or T. Return grille located in garage will be removed in the same manner as supply.</td>
</tr>
<tr>
<td>6.6188.2b</td>
<td>Patching of the hole in the duct system created by removal</td>
<td>All holes in sheet metal ducts will be patched with sheet metal and secured with sufficient screws to hold the patch flat without gaps. Holes left in any Y or T will be capped with sheet metal caps and fastened with at least three screws.</td>
</tr>
<tr>
<td>6.6188.2c</td>
<td>Sealing of the patch</td>
<td>All patches will be sealed with mastic meeting UL 181 and in accordance with manufacturer specifications.</td>
</tr>
<tr>
<td>6.6188.2d</td>
<td>Removal of discarded ducts</td>
<td>All abandoned ductwork will be removed from work area.</td>
</tr>
<tr>
<td>6.6188.2e</td>
<td>Patching of the register hole in garage</td>
<td>Holes created by the removal of the register and boot will be patched and taped using material meeting local codes.</td>
</tr>
<tr>
<td>6.6188.2f</td>
<td>External static pressure testing</td>
<td>Units will be tested for external static pressure (ESP) before and after work. If there is a significant rise in ESP, air flow testing will be required.</td>
</tr>
<tr>
<td>6.6188.2g</td>
<td>CAZ testing</td>
<td>CAZ testing will be performed where combustion appliances are utilized.</td>
</tr>
</tbody>
</table>

### 6.6204.1 Commissioning Existing Exhaust or Supply Ventilation Systems

**Topic:** Whole Building Ventilation  
**Subtopic:** Equipment Evaluation  
** Desired Outcome:** Verify proper operation of existing systems
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Verification Method</th>
<th>Evaluation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection will be performed and documented for:</td>
<td>• Electrical connections</td>
<td>Evaluate systems</td>
<td>Identification Specification(s): Identify whole building ventilation strategy that was installed in the home, based on options described in current version of ASHRAE 62.2, e.g., exhaust only, supply only, balanced, combining local and whole home ventilation delivery, incorporating infiltration credit, etc. Objective(s): Ensure suitable whole building ventilation strategy is installed Identify testing requirements to determine installed system air flow</td>
</tr>
<tr>
<td>• Name plate (rated sone and flow)</td>
<td>• Damper operation (internal and external)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Motor cleanliness</td>
<td>Ducts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Connections (proper materials, sealed and connected)</td>
<td>• Insulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Support</td>
<td>• Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sizing</td>
<td>• Termination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.6204.1b Calibrated device will be used to test for flow measurement</td>
<td>Ensure proper flow</td>
<td></td>
<td>Title: Equipment inspection Specification(s): Visually inspect and document status of: • Electrical connections • Name plate (rated sone and flow) • Motor cleanliness Objective(s): Evaluate equipment</td>
</tr>
</tbody>
</table>
6.6204.1d Total ventilation airflow

| 6.6204.1d  | Total exhaust and/or supply system ventilation airflow will be measured | Ensure airflow is as designed | Title: Measurement and Adjustment
| Specification(s): Using a calibrated device, measure air flow of all necessary components, including building air leakage when relevant. Adjust ventilation equipment air flows as necessary to meet the ventilation rates required by the current version of ASHRAE 62.2.
| Objective(s): Provide sufficient airflow per current ventilation standards. Verify suitable performance of installed ventilation strategy. |

6.6205.1 Manufactured Housing Exhaust-Only Strategies

| Title: Pathway inspection
| Specification(s): Visually inspect and document status of ducting or other airflow pathways to ensure proper:
| Objective(s): Correct deficiencies

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 6.6204.1c Work order Comment | Work order will be developed as necessary in accordance with systems check and flow rate | Correct deficiencies
| | Ensure proper operation | |
### 6.6205.1a Assessment Comment
Assessment will be done using ASHRAE 62.2 standard:
- Blower door test
- Fan flow measurements
- Calculations

<table>
<thead>
<tr>
<th>Determine the ventilation needs of the whole house</th>
</tr>
</thead>
</table>

### 6.6205.1b Selection Comment
Fan type will be capable of continuous operation and selected in accordance with ASHRAE 62.2 for:
- Sizing
- Climate considerations
- Control strategy
- Sone rating
- Durability

Fan will be ENERGY STAR qualified

<table>
<thead>
<tr>
<th>Determine proper fan selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize energy consumption during fan operation</td>
</tr>
</tbody>
</table>

### 6.6205.1c Location Comment
No resistance greater than 3 pascals will exist between fan intake location with reference to the common area

Exhaust ventilation for common spaces will not be installed in bathrooms or bedrooms

| Ensure fresh air distribution to common areas |

### 6.6205.1d Climate considerations Comment
ASHRAE 62.2 will be referenced for climate considerations

Whole house mechanical net exhaust flow for hot-humid climate will not exceed 7.5 cubic feet per minute/100 square feet

<table>
<thead>
<tr>
<th>Maintain building durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect occupant health</td>
</tr>
</tbody>
</table>

### 6.6205.1e Combustion Appliance Zone (CAZ) testing Comment
CAZ test will be performed where combustion appliances are utilized, where applicable

| Identify possible conditions that can cause unsafe equipment operating conditions |

### 6.6205.1f Occupant education Comment
Occupant will be educated on:
- Purpose of the ventilation system
- Proper operation and use of controls
- Cost and benefit of system
- Manual shut off

