Georgia Weatherization Assistance Program - Manufactured Housing Field Guide - February 2019

Weatherization Works

Standard Work Specifications
Field Guide for
Manufactured Housing
created by

Georgia Environmental Finance Authority
Summary

The Georgia Weatherization Assistance Program (WAP) Manufactured Housing Field Guide was developed to align with the U.S. Department of Energy (DOE) Standard Work Specifications (SWS) for Manufactured Housing Energy Upgrades and to support and promote high quality work. This guide was created through a collaborative effort between Southface Energy Institute, Santa Fe Community College, and other participating DOE Weatherization Training Centers. It includes text and photo guides to assist Retrofit Installer Technicians, Crew Leaders, Energy Auditors, and Quality Control Inspectors with effectively performing the tasks required by the WAP. All sections in this Field Guide follow the requirements set forth by the SWS. All tasks and methods outlined in this Field Guide define measure installation and diagnostic testing best practices that should be followed throughout the state.

Codes and Standards

While the SWS and Georgia Weatherization Manufactured Housing Field Guide 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. 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.
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2.0100.1 - Global Worker Safety

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.

2.0100.1b - Hand protection

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Durable and wrist-protecting gloves will be worn that can withstand work activity

Objective(s):
Minimize skin contact with contaminants

Protect hands from hazards

Unsafe
Recognize potential risks

Safe
Wear appropriate hand protection
GOOD: Wear nitrile gloves when handling mastic

Inspect gloves for holes and damage to minimize risk
2.0100.1 - Global Worker Safety

**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.

2.0100.1c - Respiratory protection

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

**Specification(s):**
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

When applying high-pressure SPF insulation, supplied air respirators (SARs) will be used

Consult MSDS for respiratory protection requirements

OSHA 1910.134 shall be followed for the implementation of a respiratory protection program

**Objective(s):**
Minimize exposure to airborne contaminants (e.g., insulation materials, mold spores, feces, bacteria, chemicals)
Unsafe

Workers need to properly protect their airways when retrofitting

Best Practice

Retrofits can have multiple different respiratory protection requirements

Whenever airborne contaminants are a possibility, wear an N-95 mask

For two-component spray insulation, P-100 respirators should be used

All P-100s should be fitted to the individual worker

When working with high-pressure spray foam, use a Supplied Air Respirator

Safety Data Sheets (SDS) are required to replace MSDS as of June 2015; binders and signs may still be labeled as MSDS

When unsure what level of protection is necessary, check the SDS
2.0100.1 - Global Worker Safety

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.

2.0100.1h - Power tool safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Power tools will be inspected and used in accordance with manufacturer specifications and OSHA regulations to eliminate hazards such as those associated with missing ground prongs, ungrounded circuits, misuse of power tools, noise, and improper or defective cords or extension cords. All tools must be maintained in proper operating condition with all guards securely in place.

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.

Objective(s):
Prevent power tool injuries

Prevent buildup of toxic or flammable contaminants
Bad Practice
Worker is using a circular saw with no eye or ear protection, and is not properly supporting the material to be cut.

Best Practice
Worker is cutting off of a stable surface, with appropriate eye and ear protection.

Inspect power and extension cords closely for damage. Follow manufacturer's instructions for repair or replacement.

Generator has been moved off the trailer to ensure no buildup of harmful exhaust gases.
2.0100.1 - Global Worker Safety

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.

2.0100.1j - Ergonomic safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
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

Objective(s):
Prevent injuries from awkward postures, repetitive motions, and improper lifting

Unsafe
Workers will take precautions to protect themselves on the job site

Best Practice
Hard hats, knee pads, bump caps, and team lifts help to prevent injury

2.0101.1 - Air Sealing Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0101.1a - Worker safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Worker safety specifications will be in accordance with SWS Global Worker Safety

Complete safety action plan based on hazard; plan will be in place for each job site

Objective(s):
Prevent injury

Minimize exposure to health and safety hazards
2.0101.1 - Air Sealing Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0101.1b - Moisture precautions for crawl spaces and basements

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Exposed earth will be covered with a continuous, durable, and sealed class I vapor retarder that is suitable for ground contact exposure to normal service traffic

Causes of air dew points greater than 55°F will be identified and eliminated in crawl spaces connected to conditioned spaces

Seasonal dehumidification (e.g., dehumidified or conditioned with air conditioner supply) will be recommended where humidity sources, including outdoor air incursion, cannot be eliminated

Undesigned penetrations between the crawl space or basement and the outdoors will be sealed

Holes between the crawl space or basement and the living space will be sealed

Open sumps and intentional slab or vapor barrier penetrations will be sealed or capped to control moisture and radon levels

Objective(s):
Ensure durability of repairs

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

Reduce potential for occupant exposure to radon and other soil gases
2.0101.1 - Air Sealing Worker Safety

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

2.0101.1c - Moisture precautions: living space

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

**Specification(s):**
Moisture sources in the building will be identified and reduced or removed

Where local ventilation will be installed, (e.g., baths, kitchens), exhaust units will be vented to the outdoors in accordance with ASHRAE 62.2

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

Unvented gas or propane cooking stoves will be tested for carbon monoxide (CO) per BPI Standard and corrected as required before air sealing work begins

If replacing air conditioning system, new system will be sized to optimize dehumidification

Properly sized dehumidifier will be installed to satisfy latent and sensible loads, when necessary

ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) will be used to size replacement AC and heat pumps

Enhanced dehumidification will be installed in the Gulf Coast region areas on the Gulf side of the warm humid line on the International Energy Conservation Code map

**Objective(s):**
Ensure durability of building components and repairs

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

Reduce potential occupant exposure to CO
2.0101.1 - Air Sealing Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0101.1d - Moisture precautions for exterior water

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Before air sealing and insulating building components, exterior water management will be addressed

Before insulating 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) will be in accordance with EPA Indoor airPLUS Construction Specifications Section 1.1

Objective(s):
Reduce potential for occupant exposure to mold and other moisture-related hazards
2.0102.1 - Insulation Worker Safety

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

2.0102.1a - Worker safety

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

**Specification(s):**
Worker safety specifications will be followed in accordance with SWS 2.0100 Global Worker Safety

**Objective(s):**
Prevent injury

Minimize exposure to health and safety hazards
2.0102.1 - Insulation Worker Safety

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

2.0102.1b - Asbestos containing materials (ACM)

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

Specification(s):
OSHA asbestos abatement protocol 29 CFR 1926.1101 will be followed if vermiculite insulation is present

Assess potential asbestos hazard; if unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material, and to sample and test as needed

If suspected ACM is in good condition, do not disturb

If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s)

For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair, in accordance with federal, state, and local requirements; only a licensed or trained professional may abate, repair, or remove ACM

When working around ACM, do not:

- Dust, sweep, or vacuum ACM debris
- Saw, sand, scrape, or drill holes in the material
- Use abrasive pads or brushes to strip materials

Asbestos abatement or repair work should be completed prior to blower door testing; exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing) unless the material has been tested and found not to contain asbestos

Objective(s):
Protect workers and occupants from potential asbestos hazards
2.0102.1 - Insulation Worker Safety

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

2.0102.1c - Materials

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

Specification(s):
All materials will be handled in accordance with manufacturer specifications or material safety data sheets (MSDS) standards

Objective(s):
Eliminate hazards associated with incorrect, defective, or improperly used or installed materials
2.0102.1 - Insulation Worker Safety

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

2.0102.1d - Lead paint assessment

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

**Specification(s):**
Presence of lead based paint in pre-1978 homes will be assumed unless testing confirms otherwise

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 rule making or any more stringent state or federal standards

**Objective(s):**
Protect worker and occupant from potential lead hazards
2.0103.2 - Heating and Cooling Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0103.2b - Mercury

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
When replacing existing thermostats, identify and dispose of any mercury containing thermostats in accordance with Environmental Protection Agency (EPA) guidance

Objective(s):
Protect worker and occupant from mercury exposure

Unsafe
Mercy thermostats should be replaced and disposed of properly

Unsafe
Do NOT dispose of mercury thermostats in the trash–find local recycling

Paraphrased from 40 CFR 273.14: A universal waste mercury-containing thermostat or container containing only universal waste mercury-containing thermostats should be labeled or marked clearly with any of the following phrases: "Universal Waste-Mercury Thermostat(s)," "Waste Mercury Thermostat(s)," or "Used Mercury Thermostat(s)." **Contact thermostat-recycle.org or earth911.org for recycling options.
2.0103.2 - Heating and Cooling Worker Safety

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

2.0103.2c - Asbestos

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

**Specification(s):**
Suspected asbestos hazards will be identified in furnaces (e.g., gaskets), wood stoves, zonal heating devices, electrical wiring insulation, boilers, and pipe insulation and corrected in accordance with EPA guidance

Workers will take precautionary measures to avoid exposure

**Objective(s):**
Protect worker and occupant from asbestos exposure

Unsafe
Have an AHERA-certified professional test all areas with suspected asbestos. Remediate in accordance with EPA rules.

Refer to Georgia Weatherization Health and Safety Plan.
2.0103.2 - Heating and Cooling Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0103.2d - Personal protective equipment (PPE)

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Workers will wear personal protective equipment (PPE) as needed to protect themselves against exposure to hazards (e.g., pests, sewage, flooded duct work, mold, chemicals, scat, viruses)

Long sleeves and long pants should be worn as additional protection from liquid nitrogen and other hazardous materials

Objective(s):
Protect worker from exposure to hazards

Protect worker from skin contact with liquid nitrogen

Unsafe
When working with refrigerants, short sleeves are inappropriate

Safe
When working with refrigerants, workers should dress appropriately
Wear work gloves when working with metal ducts

Assess the site and situation to determine proper PPE to minimize risks
2.0103.2 - Heating and Cooling Worker Safety

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

2.0103.2e - Combustible gas detection

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

**Specification(s):**
Worker will check for presence of combustible gas leaks before work begins

Leaks will be repaired before work is performed

**Objective(s):**
Protect worker and occupant from exposure to hazards

---

**Tools:**
1. Combustion gas detector
2. Spray bottle

**Materials:**
1. Noncorrosive leak detection fluid

Leakage will be located using an approved combustible gas detector, a noncorrosive leak detection fluid or an equivalent nonflammable solution. Matches, candles, open flames or other methods that could provide a source of ignition cannot be used. Where leakage or other defects are located, the affected portion of the piping system will be repaired or replaced and retested.
Fuel leaks discovered during initial audit should be flagged

Use approved combustion gas sniffer to see if repaired line still leaks

Repeatedly test repair site for leakage over a 10 minute period

Allow testing solution to sit on newly repaired pipe joint for 10 minutes

Confirm repair and remove flag
2.0103.2 - Heating and Cooling Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0103.2f - Carbon monoxide (CO)

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Workers will check for presence of ambient CO before and during work

CO issues will be addressed before work is performed or continued

Objective(s):
Protect worker and occupant from exposure to hazards

Unsafe
STOP WORK if CO levels are higher than 35ppm!!

Tools:
1. Personal CO detector

Technicians in the field must have a dedicated CO monitoring device on their person to monitor ambient CO levels independent of the combustion analyzer.
2.0105.1 - Baseload Worker Safety

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

2.0105.1a - Worker safety

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

**Specification(s):**
All worker safety specifications in SWS 2.0100 Global Worker Safety section will be followed

**Objective(s):**
Prevent injury

Minimize exposure to health and safety hazards
2.0105.2 - Licensed Electrical Professional

Desired Outcome:
Work completed safely without injury from shock or arc flash

2.0105.2a - Worker safety

Desired Outcome:
Work completed safely without injury from shock or arc flash

Specification(s):
Any fixture, ballast, line voltage control, receptacle, or circuit modification will be performed by a licensed electrical professional in accordance with ANSI/NFPA 70 or as required by the authority having jurisdiction

All workers will comply with ANSI/NFPA 70E

All OSHA standard practices will be followed

Objective(s):
Prevent property damage

Ensure worker safety
2.0106.1 - Material Selection, Labeling, and Material Safety Data Sheets (MSDSs)

**Desired Outcome:**
Occupant and worker risk from hazardous materials minimized

2.0106.1a - Material selection

**Desired Outcome:**
Occupant and worker risk from hazardous materials minimized

**Specification(s):**
Materials that do not create long-term health risks for occupants and workers will be used

**Objective(s):**
Improve indoor air quality in the living space
2.0106.1 - Material Selection, Labeling, and Material Safety Data Sheets (MSDSs)

**Desired Outcome:**
Occupant and worker risk from hazardous materials minimized

2.0106.1b - Material labels

**Desired Outcome:**
Occupant and worker risk from hazardous materials minimized

**Specification(s):**
Manufacturer specifications will be followed

**Objective(s):**
Reduce risk of exposure to harmful substances

Follow safety procedures
2.0106.1 - Material Selection, Labeling, and Material Safety Data Sheets (MSDSs)

Desired Outcome:
Occupant and worker risk from hazardous materials minimized

2.0106.1c - Material Safety Data Sheets (MSDSs)

Desired Outcome:
Occupant and worker risk from hazardous materials minimized

Specification(s):
MSDSs will be provided onsite and available during all work

Objective(s):
Assess exposure risk
Prepare a response in case of emergency
2.0107.5 - Prework Qualifications (Home Installation)

Desired Outcome:
Manufactured home is properly installed

2.0107.5a - Installation deficiencies

Desired Outcome:
Manufactured home is properly installed

Specification(s):
Any installation deficiencies that may affect worker safety or integrity or installed measures will be repaired before starting work

Objective(s):
Ensure site is safe and ready for upgrade

Unsafe
The concrete pad is not centered under the pier, rendering the pier susceptible to tilting or collapse

Safe
Approved, properly installed piers, anchors, and tie downs

Tools:
1. Level
2. Cordless driver drill
3. Flashlight

Inspect homes for safety before work. Look for stuck doors and windows, buckled siding, and loose tie-downs as evidence of settling. Inspect piers to ensure that they are solid and level. Check for loose or missing wooden shims and wedges. Inspect anchors and straps for tightness and proper installation per manufacturer's recommendations.
Carefully inspect the foundation piers. Look for loose or missing shims and wedges.
2.0201.1 - Combustion Appliance Zone (CAZ) Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.1a - Assessment

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Emergency problems (e.g., ambient gas levels greater than 10% Lower Explosion Limit (LEL), ambient CO levels that exceed 70 ppm) will be communicated clearly and immediately to the customer, the home shall be evacuated, and appropriate personnel (e.g.: HVAC technician, utility, emergency services) shall be contacted.

Significant problems (e.g., gas leak less than 10% LEL, ambient CO levels that exceed 35 ppm but less than 70 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested

Examine appliance for signs of damage, misuse, improper repairs, and lack of maintenance

Objective(s):
Ensure system does not have potentially fatal problems
2.0201.1 - Combustion Appliance Zone (CAZ) Testing

**Desired Outcome:**
Accurate information about appliance safe operation is gathered

2.0201.1b - Fuel leak detection

**Desired Outcome:**
Accurate information about appliance safe operation is gathered

**Specification(s):**
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

**Objective(s):**
Detect fuel gas leaks

Determine and report need for repair
2.0201.1 - Combustion Appliance Zone (CAZ) Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.1d - Base pressure test

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Baseline pressure for naturally drafting vented appliances will be measured in Combustion Appliance Zone with reference to outdoors

Objective(s):
Measure pressure difference between combustion zone and the outside under natural conditions
2.0201.1 - Combustion Appliance Zone (CAZ) Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.1e - Depressurization test

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
CAZ depressurization testing will be administered for all atmospherically vented appliances located inside the pressure boundary.

Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof; the test will be done to determine the largest negative pressure per BPI Standard 1200.