A label indicating the presence and purpose of the ventilation system will be included or a copy of the system operation guide will be posted at the electrical panel

Operation guide or label will be permanently attached and in full sight

<table>
<thead>
<tr>
<th>Ensure occupant is educated on the safe and efficient operation of the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deliver intended air exchange</td>
</tr>
</tbody>
</table>

### 6.6205.1g Total exhaust airflow Comment
Total exhaust system airflow will be measured

| Ensure exhaust airflow is as designed |

### 6.6206.1 Decommissioning Existing Exhaust or Supply Ventilation Systems

**Topic:** Whole Building Ventilation  
**Subtopic:** Equipment Removal  
**Desired Outcome:** Safely and properly eliminate fan

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
### 6.6206.1a Power supply

- **Comment**: Power supply will be disconnected and properly terminated in visible junction box
- **Safe removal of equipment**
- **Ensure worker safety**

### 6.6206.1b Fan components

- **Comment**: Fan components will be removed and disposed of lawfully
  - Duct work will be removed if necessary
  - Fan housing will be left in place, ducts will be removed, and leakage points will be air sealed
  - Hole will be sealed and insulated to preserve the thermal and pressure boundary
- **Remove fan**
- **Preserve aesthetics, and thermal and pressure boundary**

### 6.6206.1c Fan opening

- **Comment**: Fan opening will be sealed and insulated
  - If necessary, the void from the duct work removal will be insulated
  - Fan termination will be sealed
- **Maximize energy efficiency**
- **Preserve the thermal and pressure boundary**

### 6.6206.1d Combustion safety test

- **Comment**: Combustion safety test will be performed where combustion appliances are utilized
- **Identify possible conditions that can cause unsafe equipment operating conditions**

---

### 6.6288.2 Sound Ratings—New Fan Installation

**Topic**: Whole Building Ventilation

**Subtopic**: Special Considerations

**Desired Outcome**: Systems operate as quietly as possible

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.6288.2a Primary ventilation system/continuously operating fan</strong></td>
<td>System will be rated at a sound no greater than 1.0 sone</td>
<td>Minimize noise, Maximize fan use</td>
</tr>
<tr>
<td><strong>6.6288.2b Intermittent spot ventilation system</strong></td>
<td>Spot ventilation (local mechanical exhaust systems operated as needed by the occupant; e.g., range hood, bath fans) will be rated at a sound no greater than 3.0 sone</td>
<td>Minimize noise, Maximize fan use</td>
</tr>
</tbody>
</table>

---

### 6.9901.1 Supplemental Ventilation Information—ASHRAE 62.2

**Topic**: Additional Resources

**Subtopic**: Codes and Standards Resources

**Desired Outcome**: To provide supplemental ventilation information—ASHRAE 62.2

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.9901.1a Ventilation fan flow rate</strong></td>
<td>ASHRAE Standard 62.2-2013 and the calculation of the infiltration credit allow adjustments to primary ventilation fan flow rates for existing houses using a single fan.</td>
<td>To provide supplemental ventilation information—ASHRAE 62.2</td>
</tr>
</tbody>
</table>
Section 7: Baseload

7.8001.1 Refrigerator and Freezer Replacement

Topic: Plug Load
Subtopic: Refrigerators/Freezers
Desired Outcome: A more energy efficient appliance installed

For supporting material, see Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
<th></th>
</tr>
</thead>
</table>
| 7.8001.1a Selection Comment   | Appliance will have an efficiency level of at least 40% better than minimum federal requirements  
Appliance will fit in the available space without blocking access to light switches, cabinets, etc.  
Appliance will carry a minimum one-year warranty that will provide a replacement appliance if repeated issues relating to health, safety, or performance occur | Ensure occupant satisfaction with appliance          | 3057 |
| 7.8001.1b Installation Comment | Appliance will be installed in accordance with manufacturer specifications and local codes  
Any penetrations to the exterior of the home created by the installation of the appliance will be sealed  
Energy-related appliance controls will be demonstrated to the occupant  
Specific information on the proper maintenance of the equipment will be provided to the occupant  
Warranty information, operation manuals, and installer contact information will be provided to the occupant | Achieve intended appliance function  
Preserve food at low energy use  
Educate occupant on how to operate and maintain the appliance | 3058 |
| 7.8001.1c Decommissioning Comment | Appliances replaced by new units will be recycled or disposed of in accordance with federal, state, or local regulations  
Appliances infested with pests will be enclosed before moving | Prevent reuse of inefficient equipment and components  
Protect the environment  
Protect worker safety | 3059 |

7.8001.2 Cleaning and Tuning Existing Refrigerators and Freezers

Topic: Plug Load
Subtopic: Refrigerators/Freezers
Desired Outcome: Energy used for food preservation reduced

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
<th></th>
</tr>
</thead>
</table>
| 7.8001.2a Clean and tune Comment | Dirty or clogged coils will be cleaned  
Air flow to the coils will be provided in accordance with manufacturer specifications  
Appliance will be located away from heat sources (e.g., supply registers, direct sunlight) if possible  
Interior temperatures will be measured, and the appliance must maintain:  
  - Freezer temperature at 0°  
  - Fresh food at 35-40°  
Specific information about the proper maintenance of the equipment will be provided to the occupant  
Condensation control switch will be left in the appropriate position, given occupant preference and moisture load in the house | Reduce energy use  
Improve performance  
Educate occupant on how to operate and maintain the appliance | 3060 |