Objective(s):
Determine worst-case depressurization in combustion zone due mechanical system fans
2.0201.2 - Combustion Safety - Make-up Air

**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.

2.0201.2a - Outside combustion make-up air

**Desired Outcome:**
Buildup of dangerous combustion byproducts in the living space prevented

**Specification(s):**
Where applicable, combustion air will be provided from the outside and installed in accordance with the IRC for the type of appliance installed

**Objective(s):**
Prevent combustion byproducts from entering the house
2.0201.2 - Combustion Safety - Make-up Air

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.

2.0201.2b - New appliances

Desired Outcome:
Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):
If replacing appliances, a sealed-combustion, direct-vent appliance will be installed if possible. New appliances will be installed in accordance with manufacturer specifications, the IRC and additional applicable codes

Objective(s):
Prevent combustion byproducts from entering the house
2.0201.2 - Combustion Safety - Make-up Air

**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.

2.0201.2c - CO detection and warning equipment

**Desired Outcome:**
Buildup of dangerous combustion byproducts in the living space prevented

**Specification(s):**
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

**Objective(s):**
Alert occupant to CO exposure
2.0201.2 - Combustion Safety - Make-up Air

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.

2.0201.2d - Gas ovens

Desired Outcome:
Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):
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 225 ppm as measured

Objective(s):
Ensure clean burn of gas ovens
2.0201.2 - Combustion Safety - Make-up Air

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.

2.0201.2e - Gas range burners

Desired Outcome:
Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):
Specify clean and tune if the flame has any discoloration, flame impingement, an irregular pattern, or if burners are visibly dirty, corroded, or bent

Objective(s):
Ensure clean burn and operation of gas range burners
2.0201.2 - Combustion Safety - Make-up Air

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.

2.0201.2f - Solid fuel burning appliances

Desired Outcome:
Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):
If the solid fuel burning appliance is the primary heat source and has signs of structural failure replace solid fuel burning appliance with UL-listed and EPA - certified appliances if the existing appliance is not UL-listed

Objective(s):
Ensure safe operations of solid fuel burning appliances
2.0201.3 - Vented Combustion Appliance Safety Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.3a - Spillage Test

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
In conditions with largest negative pressure as determined from Detail 2.0201.1e:

If spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate

If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate

Objective(s):
Detect excessive spillage of combustion gases

For all homes with combustion appliances:

• If the gas supplier has shut off and locked the gas valve at the meter or the propane tank is empty, and the client states they are not and will not be using the appliance(s), then the client must remove the appliance(s) or disable them by disconnecting and capping off the gas line.
• Since no combustion safety testing was performed, there is no liability on the agency’s part should the client later restore fuel to the appliance(s).
• If the client refuses to have the system disabled, defer the home.
• If it appears that the client intends to restore the fuel supply and return the combustion appliance(s) to service, defer the home until combustion safety testing can be performed on them.
• Document everything in writing and obtain a client signature to acknowledge the conditions.

All open combustion appliances must either be isolated in a sealed enclosure or replaced with a sealed combustion or direct vent appliance rated for manufactured home use. Also see SWS specifications 2.0204.1b and 2.0204.1d.
2.0201.3 - Vented Combustion Appliance Safety Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.3b - Carbon monoxide (CO) test in appliance vent

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
CO will be tested for in undiluted flue gases of combustion appliances

In conditions with largest negative pressure as determined from Detail 2.0201.1e:

If CO levels exceed 400 ppm air-free measurement in furnaces, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)

If CO levels exceed 200 ppm air-free measurement in water heaters or room heaters, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)

Objective(s):
Measure CO and report excessive levels
2.0201.3 - Vented Combustion Appliance Safety Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.3c - Final test out

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Final combustion testing will be conducted at project completion to ensure compliance with the above specifications

Objective(s):
Ensure safe operation of combustion appliance within the whole house system after any repair project

Unsafe
If venting system puts occupants at risk, it needs immediate attention

Safe
Properly vented appliances make a house healthier and more efficient
Inspect venting systems for damage
Inspect venting systems for disconnected pipes
Inspect venting systems for inadequate slope
Inspect for missing draft diverter
2.0202.1 - Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters

**Desired Outcome:**
Elimination of combustion byproducts

**2.0202.1a - Removal**

**Desired Outcome:**
Elimination of combustion byproducts

**Specification(s):**
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

**Objective(s):**
Eliminate sources of combustion byproduct within a living space
2.0202.1 - Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters

Desired Outcome:
Elimination of combustion byproducts

2.0202.1b - Occupant education

Desired Outcome:
Elimination of combustion byproducts

Specification(s):
Occupant will be educated on potential hazards of unvented combustion appliances (primary or secondary) within a living space

Objective(s):
Inform occupant about possible hazards associated with combustion byproducts and moisture
2.0203.1 - Combustion Air for Natural Draft Appliances

Desired Outcome:
Sufficient air provided in the Combustion Appliance Zone (CAZ)

2.0203.1a - Required combustion air

Desired Outcome:
Sufficient air provided in the Combustion Appliance Zone (CAZ)

Specification(s):
The required volume of indoor air will be determined in accordance with IRC and authority having jurisdiction, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), IRC will be used

Exception: Existing appliances that have passed combustion safety testing per BPI 1200 are deemed to have sufficient combustion air

Objective(s):
Determine if existing conditions meet the combustion air calculation

Best Practice
Measure the volume available for combustion air to ensure actual volume present exceeds calculated volume.

G2407.5.1 (304.5.1) Standard method. The minimum required volume shall be 50 cubic feet per 1,000 input Btu/h. G2407.5.2 (304.5.2) Known air-infiltration-rate method. Where the air infiltration rate of a structure is known, the minimum required volume shall be determined as follows:

For appliances other than fan assisted, calculate volume using Equation 24-1. Required Volume(natural draft) ≥( (21ft3/ACHn)*(Input(other)/1,000BTU/hr)) where: Input(other) = All appliances other than fan assisted (input in Btu/h), and ACH = Air changes per hour under natural
conditions. For purposes of this calculation, an infiltration rate greater than 0.60 ACH shall not be used in Equations 24-1.
2.0203.1 - Combustion Air for Natural Draft Appliances

Desired Outcome:
Sufficient air provided in the Combustion Appliance Zone (CAZ)

2.0203.1b - Additional combustion air (if action is required)

Desired Outcome:
Sufficient air provided in the Combustion Appliance Zone (CAZ)

Specification(s):
Additional combustion air will be provided in accordance with IRC and authority having jurisdiction when necessary to solve spillage problems

Objective(s):
Ensure adequate combustion air for operation of the appliance

Tools:
1. Drywall saw
2. Drill
3. Tin snips
4. Tape measure

Materials:
1. Metal ducts
2. Galvanized straps or L-brackets to secure high/low vents
3. Screws
4. Louvered grilles (optional)
5. Louvered doors (optional)

Combustion appliances require 50 cubic feet of volume for every 1,000 Btuh input. If this is not available, provide makeup air in accordance with the IRC G.2407 or local code.
When high/low vents are used, use two metal ducts each having 1 square inch of cross-sectional area for every 4,000 Btuh input. Extend each into the attic above the insulation level. Terminate one vent within 12" of the ceiling, and one vent within 12" of the floor. The vents may be concentric (one inside the other) to save space, so long as the difference between the area of the larger and smaller vents is equal to or greater than the 1 square inch/4,000 Btuh requirement.

If using a single large opening in the ceiling, make the opening total 1 square inch per 3,000 Btuh input.

If high/low vents extend horizontally through a CAZ wall, use vents with 1 square inch of area per 2,000 Btuh of input.

Louvered grilles or doors may be used to connect the CAZ to larger sections of the home to achieve the required volume, but be aware that using this approach has higher potential for creating a carbon monoxide pathway into the home than does creating a sealed CAZ with high/low vents.
2.0203.1 - Combustion Air for Natural Draft Appliances

Desired Outcome:
Sufficient air provided in the Combustion Appliance Zone (CAZ)

2.0203.1c - Spillage testing

Desired Outcome:
Sufficient air provided in the Combustion Appliance Zone (CAZ)

Specification(s):
If spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate

If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate

Objective(s):
Detect excessive spillage of combustion gases

Tools:
1. Smoke pencil
2. Stopwatch or timer
3. Mirror

Natural draft appliances must be tested for spillage

Unsafe

Spillage must not exceed 2 minutes in warm vent and 5 minutes in cold vent
Inspect appliance for evidence of damage or unsafe operation before testing

Fire up appliance in order to test
2.0203.2 - Combustion Flue Gas—Orphaned Water Heaters

Desired Outcome:
Flue gases successfully removed from the house

2.0203.2d - Required combustion air

Desired Outcome:
Flue gases successfully removed from the house

Specification(s):
The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with IRC and authority having jurisdiction.

Exception: Existing appliances that have passed combustion safety testing per BPI 1200 are deemed to have sufficient combustion air.

Objective(s):
Determine if existing conditions meet the combustion air calculation

Best Practice
Measure the volume available for combustion air to ensure actual volume present exceeds calculated volume.
2.0203.2 - Combustion Flue Gas—Orphaned Water Heaters

Desired Outcome:
Flue gasses successfully removed from the house

2.0203.2e - Additional combustion air (if action is required)

Desired Outcome:
Flue gasses successfully removed from the house

Specification(s):
Additional combustion air will be provided in accordance with IRC or other authority having jurisdiction

Objective(s):
Ensure adequate combustion air for operation of the appliance

Tools:
1. Drywall saw
2. Drill
3. Tin snips
4. Tape measure

Materials:
1. Metal ducts
2. Galvanized straps or L-brackets to secure high/low vents
3. Screws
4. Louvered grilles
5. Louvered doors

Combustion appliances require 50 cubic feet of volume for every 1,000 Btuh input. If this is not available, provide makeup air in accordance with the IRC G.2407 or local code
Select vent sizes based on the total input Btus in the CAZ. Concentric vents are shown.

Cut hole in ceiling and mount high/low vents to framing.

Complete installation by adding supports and fasteners as required for stability and durability.

Terminate low vent within 12" of the floor. This one is fastened to a section of larger diameter duct for stability.
2.0203.4 - Occupant Education

Desired Outcome:
Ensure persistence of resident safety

2.0203.4a - Occupant health and safety

Desired Outcome:
Ensure persistence of resident safety

Specification(s):
All homes will have a functioning CO alarm

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 weather stripping or conduct air sealing between the garage or crawl space and the home)

Objective(s):
Ensure occupant health and safety

Ensure indoor CO levels do not exceed outdoor CO levels
2.0203.4 - Occupant Education

**Desired Outcome:**
Ensure persistence of resident safety

2.0203.4b - Occupant education

**Desired Outcome:**
Ensure persistence of resident safety

**Specification(s):**
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 risk of high CO concentrations; EPA provides possible expanded actions and offers client education information in an appendix to the protocols

**Objective(s):**
Ensure occupant can operate and maintain installations

Inform occupant regarding possible CO hazards
2.0204.1 - Isolating Combustion Water Heater Closet

Desired Outcome:
Isolate combustion water heater closet from conditioned space

Note:

2.0204.1d - Post-work testing/verification

Desired Outcome:
Isolate combustion water heater closet from conditioned space

Specification(s):
Blower door assisted zonal pressure diagnostics will be used to verify isolation has been achieved

Objective(s):
Prevent combustion gases from entering living area

Tools:
1. blower door assembly
2. manometer
3. 1/4" hose
4. steel tube or probe
5. drill

If not isolated, water heater must be direct vent or tankless. If isolated, ensure adequate combustion air is available.
Ensure the house is depressurized to -50 pascals before performing zonal pressure diagnostics.
2.0301.1 - Smoke Alarm

**Desired Outcome:**
Properly installed smoke alarms

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

2.0301.1a - Smoke alarm (hardwired)

**Desired Outcome:**
Properly installed smoke alarms

**Specification(s):**
When installing hardwired smoke alarms, it will be listed and labeled in accordance with UL 217 and installed in accordance with the IRC or as required by the authority having jurisdiction

**Objective(s):**
Ensure proper installation

Unsafe
Hard-wired smoke alarm mount with alarm missing

Safe
Hard-wired smoke alarm mount with alarm replaced
2.0301.1 - Smoke Alarm

**Desired Outcome:**
Properly installed smoke alarms

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

2.0301.1b - Smoke alarm (battery operated)

**Desired Outcome:**
Properly installed smoke alarms

**Specification(s):**
When installing battery operated smoke alarms, it will be installed in accordance with manufacturer specifications

**Objective(s):**
Ensure proper installation
2.0301.2 - Carbon Monoxide Alarm or Monitor

**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.

2.0301.2b - CO detection and warning equipment (battery operated)

**Desired Outcome:**
Properly installed CO alarms or monitors

**Specification(s):**
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(s):**
Ensure proper installation
2.0401.1 - Air Sealing Moisture Precautions

Desired Outcome:
Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

2.0401.1a - Moisture precautions for attics

Desired Outcome:
Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

Specification(s):
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

Where possible, water resistant sealants and/or closed cell foams will be used 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(s):
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.

Increase durability of seal

Avoid moisture-related damage to the home
2.0401.1 - Air Sealing Moisture Precautions

Desired Outcome:
Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

2.0401.1b - Moisture precautions for crawl spaces

Desired Outcome:
Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

Specification(s):
Exposed earth will be covered with a continuous, durable, sealed Class 1 vapor retarder a minimum of 6 mils in thickness

Any vapor retarder shall not encapsulate wood building materials or spray foam

Holes between the crawl space and the living space will be sealed

Objective(s):
Ensure durability of repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards
2.0401.1 - Air Sealing Moisture Precautions

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

2.0401.1c - Moisture precautions for the living space

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

**Specification(s):**
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

Unvented combustion appliances that are not listed to ANSI Z21.11.2 will be removed

**Objective(s):**
Ensure durability of repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards
2.0401.1 - Air Sealing Moisture Precautions

Desired Outcome:
Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

2.0401.1d - Moisture precautions for exterior water

Desired Outcome:
Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

Specification(s):
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 Environmental Protection Agency (EPA) Indoor airPLUS Construction Specifications Section 1.1
- Possible mitigation by waterproofing or installing draining plane with construction adhesive

Objective(s):
Reduce potential for occupant exposure to mold and other moisture-related hazards
2.0402.1 - Drainage

Desired Outcome:
Move water away from home

2.0402.1a - Work assessment

Desired Outcome:
Move water away from home

Specification(s):
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

Objective(s):
Verify scope of work

Ensure that work space is ready for work
2.0402.1 - Drainage

Desired Outcome:
Move water away from home

2.0402.1c - Occupant education

Desired Outcome:
Move water away from home

Specification(s):
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

Objective(s):
Maintain durability

Ensure water is moved down and away from home
2.0403.4 - Pier and Skirting Foundations—Ground Moisture Barriers

Desired Outcome:
Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

2.0403.4a - Coverage

Desired Outcome:
Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

Specification(s):
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

Objective(s):
Reduce ground moisture entering crawl space

Tools:
1. Utility knife
2. Hammer or mallet
3. Scissors

Materials:
1. Polyethylene vapor barrier, 6-mil thickness or greater
2. Waterproof tape
3. Polyurethane caulking or construction adhesive
4. Landscape staples

Before
Manufactured home crawlspace with incomplete ground vapor barrier

After
Manufactured home crawlspace with complete ground vapor barrier
Aim for complete coverage. If access to the entire crawlspace is impossible, cover all accessible areas. Overlap seams in vapor barrier by at least twelve inches, and seal them with waterproof tape and/or polyurethane caulk or adhesive. Wrap and cover support piers at least six inches high.