7.8002.1 Entertainment and Computer Systems and Components Replacement

Topic: Plug Load
Subtopic: Electronics
Desired Outcome: Energy used for electronic entertainment and computer use reduced while effective performance is maintained

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8002.1a Selection</td>
<td>Category of equipment selected will meet occupant preferences and have the lowest available energy use (e.g., plasma vs. light-emitting diode (LED))</td>
<td>Reduce energy use  Ensure occupant satisfaction with appliance</td>
</tr>
<tr>
<td></td>
<td>Equipment will have a minimum energy efficiency level of ENERGY STAR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment will be selected that does not have to be left on during non-use periods for updates (e.g., gaming systems, set-top boxes)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standby losses for system will be one watt or less</td>
<td></td>
</tr>
<tr>
<td>7.8002.1b Installation</td>
<td>Equipment will be installed in accordance with manufacturer specifications (e.g., air circulation) and meet all applicable codes</td>
<td>Reduce energy use  Ensure equipment is available for use when needed</td>
</tr>
<tr>
<td></td>
<td>Any penetrations to the exterior of the home created by the installation of the equipment will be sealed</td>
<td>Ensure equipment is convenient to turn off when not in use</td>
</tr>
<tr>
<td></td>
<td>All energy saving features will be enabled unless specifically directed otherwise by the occupant</td>
<td>Educate occupant on how to operate and maintain equipment</td>
</tr>
<tr>
<td></td>
<td>A readily accessible means of disconnection (e.g., power strip, timer) will be provided for equipment that must be disconnected from the power source to avoid standby losses and whose performance will not be damaged by being disconnected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All equipment controls will be demonstrated to the occupant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Specific information about the proper maintenance of the equipment will be provided to the occupant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warranty information, operation manuals, and installer contact information will be provided to the occupant</td>
<td></td>
</tr>
<tr>
<td>7.8002.1c Decommissioning</td>
<td>Equipment will be recycled or disposed of using Environmental Protection Agency (EPA) Responsible Recycling (R2) initiative principles</td>
<td>Prevent reuse of inefficient equipment and components  Reduce waste  Properly dispose of hazardous materials</td>
</tr>
</tbody>
</table>

### 7.8003.1 Lighting Upgrade

**Topic:** Plug Load  
**Subtopic:** Lighting  
**Desired Outcome:** Energy used for lighting reduced while maintaining adequate and safe lighting levels

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8003.1a Daylighting</td>
<td>Window coverings (e.g., blinds, shades, moveable insulation) will be replaced or maneuvered to maximize useful daylight where appropriate</td>
<td>Reduce energy use without negative consequences (e.g., glare, unintentional heating)</td>
</tr>
<tr>
<td></td>
<td>Active and passive daylighting will be properly oriented, designed, and installed where appropriate</td>
<td></td>
</tr>
</tbody>
</table>
### 7.8003.1b Selection

**Comment:**

All bulbs, fixtures, and controls will be appropriate for the intended application (e.g., enclosed, orientation, dimmable, potential for breakage, indoor and outdoor).

All bulbs, fixtures, and controls will be selected to provide the brightness and light quality required in that application (e.g., task lighting, trip-and-fall hazards, nightlights).

Selected equipment should have the highest level of efficiency within a technology [e.g., compact fluorescent lamp (CFL), LED].

All bulbs, fixtures, and controls will be ENERGY STAR rated where applicable.

When possible, bulbs, fixtures, and controls will be selected that will facilitate the use of future lighting technologies (e.g., LEDs).

When incandescent bulbs cannot be replaced or when occupant chooses not to replace, a dimmer will be selected.

Power quality will be evaluated before new lighting is selected.

Light/lamp wattage should not exceed rated wattage of fixture.

Bulb replacements will be chosen based on expected durability, light quality, and lifetime energy use of the bulb.

Controls to turn off lights when not needed (e.g., no one in room) will be provided.

All bulbs, fixtures, and controls will be UL-approved and installed in accordance with local code(s) and NFPA 70 National Electric Code.

Fluorescent light ballasts containing polychlorinated biphenyls (PCBs) will be replaced in accordance with the EPA’s Healthy Indoor Environment Protocols for Home Energy Upgrades.

**Objective(S):**

Provide improved lighting quality at lower energy use.

Select equipment that will not be an unnecessary barrier to future technologies.

Avoid inferior products and unsatisfied occupants.

---

### 7.8004.1 Washing Machine

**Topic:** Plug Load  
**Subtopic:** Laundry

**Desired Outcome:** Energy and environmental impact for washing clothes reduced

**Note:** The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

### 7.8004.1a Selection

**Comment:**

Minimum appliance efficiency will be ENERGY STAR and Water Sense or better.

Classes within ENERGY STAR standards will be considered so as to achieve greater savings.

Adequate clearance will be maintained around appliance when fit into available space so access to cabinets and light switches are not blocked.

Appliance will be covered by a minimum one-year warranty.

Equipment will be selected with features that reduce peak electric demand, absolute energy use, and water use.

Standby losses for equipment will be one watt or less.

**Objective(S):**

Reduce energy use.

Ensure occupant satisfaction with appliance.
### 7.8004.1b Installation

**Comment**

Appliance will be installed in accordance with manufacturer specifications (e.g., leveling, plumbing connection, electrical connection, interior lighting) and meet all applicable codes. Shut-off valves will be installed by a licensed plumber or other qualified contractor in accordance with the authority having jurisdiction, if not already present. Hoses that can withstand water pressure at the location will be installed. If located in conditioned or finished area, overflow pan will be installed and drained to a safe location. Any penetrations to the exterior of the home created by the installation of the appliance will be sealed. Energy-related appliance controls will be demonstrated to the occupant. Specific information about proper maintenance of the equipment will be provided to the occupant. Water quality will be evaluated using a pH and hardness tests, and the occupant will be informed on detergent levels and type to optimize performance. Warranty information, operation manuals, and installer contact information will be provided to the occupant.

<table>
<thead>
<tr>
<th>Desired Outcome:</th>
<th>Energy and environmental impact for drying clothes reduced</th>
</tr>
</thead>
</table>

**Specify**

- Ensure equipment functions as designed
- Reduce water consumption
- Prevent water damage
- Educate occupants on how to maintain washer to ensure savings

**Observe**

- Prevent the reuse of inefficient equipment and its components
- Reduce waste
- Ensure occupant health

---

### 7.8004.1c Decommissioning

**Comment**

Replaced appliances will be recycled or removed in accordance with local regulations, including older equipment switches containing mercury.

<table>
<thead>
<tr>
<th>Desired Outcome:</th>
<th>Energy and environmental impact for drying clothes reduced</th>
</tr>
</thead>
</table>

**Specify**

- Prevent the reuse of inefficient equipment and its components
- Reduce waste
- Ensure occupant health

---

### 7.8004.2 Clothes Dryer Replacement

**Topic:** Plug Load  
**Subtopic:** Laundry  
**Desired Outcome:** Energy and environmental impact for drying clothes reduced

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>Desired Outcome:</th>
<th>Energy and environmental impact for drying clothes reduced</th>
</tr>
</thead>
</table>

**Specify**

- Reduce energy use
- Avoid increasing total energy use (gas and electric) when fuel switching

---

### 7.8004.2a Selection

**Comment**

Total energy use will be factored into the selection process if fuel switching is being considered. Dryer will be equipped with moisture sensor. Equipment will be selected with energy features that reduce both peak electric demand and absolute energy use. Standby losses for equipment will be one watt or less. A dryer best matched to the venting options will be selected (e.g., central location, length of vent, cost of venting). Appliance will be covered by a minimum one-year warranty.

<table>
<thead>
<tr>
<th>Desired Outcome:</th>
<th>Energy and environmental impact for drying clothes reduced</th>
</tr>
</thead>
</table>

**Specify**

- Reduce energy use
- Avoid increasing total energy use (gas and electric) when fuel switching

---
**Installation**

Appliance will be installed in accordance with manufacturer specifications (e.g., leveling, plumbing connection, electrical connection, interior lighting) and meet all applicable codes.

If existing venting does not meet the following criteria (as well as manufacturer specifications and applicable codes), new venting will be installed using the following specifications:

- Appliance will be vented to the outside using metal-to-metal or UL-listed foil-type venting material.
- Venting design will meet standards for optimal venting.
- Venting will not be constricted or blocked.
- Only screws will be used to connect metal-to-metal and must not catch lint inside venting material.
- Only clamps will be used on semi-rigid metal and UL-listed foil-type venting materials.
- Pest screen will be installed at the termination.
- At least 3’ of the vent closest to the exterior of the house will be insulated with a minimum of R-6.

All dryers, other than condensing dryers, will be vented to the outdoors.

If a combustion appliance is used, combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single-Family Housing or other equivalent practice.

Any penetrations to the exterior of the home created by the installation of the appliance will be sealed.

Energy-related appliance controls will be demonstrated to the occupant.

Specific information of the proper maintenance of the equipment will be provided to the occupant.

Warranty information, operation manuals, and installer contact information will be provided to the occupant.

**Decommissioning**

Replaced appliances will be recycled or removed and disposed of in accordance with local regulations, including older equipment switches containing mercury.

Prevent the reuse of inefficient equipment and its components.

Reduce waste.

Ensure occupant health.

---

**7.8101.1 Shower Head and Faucet Aerator**

**Topic:** Water Heating

**Subtopic:** Water Use Reduction

**Desired Outcome:** Energy and water use reduced while occupant needs for water flow maintained.

**Note:** The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

### 7.8101.1.a Work assessment

Installer prework assessment will be conducted to determine if plumbing needs corrected before installing high-efficiency shower head or faucet.

Verify scope of work.

### 7.8101.1.b Selection

The rated flow of new shower heads will be 2.5 gallons per minute (GPM) or less.

If multiple heads are provided, the total flow rate will not exceed 2.5 GPM.

Aerator flow rate will be 2.2 GPM or less.

All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards.

Reduce water and energy consumption.