1. Remove skirting as needed for access to crawlspace
2. Measure, cut, and spread vapor barrier material after removing debris over 1/2" in size. Notch around obstructions
3. Wrap piers and columns at least six inches high. Use additional material to cover any gaps and holes in vapor barrier
4. Secure vapor barrier to ground with corrosion-resistant landscape staples, or weigh it down with ballast
5. Remove tools and excess material
6. Reinstall skirting
2.0403.4 - Pier and Skirting Foundations—Ground Moisture Barriers

Desired Outcome:
Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

2.0403.4b - Material specification

Desired Outcome:
Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

Specification(s):
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

Objective(s):
Ensure crawl space is accessible for service and maintenance without damaging the integrity of the ground moisture barrier

Best Practice
Barrier must be at least 6 mil

Best Practice
Talk to occupant about expected life of ground barrier and eventual need to replace it
Materials:

1. Plastic sheeting (at least 6 mil)
2. Furring strips
3. Fasteners

The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of $<0.1$ (which translates to 4mil or thicker). From 2007 IRC definition of vapor retarders: Class I: $\leq 0.1$ perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable). Vapor barrier must be at least 6 mil thickness.
2.0501.2 - Pier and Skirting Foundation—Venting

Desired Outcome:
Pollutants are effectively vented

2.0501.2b - Occupant education

Desired Outcome:
Pollutants are effectively vented

Specification(s):
Occupants will be educated on purpose, operation, and maintenance of vents

Objective(s):
Ensure vents function as intended

Teach homeowners how and when to operate foundation vents

Instruct homeowners that vents are intended to provide a path to outdoors for pollutants and soil moisture. Ideal settings for vents may be climate-dependents, but typically vents may be closed throughout the fall and winter when the air is relatively dry to conserve heat. They can be reopened when warmer weather begins in spring.
Close vents in fall or winter when heating season starts

Open foundation vents in spring time when weather warms
2.0602.1 - Static Electric Shock

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

2.0602.1a - Rigid fill tube

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

Specification(s):
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

Objective(s):
Prevent injury to the installer
2.0602.1 - Static Electric Shock

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

2.0602.1b - Metal coupler grounding

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

**Specification(s):**
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

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

**Objective(s):**
Divert static discharge of electricity to ground instead of installer
2.0602.2 - House Current Electric Hazard

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.

2.0602.2c - Electrical tool safety

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

Specification(s):
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

For arc flash hazards, NFPA 70E will be consulted

Objective(s):
Avoid electrical shock and arc flash hazards
Unsafe
Inspect house for unsafe electrical situations

Best Practice
Attics and crawl spaces should be inspected closely for electrical safety before work begins

Unsafe
Use GFCIs and three-wire extension cords for all power tools

Best Practice
Electrical wiring should not be located near a water source

Unsafe
Use fiberglass ladders in place of metal
2.0602.2 - House Current Electric Hazard

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.

2.0602.2d - Aluminum wiring

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

Specification(s):
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

Objective(s):
Prevent injury to installer and occupant
Prevent damage to structure

Unsafe
Have a certified electrician perform a load test before any weatherization work if aluminum wire is present.

Safe
This panel does not contain aluminum wire.
Tools:

1. Screwdriver (to remove panel cover)
2. Flashlight

Check for the presence of aluminum wire (identified by its light gray color). If aluminum wire is present, you may proceed with the audit. However, retrofit work on the home may not begin until after a certified electrician has inspected every single wiring connection, including all breakers, junction boxes, lights, switches, receptacles, and appliances and determined that the wiring does not present a fire hazard.

1. Inspect panel box for presence of (silver or gray colored) aluminum wire

2. Have a certified electrician inspect every aluminum wire connection in the home

3. After electrician verifies wiring is safe, proceed with retrofit work

4. Perform retrofit measures

5. When retrofit is complete, have certified electrician re-check wiring for safety
2.0702.1 - Warranty and Service Agreement

**Desired Outcome:**
Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

2.0702.1a - Warranty

**Desired Outcome:**
Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

**Specification(s):**
A minimum 1-year warranty for materials, workmanship, and serviceability will be provided to occupants upon completion of work

**Objective(s):**
Provide recourse to occupants for failures in materials, workmanship, and serviceability
2.0702.1 - Warranty and Service Agreement

Desired Outcome:
Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

2.0702.1b - Warranty and Maintenance Agreement - Client Education

Desired Outcome:
Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

Specification(s):
Provide occupants with manufacturers' warranties on installed equipment and inform of installer maintenance agreement options

Share information on company related annual inspections and maintenance agreements as well as manufacturer related warranty details

Objective(s):
Ensure occupants are aware of warranty and maintenance agreement options
2.0702.1 - Warranty and Service Agreement

Desired Outcome:
Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

2.0702.1c - General conditions

Desired Outcome:
Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

Specification(s):
At a minimum, the following concerns and warnings will be addressed within the warranty, as applicable to the work being warrantied:

- Possible drying and shrinking effects
- Storage of hazardous and flammable materials
- Mold

Objective(s):
Educate occupants on potential hazards
3.1001.4 - General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Note:

3.1001.4b - Air sealing penetrations

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Specification(s):
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

Objective(s):
Ensure closure is permanent and supports any load (e.g., wind, insulation, mechanical pressures)

Ensure sealant is effective and durable

Before
Gaps around floor penetrations, such as plumbing, HVAC, and electrical

After
Gaps should be sealed to maintain air barrier
Prepare work space by removing any insulation

Infill with backer rod

Apply appropriate caulking to ensure backing/infill does not move

Visually inspect to verify no gaps remain
3.1001.4 - General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Note:

3.1001.4c - Sealant selection

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Specification(s):
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

Objective(s):
Create a permanent seal
Ensure sealant meets or exceeds the performance characteristics of the surrounding materials
Create a continuous seal

Bad Practice
Avoid sealants that do not allow for expansion between dissimilar materials

Best Practice
Flexible sealants compensate for differential expansion and maintain a seal

air sealing > attics > penetrations and chases
Tools:
1. Caulk gun
2. Spray foam gun

Materials:
1. Caulk
2. Spray foam

Caulking can be used to span gaps up to 1/4 inch
Spray foam can be used to span gaps up to 3 inches
Check manufacturer specifications to verify spanning capabilities

Also check manufacturer specs for incompatibility with intended surfaces
3.1001.4 - General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

**Desired Outcome:**
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

**Note:**

3.1001.4d - Ceiling hole repair

**Desired Outcome:**
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

**Specification(s):**
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

**Objective(s):**
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
Hole in drywall ceiling

Drywall patch in place

**Tools:**

1. 6-inch and 12-inch drywall taping knives
2. Sanding block or sanding sponge
3. Utility knife
4. Keyhole saw
5. Screw gun

**Materials:**

1. Drywall or paneling
2. Fiberglass joint tape
3. Joint compound
4. Drywall screws
5. Support material if needed (typically 1X4, 1X6, or 2X4 dimensional lumber)

For holes in paneled ceilings, use matching panels for repairs. Consider replacing entire sections to avoid creating unsightly mismatched patches. For small holes, enlarge to a rectangular shape and install 1 X 4 blocks above two edges of the hole. For larger holes, enlarge opening to centers of nearest trusses and fasten the patch to the framing.

Replace any missing insulation and repair holes in vapor barrier

Prepare the hole by cutting the edges clean and square

Cut drywall and fasten in place
Add joint tape and first coat of joint compound.
3.1001.4 - General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Note:

3.1001.4e - Materials

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Specification(s):
Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):
Select materials to ensure durable and permanent repair

Best Practice
Choose durable, high quality sealants that are compatible with existing materials

Tools:
1. Caulking gun
2. Reusable spray foam gun
3. Utility knife

Materials:
1. Caulk
2. Foam sealant
3. Foam board
4. Drywall
5. Joint compound
3.1001.4 - General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Note:

3.1001.4f - High temperature application

Desired Outcome:
Penetrations sealed to prevent air leakage and moisture movement between unconditioned and conditioned space

Specification(s):
Only noncombustible materials will be used in contact with chimneys, vents, and flues

Local codes will be referenced

Objective(s):
Prevent a fire hazard

Tools:
1. Drill/screwdriver
2. Caulk gun
3. Metal snips

Materials:
1. High-temperature caulk
2. Non-combustible rigid material (ex: aluminum or steel flashing, cement board)

Before
Gaps around combustion exhaust flues need to be sealed

After
Sealed penetrations and chases should utilize high-temperature materials
Spray foam sealant is not allowed in high-temperature applications, even if labeled as fire block or fire foam, and regardless of being colored pink or orange.