Ensure occupant satisfaction.
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8101.1c Installation</td>
<td>Equipment will be installed in accordance with manufacturer specifications and meet all applicable building codes</td>
<td>Reduce water and energy consumption</td>
</tr>
<tr>
<td></td>
<td>Water quality will be evaluated for debris that may clog the equipment</td>
<td>Ensure occupant satisfaction with water flow</td>
</tr>
<tr>
<td></td>
<td>Once installed, high-efficiency shower heads or faucet aerators will be tested to determine if equipment is tightened adequately to prevent leakage at the point of connection</td>
<td>Eliminate water leakage</td>
</tr>
<tr>
<td></td>
<td>If needed, shower diverter will be repaired or replaced</td>
<td>Prevent water damage</td>
</tr>
<tr>
<td></td>
<td>Any penetrations to the exterior of the home created by the installation of the equipment will be sealed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any damage done to the house during installation will be repaired</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Specific information about proper maintenance of the equipment will be provided to the occupant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warranty information, operation manuals, and installer contact information will be provided to the occupant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water flow that satisfies the occupant will be provided by all shower heads and faucet aerators</td>
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</tr>
<tr>
<td></td>
<td>Occupant's acceptance of the shower head and/or aerator will be documented</td>
<td></td>
</tr>
</tbody>
</table>

**7.8102.1 Water Heater Selection**

**Topic:** Water Heating  
**Subtopic:** Installation and Replacement  
**Desired Outcome:** Safe, reliable, and efficient hot water source selected that meets occupant needs at lowest possible cost of ownership and operation

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.
Selection parameters

Comment

Equipment will provide sufficient, affordable, safe, and healthy hot water for the occupant in accordance with 2012 IRC P2801

Potential for solar hot water heating or other renewable energy systems will be assessed in selecting the hot water equipment

Potential for health and safety hazards (e.g., back drafting, flame roll-out, obstructions) will be assessed in selecting equipment, and the cost of remediating such problems will be included in any cost and benefit calculations

If a combustion-based system is selected, it will be either direct vented or power vented, and ENERGY STAR® qualified or an Energy Factor (EF) of 0.58 or higher

If combustion equipment is selected, a low nitrogen oxide burner will be included

Equipment will be functional at high efficiency under all load conditions

Standby losses will be reduced to maximum potential

Fuel type will be selected based on affordability to occupant

Equipment will be freeze resistant or installed in a conditioned space

Efficiency of equipment will be maintained throughout life of system

Occupant control of hot water temperature will be provided on the equipment

The following will be determined from the occupant:

- Lifestyle
- Current and future needs
- Space considerations
- Fuel options
- Health and safety considerations
- Appliance options
- Maintenance and operation cost
- Return on investment concerns

Save energy and water

Protect the environment

Identify appliance options based on the needs and wants of the occupant

Product selection

Comment

Water heater will be selected based on performance requirements of the occupant, available fuel sources, energy efficiency, and total life cycle cost

In very cold climates, on-demand water heaters will be sized to meet the demand of water flow at very low water intake temperatures

When evaluating an existing thermal solar water heating system, a solar expert should be consulted

The proper installation and maintenance of solar hot water systems is provided in the Uniform Solar Energy Code (USEC) and 2012 IRC Chapter 23

Ensure equipment meets the occupant's expectations while providing efficient energy and water use

Storage-Type Appliance

Topic: Water Heating

Subtopic: Installation and Replacement

Desired Outcome: Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8102.2a</td>
<td>Hazardous material removal</td>
<td>Remediate health hazards using EPA-certified contractors</td>
</tr>
</tbody>
</table>

Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified

Written notification will be provided to occupants of the discovery of hazardous material, including contact information for regional EPA asbestos coordinator

Occupant will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation)
<table>
<thead>
<tr>
<th>TITLE</th>
<th>SPECIFICATION(S)</th>
<th>OBJECTIVE(S)</th>
</tr>
</thead>
</table>
| 7.8102.2b Equipment removal | **Comment** Accepted industry procedures and practices will be followed to:  
- Remove old water heater and associated components in accordance with 2012 IRC R105.1 or authority having jurisdiction  
- Seal any unused chimney openings and penetrations in accordance with 2012 IRC N1102.4.1.1 or authority having jurisdiction  
- Remove unused oil tank, lines, valves, and associated equipment in accordance with 2012 IRC M2201.7 or authority having jurisdiction  

All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards | **Objective**  
Ensure the safety of the workers and occupants  
Preserve integrity of the building  
Remove old equipment in a timely and efficient manner |
| **3079** |
| 7.8102.2c New equipment installation | **Comment** New water heater and associated components will be installed by a licensed contractor to accepted industry standards, in accordance with the 2012 IRC and manufacturer specifications  
The system will be installed to be freeze resistant  
Any existing water leaks will be repaired before installation begins  
Any penetrations to the exterior of the home created by the installation of the equipment will be sealed | **Objective**  
Ensure the safety of the workers and occupants  
Preserve integrity of the building  
Remove old equipment in a timely and efficient manner |
| **3080** |
| 7.8102.2d Emergency drain pan | **Comment** An emergency drain pan will be installed with sides that extend a minimum of 4” above floor if leakage would cause damage to the home and in accordance with P2801.5 of the 2012 IRC  
A ¾” drain line or larger will be connected to tapping on pan and terminated in accordance with P2801.5.2 of the 2012 IRC  

Collect and safely dispose of water escaping from the storage tank |
| **3081** |
| 7.8102.2e Expansion tank | **Comment** A potable water expansion tank will be installed on the cold water side  
A direct connection with no valves between the storage tank and expansion tank will be installed in accordance with the 2012 IRC, authority having jurisdiction, and according to manufacturer specifications  

Protect the storage tank from expansion |
| **3082** |
| 7.8102.2f Temperature and pressure relief valve | **Comment** Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications  
Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC  

Discharge excessive energy (pressure or temperature) from storage tank to safe location |
| **3083** |
| 7.8102.2g Dielectric unions | **Comment** Dielectric unions will be installed in accordance with the 2012 IRC, authority having jurisdiction, and according to manufacturer specifications  