Prepare work area by removing any insulation and debris

Use high-temperature caulking (600°F min)

Apply first ring of caulking to match shape of opening

Apply second ring of caulking to size and shape of rigid material

Fasten rigid material and apply additional caulking

Fasten rigid material to cover penetration and seal against flue with caulk
3.1101.1 - Exterior Holes and Penetrations

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

3.1101.1b - Materials

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

**Specification(s):**
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)

**Objective(s):**
Select materials to ensure durable and permanent repair

Before
Hole in exterior wall of manufactured home aluminum siding

After
Completed wall patch
**Tools:**
1. Sheet metal nibbler
2. Power saw
3. Snips
4. Screw gun
5. Caulking gun

**Materials:**
1. Aluminum siding or flashing
2. Oriented Strand Board (OSB) sheathing
3. Vinyl siding
4. Galvanized steel
5. Corrosion-resistant fasteners
6. High quality caulk formulated for exterior use

Replace damaged siding

Use siding that matches the existing material's contour, texture, and color
3.1101.2 - Interior Holes and Penetrations

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

3.1101.2b - Interior wall air sealing

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

**Specification(s):**
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

**Objective(s):**
Minimize air leakage

Maintain durability

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

Ensure sealant is effective and durable

![Before](Unsealed penetrations through top plate)

![After](Sealed wiring penetrations through top plate)
Tools:
1. Caulking gun
2. Reusable spray foam gun

Materials:
1. Caulk
2. Spray polyurethane foam
3. Foam backer rod or pieces of fiberglass batt

1. Locate and expose penetrations to prepare for sealant
2. Use caulk or foam (approved by local code) to seal wiring penetrations through top plate
3. Ensure that all accessible gaps, holes, and penetrations are filled
3.1101.3 - Holes, Penetrations, and Marriage Line

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

3.1101.3c - Marriage line air sealing

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

**Specification(s):**
All accessible holes and penetrations at marriage lines will be sealed continuously at end walls, floors, and ceiling

Backing or infill will be provided at the marriage line as needed

All remaining gaps will be sealed with an approved material

**Objective(s):**
Minimize air leakage

Maintain durability

Ensure sealant is effective and durable

Identify leaks in marriage line using a blower door
You may need to remove trim to determine what type of sealing is needed at the marriage line. Some original installations use a compressed open-cell polyurethane foam sealing strip with excellent air sealing properties and will need little or no additional work. Other installations may feature fiberglass or other ineffective air sealing measures and require extensive caulking and foaming to reduce air infiltration. Use a blower door to pressurize the house and use smoke to pinpoint leak locations.

Identify leaks in marriage line using a blower door and smoke

Foam, caulk, and seal leaks between halves of double wide manufactured homes
3.1201.5 - Manufactured Housing Windows and Doors

Desired Outcome:
Windows and doors are operable, sealed, and weathertight

Note:

3.1201.5b - Lead paint assessment

Desired Outcome:
Windows and doors are operable, sealed, and weathertight

Specification(s):
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

Objective(s):
Protect worker and occupant from potential lead hazards

Best Practice
In homes built before 1978, test paint before beginning renovation
**Tools:**

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

1. Clean tools and sample site to prevent contamination
2. Cut sample site at an angle to expose all older paint layers
3. Break capsules and shake to mix reagents. Swab sample site for 30 seconds
4. Check swab for reaction
5. Red indicates lead positive. White is lead negative
6. If negative, verify validity of test with provided calibration card
7. Lead in calibration card should test
8. Record test results to maintain
positive and turn red documentation
3.1201.5 - Manufactured Housing Windows and Doors

Desired Outcome:
Windows and doors are operable, sealed, and weathertight

Note:

3.1201.5d - Air infiltration

Desired Outcome:
Windows and doors are operable, sealed, and weathertight

Specification(s):
Details that reduce air infiltration will be repaired, replaced, sealed, or installed (e.g., plastic gliders, weatherstripping, cranks, latches, locks, knobs, thresholds)

Objective(s):
Reduce air infiltration

Tools:
1. Drill/screwdriver
2. Utility knife
3. Tape measure
4. Caulk gun

Materials:
1. Weatherstripping
2. Door sweep
3. Fasteners
4. Caulk
5. Felt corner pads

Door or window replacement requires written approval from GEFA.
Use an automatic (retractable) door sweep if a standard sweep interferes with a client’s floor when adjusted to seal against the threshold.

1. Door jamb is missing any weatherstripping
2. Measure door jamb for weatherstripping
3. Install new weatherstrip
4. Measure bottom of door for door sweep
5. Install new door sweep
6. Adjust strike-plate and door jambs as necessary to secure a good fit
7. If properly adjusted, light should no longer be visible around door and air movement should no longer be detected
3.1201.6 - Interior Storm Windows

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

Note:

3.1201.6b - Fixed storm window

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

Specification(s):
Fixed interior storm windows will not be installed in egress locations

Objective(s):
Safety

Unsafe
Do not install fixed storm windows in bedroom windows designated as egress locations

Safe
Fixed storm windows may be installed in non-egress locations only

Storm windows installed in egress (bedroom) windows must be operable or removable, and conform to the following standard: Voluntary Standard Egress Window Systems for Utilization in Manufactured Housing, AAMA 1704-85
3.1202.3 - Replacing Damaged Window Glass in Manufactured Housing

Desired Outcome:
Glass complete and intact

Note:

3.1202.3b - Lead paint assessment

Desired Outcome:
Glass complete and intact

Specification(s):
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

Objective(s):
Protect worker and occupant from potential lead hazards

EPA RRP certification required to conduct Lead Paint assessment.
3.1203.3 - Replacement of Manufactured Housing Windows and Doors

Desired Outcome:
Smooth operation and an airtight and weathertight fit of replacement windows and doors

Note:

3.1203.3b - Lead paint assessment

Desired Outcome:
Smooth operation and an airtight and weathertight fit of replacement windows and doors

Specification(s):
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

Objective(s):
Protect worker and occupant from potential lead hazards

EPA RRP certification required to conduct Lead Paint assessment.
3.1203.3 - Replacement of Manufactured Housing Windows and Doors

Desired Outcome:
Smooth operation and an airtight and weathertight fit of replacement windows and doors

Note:

3.1203.3f - Safety

Desired Outcome:
Smooth operation and an airtight and weathertight fit of replacement windows and doors

Specification(s):
Egress windows will only be replaced with egress windows

Objective(s):
Provide safe egress for occupants

Windows installed in egress (bedroom) windows must conform to the following standard: Voluntary Standard Egress Window Systems for Utilization in Manufactured Housing, AAMA 1704-85
3.1301.1 - Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board

**Desired Outcome:**
Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space

**Note:**

3.1301.1d - Bottom board penetrations

**Desired Outcome:**
Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space

**Specification(s):**
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 (hole size and type) of the penetrations (e.g., electrical, PVC, gas line, dryer vent)

The patch will not bend, sag, or move once installed

**Objective(s):**
Ensure combustion equipment is not compromised

Minimize air leakage around penetrations
Unsealed penetration through bottom board

Properly sealed penetration through manufactured home bottom board and at floor

Tools:
1. Outward clinching (stitch) stapler
2. Utility knife
3. Cordless driver/drill
4. Reusable foam gun
5. Caulking gun
6. Nail gun

Materials:
1. Belly/bottom board fabric
2. Belly/bottom board repair tape
3. Staples
4. Screws
5. Foam board
6. 1X2 nailers
7. Spray foam sealant
8. High quality exterior caulk

Label combustion air inlets with the words, "DO NOT SEAL"

Seal penetrations THROUGH THE BELLY with compatible materials like foam board, belly board, or Flex Mend (tm)
### 3.1301.2 - Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring

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

### 3.1301.2b - Floor air sealing (decking, subfloor, floor decking)

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

**Specification(s):**
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.

**Objective(s):**
Ensure resulting closure is permanent and supports expected load.

Ensure sealant is effective and durable.