Break the stray voltage electrical circuit through the storage tank |
| **3084** |
| 7.8102.2h Backflow prevention | **Comment** Backflow prevention will be installed in accordance with manufacturer specifications and all applicable codes  

Protect water supply from contamination |
| **3085** |
| 7.8102.2i Thermal efficiency | **Comment** If additional tank insulation is installed, it will be rated a minimum of R-11 and will be installed to manufacturer specifications  
If additional insulation is installed, it will be installed based on fuel type, making sure not to obstruct draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates  
The first 6’ of inlet and outlet piping will be insulated in accordance with manufacturer specifications  
Pipe insulation must remain 3” from gas water heater vent  
Heat traps will be installed on the inlet and outlet piping where not provided by manufacturer  

Reduce standby loss from near tank piping and storage tank  
Ensure insulation does not make contact with flue gas venting |
| **3086** |
| 7.8102.2j Fuel supply | **Comment** Electric or fossil fuel supply components will be installed to accepted industry standards as per NFPA 31 and 54, or NFPA 70 National Electric Code (NEC) for electric components, or authority having jurisdiction  

Provide sufficient fuel to the water heater, burner, or element |
| **3087** |
| 7.8102.2k Discharge temperature | **Comment** Discharge temperature will be set not to exceed 120° or as prescribed by local code  

Ensure safe hot water supply temperature to fixtures |
| **3088** |
### 7.8102.2 Commissioning of system

The following will be checked once the system has been filled and purged:

- Safety controls
- Combustion safety and efficiency
- Operational controls
- Fuel and water leaks
- Local code requirements

Commissioning will be in compliance with manufacturer specifications and relevant industry standards.

#### 7.8102.2m Occupant safety

Carbon monoxide alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction.

- Occupant will be provided information regarding the health effects and risk of high CO concentrations, as well as a list of monitors that can provide more detail regarding CO levels.
- Ambient CO to be maintained at or under 10 ppm or within acceptable limits as comparable to outside concentrations.

Ensure occupant life safety; CO alarms are designed to detect levels at which occupants might become unable to evacuate.

#### 7.8102.2n Occupant education

Completed work will be reviewed. Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature and target temperature in accordance with local code
- Periodic drain and flush
- Expansion tank and backflow preventer (no occupant maintenance required)
- Periodic inspection, maintenance, or replacement

Ensure occupant is informed of the safe, efficient operation and maintenance of the system.

---

**7.8102.3 On-Demand Appliance**

**Topic:** Water Heating  
**Subtopic:** Installation and Replacement  
**Desired Outcome:** Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

### 7.8102.3a Hazardous material removal

Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified.

- Written notification will be provided to occupants of the discovery of hazardous material, including contact information for regional EPA asbestos coordinator.
- Occupants will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation).

Remediate health hazards using EPA-certified contractors.
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| 7.8102.3b | Equipment removal | Ensure the safety of the workers and occupants  
Preserve integrity of the building  
Remove old equipment in a timely and efficient manner |
| | Accepted industry procedures and practices will be followed to: | |
| | • Remove old water heater and associated components in accordance with 2012 IRC R105.1 | |
| | • Seal any unused chimney openings and penetrations in accordance with 2012 IRC N1102.4.1.1 | |
| | • Remove unused oil tank, lines, valves, and associated equipment in accordance with 2012 IRC M2201.7 | |
| All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards | |
| 7.8102.3c | New equipment installation | Ensure the safety of the workers and occupants  
Preserve integrity of the building  
Remove old equipment in a timely and efficient manner |
| | A new water heater and associated components will be installed to accepted industry standards, in accordance with the 2012 IRC, authority having jurisdiction, and manufacturer specifications | |
| | All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction | |
| 7.8102.3d | Emergency drain pan | Collect and safely dispose of water escaping from the storage tank |
| | An emergency drain pan will be installed with sides that extend a minimum of 4" above floor if leakage would cause damage to the home and in accordance with P2801.5 of the 2012 IRC | |
| | A ¾" drain line or larger will be connected to tapping on pan and terminated in accordance with P2801.5.2 of the 2012 IRC | |
| 7.8102.3e | Temperature and pressure relief valve | Discharge excessive energy (pressure or temperature) from storage tank to safe location |
| | Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications | |
| | Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC | |
| 7.8102.3f | Dielectric unions | Break the stray voltage electrical circuit through the storage tank |
| | Dielectric unions will be installed to accepted industry standards, in accordance with the 2012 IRC, and according to manufacturer specifications | |
| 7.8102.3g | Backflow prevention and pressure regulator | Protect the water supply from contamination  
Provide for sufficient volume and pressure |
| | Backflow prevention will be installed in accordance with manufacturer specifications | |
| | House water pressure and volume will be verified as sufficient to be in accordance with manufacturer specifications | |
| | All applicable codes will be followed | |
| 7.8102.3h | Thermal efficiency | Reduce line losses |
| | Any accessible hot water lines at the appliance will be insulated to meet 2012 IRC N1103.4.2 or local requirements, whichever is greater | |
| 7.8102.3i | Required combustion air | Ensure adequate combustion air for operation of the appliance |
| | Recommendations will be made to install all on-demand appliances as sealed combustion | |
| | If not possible:  
Combustion and ventilation (excess air) requirements of gas-fired appliances, including provision of outside and inside air to account for building tightness, will be provided  
The minimum required volume shall be 50 cubic feet per 1,000 Btu/h in accordance with 2012 IRC G2407.5.1  
If needed, additional combustion air will be provided in accordance with 2012 IRC G2407 | |
| 7.8102.3j | Venting of flue gases | Ensure the safety and durability of the venting system |
| | Combustion byproducts will be removed in accordance with Chapter 24 of the International Residential Code (2012 IRC) and manufacturer specifications | |
| 7.8102.3k | Flue gas testing | Confirm that combustion is occurring safely with maximum efficiency |
| | Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012 | |
| | If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to manufacturer specifications or local codes | |
### 7.8102.3 Electric and fossil fuel supply

**Comment** Electric or fossil fuel supply components will be installed to accepted industry standards as per Chapter 24 of the 2012 IRC, the NFPA, NFPA 31, 54, and 58 for gas and oil, or NFPA 70 National Electric Code for electric.