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**Tools:**
1. Headlamp

**Materials:**
1. Backer rod
2. Sealant
Prepare work space by removing any insulation

Infill with backer rod

Apply appropriate caulking to ensure backing/infill does not move

Visually inspect to verify no gaps remain
3.1301.2 - Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring

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

3.1301.2c - Sealant selection

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

Specification(s):
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

Objective(s):
Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

Bad Practice
Avoid sealants that do not allow for expansion between dissimilar materials

Best Practice
Flexible sealants compensate for differential expansion and maintain a seal

Tools:
1. Caulk gun
2. Spray foam gun

Materials:
1. Caulk
2. Spray foam
Caulking can be used to span gaps up to 1/4 inch

Spray foam can be used to span gaps up to 3 inches

Check manufacturer specifications to verify spanning capabilities

Also check manufacturer specs for incompatibility with intended surfaces
3.1301.2 - Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring

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

3.1301.2d - Floor repair

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

**Specification(s):**
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

**Objective(s):**
Ensure floor is structurally sound

Minimize air leakage

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**Before**
Remove floor coverings from damaged area

**After**
Completed floor repair
Tools:
1. Circular saw
2. Reciprocating saw
3. Caulking gun
4. Cordless driver/drill
5. Framing square
6. Speed square
7. Utility knife
8. Sawhorses
9. Clamps
10. Jig saw or keyhole saw
11. Paddle bits to drill starter holes in floor

Materials:
1. 5/8" or 3/4" oriented strand board or plywood subflooring
2. Polyurethane caulk
3. Construction adhesive
4. 2" deck screws
5. 3" deck screws
6. 8-penny galvanized ring shank or spiral shank nails
7. 16-penny galvanized ring shank or spiral shank nails
8. 2X4, or 2X6 blocking material for nailers
9. Air sealing foam (one- or two-part SPF)
10. Belly repair tape

Paddle bits may be used to drill starter holes at the corners of the area to be patched. Cut the new patch 1/4" shorter than the hole in both length and width to allow room for expansion and contraction. Make sure to cut the patch so that the strength axis is perpendicular to the joists (the strong direction in plywood and OSB is parallel to the 8' length).

Carefully remove trim and floor coverings from area to be repaired
Mark the joist locations on either side of the damaged area
Cut out damaged area even with the inside edges of the floor joists

Make the patch 1/4" smaller than the nailing in length and width to allow for expansion
Cut four 2X4 blocks to support the patch.

Install nailers flat against the joists. Finish by toenailing or screwing 2X4s between the joists.

Make the patch 1/4" smaller than the opening in length and width to allow for expansion.

Apply subfloor adhesive to nailers.

Fasten with 2" deck screws.
3.1301.2 - Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring

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

3.1301.2f - High temperature application

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

**Specification(s):**
Only noncombustible materials will be used in contact with chimneys, combustion exhaust vents, and flues

**Objective(s):**
Prevent a fire hazard

Tools:
1. Drill/screwdriver
2. Caulk gun
3. Metal snips

Materials:
1. High-temperature caulk
2. Non-combustible rigid material (ex: aluminum or steel flashing, cement board)

*Spray foam sealant is not allowed in high-temperature applications*, even if labeled as fire block.
or fire foam, and regardless of being colored pink or orange.

1. Prepare work area by removing any insulation and debris
2. Use high-temperature caulking (600F min)
3. Apply first ring of caulking to match shape of opening
4. Apply second ring of caulking to size and shape of rigid material
5. Fasten rigid material and apply additional caulking
6. Fasten rigid material to cover penetration and seal against flue with caulk
3.1302.1 - Floor Framing—Bay Window

**Desired Outcome:**
Floor/framing around bay windows sealed and weathertight

**Note:**

3.1302.1b - Lead paint assessment

**Desired Outcome:**
Floor/framing around bay windows sealed and weathertight

**Specification(s):**
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

**Objective(s):**
Protect worker and occupant from potential lead hazards

**Best Practice**
In homes built before 1978, test paint before beginning renovation
Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2a - Work assessment

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
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

Objective(s):
Ensure work space is safe and ready for repair or installation

Verify scope of work
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2b - Repair and installation

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
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

Objective(s):
Match existing skirting

Provide resistance from outdoor elements

Limit pest access
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2c - Venting

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
Venting will be in accordance with local climate conditions or code as required

Objective(s):
Achieve and maintain building durability
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2f - Materials

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
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

Objective(s):
Achieve/increase durability
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2g - Fasteners

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
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

Objective(s):
Achieve/increase durability
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2h - Structural

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
Existing skirting support material will be structurally sound and completely intact; any damaged framing will be replaced

Objective(s):
Provide adequate support
3.1488.2 - Skirting Manufactured Homes

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Note:

3.1488.2i - Skirting stiffener/high wind support

Desired Outcome:
Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):
Skirting support (e.g., vinyl blowout rods, horizontal bracing for other types) will be placed in high-wind locations

Objective(s):
Increase strength to resist wind loading
3.1488.2 - Skirting Manufactured Homes

**Desired Outcome:**
Wind, weather, debris, and pests are excluded from the underside of the home

**Note:**

3.1488.2j - Occupant education

**Desired Outcome:**
Wind, weather, debris, and pests are excluded from the underside of the home

**Specification(s):**
Occupants will be educated on maintenance of skirting (e.g., floating panels are not tightly screwed to framing, string trimmers may damage skirting)

**Objective(s):**
Increase durability
3.1601.4 - Support for Horizontal, Suspended Ducts

Desired Outcome:
Ducts and plenums properly supported

Note:

3.1601.4a - Support (applies to all duct types)

Desired Outcome:
Ducts and plenums properly supported

Specification(s):
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

Objective(s):
Eliminate falling and sagging
3.1601.5 - Preparation and Mechanical Fastening

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Note:**

3.1601.5e - Duct board to flexible duct

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
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

**Objective(s):**
Ensure durable joints

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

---

**Bad Practice**
Flex duct improperly attached to duct board.
No starting collar is installed.

**Best Practice**
Flex duct, starting collar, and backer ring installed and sealed to duct board
Tools:
1. Cordless driver/drill
2. 1/4” nut driver bit
3. Disposable brushes
4. Tin snips
5. Utility knife
6. Zip tie tensioning tool

Materials:
1. Galvanized metal backer rings
2. Tabbed starting collars
3. Rubber gloves
4. Zip ties
5. Duct sealing mastic
6. Fiberglass mesh tape

Make sure to use a starting collar that is made for the thickness of the duct board you are using. R-6 duct board is 1-1/2” thick. The correct starting collar would therefore have 1-1/2” of solid metal between the shoulder that fits against the outside of the duct board and the base of the tabs.

You may need to cut a slot in the duct board to slide the backer ring through. Use at least three equally spaced screws to fasten the starting collar to the backer ring.