Energy input required by the appliance will be in accordance with manufacturer specifications.

**Objective(s)**

1. Provide sufficient fuel to the water heater burner or element

### 7.8102.3m Cold water supply

**Comment** The volume and pressure of the water supplied to the appliance will be in accordance with manufacturer specifications.

**Objective(s)**

1. Provide sufficient volume and pressure of water to the appliance

### 7.8102.3n Discharge temperature

**Comment** Discharge temperature will be set in accordance with manufacturer instructions and in compliance with local codes.

Use extreme caution when temperature setting is above 120°F.

**Objective(s)**

1. Ensure safe hot water supply temperature to fixtures

### 7.8102.3o Commissioning of system

**Comment** The following will be checked once the system has been connected and filled:

- Safety controls
- Combustion safety and efficiency
- Operational controls
- Fuel and water leaks
- Cycle unit
- Local code requirements

Manufacturer specifications and all relevant industry standards will be met in commissioning.

**Objective(s)**

1. Ensure system functions safely with lowest possible cost of ownership

### 7.8102.3p Ambient CO

**Comment** All homes with combustion appliances or an attached garage will have a carbon monoxide (CO) alarm.

**Objective(s)**

1. Ensure occupant health and safety

### 7.8102.3q Occupant education

**Comment** Completed work will be reviewed.

Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature and target temperature in accordance with local code
- Operation of backflow preventer and pressure regulator (no occupant maintenance required)
- Importance of keeping operating manuals accessible

**Objective(s)**

1. Ensure occupant is informed of the safe, efficient operation and maintenance of the system

### 7.8103.1 Storage-Type Appliance

**Topic:** Water Heating  
**Subtopic:** Maintenance/Inspection  
**Desired Outcome:** Safe, reliable, and efficient operation of the appliance maintained

**Note:** The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

For supporting material, see Calculation of the Infiltration Credit and Referenced Standards.

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<td>7.8103.1a Health and safety</td>
<td>Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single-Family Housing or other equivalent practice. Electrical components will be verified to comply with NEC (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire).</td>
<td>Identify potential health and safety issues</td>
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<td>SPECIFICATION(S)</td>
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<tr>
<td>7.8103.1b</td>
<td><strong>Comment</strong></td>
<td><strong>Comment</strong></td>
</tr>
<tr>
<td><strong>Visual inspection</strong></td>
<td>Inspection will be conducted to show compliance with the 2012 IRC, including but not limited to:</td>
<td>Determine needed repairs or maintenance</td>
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<td></td>
<td>Water or fuel leaks</td>
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<td>Damaged wiring</td>
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<td>Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)</td>
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<td>Corrosion (e.g., rust, mineral deposits)</td>
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<tr>
<td></td>
<td>General condition of components</td>
<td></td>
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<tr>
<td>7.8103.1c</td>
<td><strong>Comment</strong></td>
<td><strong>Comment</strong></td>
</tr>
<tr>
<td><strong>Thermal efficiency</strong></td>
<td>Water heater storage tanks shall have a minimum R-value of R-24</td>
<td>Reduce standby losses from near tank piping and storage tank</td>
</tr>
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<td></td>
<td>Added insulation will not obstruct the unit’s draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates</td>
<td>Ensure insulation does not make contact with flue gas venting</td>
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<td>The first 6’ of inlet and outlet piping will be insulated in accordance with 2012 IRC N1103.4.2 or local requirements, whichever is greater</td>
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<tr>
<td>7.8103.1d</td>
<td><strong>Comment</strong></td>
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</tr>
<tr>
<td><strong>Potable water expansion tank</strong></td>
<td>A potable water expansion tank will be installed on the cold water side</td>
<td>Absorb water expansion of the system</td>
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<td>Tanks that leak or have excessive corrosion will be replaced</td>
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<td>A direct connection with no valves from the expansion tank to the storage tank will be installed</td>
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<td>Connection will be properly supported with strapping</td>
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<td></td>
<td>An expansion tank drain will be included in nonbladder tanks</td>
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<td>Tank will be installed to accepted industry standards, in accordance with the 2012 IRC and according to manufacturer specifications</td>
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<td>Tanks that are completely full of water will be drained and refilled before being replaced or repaired</td>
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<td>Expansion tanks with bladders will have air charged to the manufacturer pressure requirements while water is not present in the tank</td>
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<td>Bladder tanks with water inside of the air bladder will be replaced in accordance with manufacturer specifications</td>
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<td></td>
<td>All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards</td>
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<tr>
<td>7.8103.1e</td>
<td><strong>Comment</strong></td>
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<tr>
<td><strong>Temperature and pressure relief valve</strong></td>
<td>Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications</td>
<td>Discharge excessive energy (pressure or temperature) from storage tank to safe location</td>
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<td>Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC</td>
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<tr>
<td>7.8103.1f</td>
<td><strong>Comment</strong></td>
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</tr>
<tr>
<td><strong>Maintenance records</strong></td>
<td>Occupants will be advised to keep records of all maintenance done to their system</td>
<td>Provide a history of system installation and maintenance to improve chance of successful future maintenance or repair</td>
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<td>Copies of or access to installation and operation manuals will be provided</td>
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<tr>
<td>7.8103.1g</td>
<td><strong>Comment</strong></td>
<td><strong>Comment</strong></td>
</tr>
<tr>
<td><strong>Occupant safety</strong></td>
<td>Carbon monoxide alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction</td>
<td>Ensure occupant life safety</td>
</tr>
<tr>
<td></td>
<td>Occupant will be provided information regarding the health effects and risk of high CO concentrations, as well as a list of monitors that can provide more detail regarding CO levels</td>
<td>Inform occupant regarding possible CO hazards</td>
</tr>
<tr>
<td>7.8103.1h</td>
<td><strong>Comment</strong></td>
<td><strong>Comment</strong></td>
</tr>
<tr>
<td><strong>Occupant education</strong></td>
<td>Completed work will be reviewed</td>
<td>Ensure occupant is informed of the safe, efficient operation and maintenance of the system</td>
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<tr>
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<td>Occupants will be educated on the safe and efficient operation and maintenance of the system, including:</td>
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<td>Adjustment of water temperature and target temperature in accordance with local code</td>
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<td>Periodic drain and flush</td>
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<td>Periodic inspection, maintenance, or replacement of anode rod</td>
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</tbody>
</table>
# 7.8103.2 On-Demand Appliance

**Topic:** Water Heating  
**Subtopic:** Maintenance/Inspection  
**Desired Outcome:** Safe, reliable, and efficient operation of the appliance maintained

*Note: The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.*

For supporting material, see Referenced Standards and Calculation of the Infiltration Credit.

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<thead>
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</table>
| 7.8103.2a Health and safety | Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single-Family Housing or other equivalent practice  
Electrical components will be verified to comply with NFPA 70 National Electric Code (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire) | Identify potential health and safety issues | 3117 |
| 7.8103.2b Visual inspection | Inspection will be conducted to show compliance with the 2012 IRC, including but not limited to:  
- Water or fuel leaks  
- Damaged or missing pipe insulation and tank insulation, where applicable  
- Damaged wiring  
- Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)  
- Corrosion (e.g., rust, mineral deposits)  
- General condition of components | Determine needed repairs or maintenance | 3118 |
| 7.8103.2c Temperature and pressure relief valve | Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications  
Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC | Discharge excessive energy (pressure or temperature) from storage tank to safe location | 3119 |
| 7.8103.2d Flue gas testing | Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012  
If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to manufacturer specifications or local codes | Perform combustion testing | 3120 |
| 7.8103.2e Required combustion air | If sealed combustion has not been installed:  
- Combustion and ventilation (excess air) requirements of gas-fired appliances, including provision of outside and inside air to account for building tightness, will be provided  
- The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with 2012 IRC G2407.5.1  
- If needed, additional combustion air will be provided in accordance with 2012 IRC G2407 | Ensure adequate combustion air for operation of the appliance | 3121 |
<p>| 7.8103.2f Venting of flue gases | Condition of venting will be inspected in accordance with Section 504 IFGC, NFPA 54, or NFPA 58 for gas water heaters or NFPA 31 for oil water heaters, and authority having local jurisdiction | Verify proper venting of flue gases | 3122 |
| 7.8103.2g Fuel supply | Condition of fuel supply components will be checked in accordance with NFPA 31 for oil, NFPA 54 for gas, NFPA 58 for propane, or NFPA 70 National Electric Code for electric, and authority having jurisdiction | Verify sufficient fuel to the water heater burner and element | 3123 |
| 7.8103.2h Cold water supply | Water supplied to the appliance will be of sufficient volume and pressure to be in accordance with manufacturer specifications | Verify sufficient volume and pressure of water to the appliance | 3124 |</p>
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<tr>
<td>7.8103.2i Discharge temperature</td>
<td>Discharge temperature will be set not to exceed 120°F or in accordance with local code, whichever is lower</td>
<td>Ensure safe hot water supply temperature to fixtures</td>
</tr>
</tbody>
</table>
| 7.8103.2j Test the system safety and operation | The following will be tested:  
  - Safety controls (e.g., water, air pressure switches)  
  - Combustion safety and efficiency  
  - Operational controls  
  - Fuel and water leaks  
  - Unit runs through complete cycle  
  - Local code requirements  
  Manufacturer specifications and all relevant industry standards will be met | Ensure system functions safely with lowest possible cost of ownership |
| 7.8103.2k Maintenance records | Occupants will be advised to keep records of all maintenance done to their system  
Copies of or access to installation and operation manuals will be provided | Improve chance of successful future maintenance or repair |
| 7.8103.2l Occupant health and safety | All homes will have a carbon monoxide (CO) alarm | Ensure occupant health and safety |
| 7.8103.2m Occupant education | Completed work will be reviewed  
Occupants will be educated on the safe and efficient operation and maintenance of the system, including:  
  - Adjustment of water temperature  
  - Target temperature in accordance with local code | Ensure occupant is informed of the safe, efficient operation and maintenance of the system |
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