Gather materials
Place backer ring inside duct board. Insert collar and bend tabs into place.
Fasten the collar to the backer ring by driving at least three equally spaced screws through the collar, duct board

Coat joint between starting collar and duct board with mastic. Liberally coat the metal collar where flex attaches
Slide flex duct liner over mastic-coated metal collar
Secure with properly tensioned zip tie.
Coat seam with mastic

Pull insulation over duct liner and secure with a zip tie.
3.1601.5 - Preparation and Mechanical Fastening

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Note:**

3.1601.5f - Duct board plenum to air handler cabinet

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
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

**Objective(s):**
Ensure durable joints

![Cabinet C-channel Duct board 1/2" screws](image)

**Best Practice**
Duct board plenum fastened with C-channel and screws
**Tools:**
1. Screw gun
2. Tin snips
3. Utility knife
4. Tape measure
5. Square

**Materials:**
1. Fiberglass duct board
2. C-channel (same width as duct board)
3. Sheet metal screws longer than the duct board thickness
4. Foil tape (for assembling duct board)
5. Mastic
6. Mesh tape (for gaps larger than 1/4")
7. Flex duct
8. Zip ties
9. Starting collar
10. Backing ring (fits inside duct board and fastens to starting collar)
3.1601.5 - Preparation and Mechanical Fastening

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Note:

3.1601.5h - Boot to gypsum

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
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

Objective(s):
Ensure durable joints

Register boot fastened to framing and sealed to gypsum with spray foam
**Tools:**

1. Caulking gun or foam gun
2. Cordless driver/drill

**Materials:**

1. Polyurethane caulk
2. Mastic and mesh tape (for gaps larger than 1/4"")
3. Screws
4. Fiberglass mesh tape (for gaps larger than 1/4"")
5. Disposable brushes
6. Spray foam sealant

Fasten boot hangers to adjacent framing, or screw through the boot into adjacent framing. Polyurethane caulk is a durable adhesive, and can accommodate up to 50% expansion and contraction. Mastic and mesh tape also form a strong, permanent seal. Spray foam may be used to seal boots into the opening once the boot is fastened in place.

1. Remove diffuser
2. Caulk the boot to the gypsum board. Angle the tip forward and force caulk into the joint
3. Wipe away excess caulk. Wear proper personal protective equipment (PPE) and use caution when working around sharp edges
4. Wipe caulk into the joint and smooth it as you go
3.1601.5 - Preparation and Mechanical Fastening

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Note:

3.1601.5i - Duct board to flex

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

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

Objective(s):
Ensure durable joints

Bad Practice
Improper attachment of flex to duct board

After
Flex duct correctly installed and sealed to duct board
Select a backer ring and flex duct installation tools

Cut the proper size hole in duct board

Select starting collar with tabs matching the thickness of the duct board

Insert the starting collar, bend tabs over and install at least 3 screws through the collar, duct board, and backer ring

Starting collar with tabs bent over and screws through the duct board and backer ring

Apply mastic liberally and install flex duct
3.1602.3 - Proprietary Spray Application

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

3.1602.3a - Internal or external application

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Specification(s):**
Sealant will be applied in accordance with manufacturer specifications, as well as UL 181M, NFPA 90A, and NFPA 90B

**Objective(s):**
Reduce duct leakage
3.1602.8 - Supply Plenum (Furnace to Trunk Duct Connection) in Both Upflow and Downflow Air Handler Configurations

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Note:**

3.1602.8b - Preparation

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Specification(s):**
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

**Objective(s):**
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)

---

After

Closet prepared for furnace installation
**Tools:**

1. Shop vac  
2. Scraper  
3. Bench duster  
4. Dust pan

**Materials:**

1. Rags

---

Dust walls and floor of cabinet. Sweep debris into piles for pickup. Wipe down walls and floor.

Vacuum cabinet clean.

Inspect plenum for damage, then clean, scrape, and seal.

Scrape loose material from insides of cabinet.

Apply mastic to inside seams of plenum.
3.1602.8 - Supply Plenum (Furnace to Trunk Duct Connection) in Both Upflow and Downflow Air Handler Configurations

Desired Outcome:
Deliver all air from air handler to the trunk duct without leakage or restriction

Note:

3.1602.8c - Plenum rebuild or repair

Desired Outcome:
Deliver all air from air handler to the trunk duct without leakage or restriction

Specification(s):
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)

Objective(s):
Minimize restrictions

Maximize air flow and air distribution

Minimize moisture issues

Prevent condensation on plenum
Best Practice
Whenever possible, install turning vanes in plenums to reduce turbulence and improve airflow

Materials:
1. Starting collars and flanges
2. Zip ties
3. Mastic duct sealant
4. Fiberglass mesh tape
5. Sheet metal screws
6. Turning vanes
7. Duct board

Using turning vanes reduces turbulence and increases air flow. Use mastic and mesh tape on the outside of duct board plenums. Properly install metal starting collars to duct board and flex duct to metal collars (see spec 3.1601.5e for detail)
3.1602.9 - Crossover Ducts

Desired Outcome:
Deliver all air from trunk to trunk without leakage or restriction

Note:

3.1602.9g - Combustion Appliance Zone (CAZ) testing

Desired Outcome:
Deliver all air from trunk to trunk without leakage or restriction

Specification(s):
CAZ testing will be performed where combustion appliances are utilized

Objective(s):
Identify unsafe equipment operating conditions

Best Practice
Complete combustion appliance zone testing to ensure a healthy, safe environment

Tools:
1. Manometer
2. Mirror
3. Chemical smoke puffer
4. Stopwatch or watch with second hand
5. Gas leak detector
6. Combustion analyzer
7. 1/4" air line tubing
3.1602.10 - Hard and Flex Branch Ducts

**Desired Outcome:**
Deliver air from trunk to termination (register/diffuser) without leakage

**Note:**

3.1602.10e - Combustion Appliance Zone (CAZ) testing

**Desired Outcome:**
Deliver air from trunk to termination (register/diffuser) without leakage

**Specification(s):**
CAZ testing will be performed where combustion appliances are utilized

**Objective(s):**
Identify unsafe equipment operating conditions
3.1602.11 - Air Sealing System

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Note:

3.1602.11a - New component to new component sealant selection

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Any closure system used will meet or exceed applicable standards

Objective(s):
Ensure effectiveness of air sealing system

Mastic sealant is an approved, durable, and effective sealant
Tools:
1. Utility knife
2. Disposable brushes

Materials:
1. UL 181 B-FX tape (cover with mastic after assembly)
2. Fiberglass mesh tape (use, along with mastic, to cover gaps wider than 1/4-inch and to add strength to assemblies)
3. Mastic (air duct sealant) labeled UL 181 B-M
4. Spray polyurethane foam

Use tape labeled 181 B-FX and/or mastic labeled 181 BM. Seal and mechanically fasten all duct connections to metal flanges. Fasten round metal ducts with at least three screws equally spaced around the diameter, and make sure that the ducts and fittings are inserted at least 1”. DO NOT USE unlisted duct tape as a sealant on any duct.

Exceptions:

1. Spray polyurethane foam shall be permitted to be applied without additional joint seals.
2. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
3. Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.

Use fiberglass mesh tape to cover gaps; coat with at least 2mm of mastic
Coat seams with mastic (air duct sealant) conforming to standard UL 181 B-M
Use tape to assemble joints, then coat with at least 2mm of mastic
3.1602.11 - Air Sealing System

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Note:**

3.1602.11c - Existing component to existing component

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Specification(s):**
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 ¾" 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

**Objective(s):**
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
Unsealed joints and connections need to be sealed to stop air leaks, improve durability, and reduce health risks.

**Tools:**
1. Disposable brushes
2. Utility knife

**Materials:**
1. Mastic
2. Fiberglass mesh tape

Fiberglass mesh tape and mastic sealant shall form the primary seal. Polyurethane spray foam may not be used in place of mesh tape and mastic.

Prepare work area by assessing any safety concerns and cleaning duct surface.

Wrap joint with fiberglass mesh tape

Apply UL 181 mastic to seal joint
3.1602.12 - Air Sealing System Components

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Note:**

3.1602.12a - Duct boot to interior surface

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Specification(s):**
Gaps between boot and gypsum less than a ¼" will be sealed using mastic or appropriate flexible caulking

Gypsum edge will be wetted before applying mastic

**Objective(s):**
Prevent air leakage

---

Before

Gaps around duct boots allow for leakage to and from the attic

After

Use a mesh in mastic system to seal duct boot to interior surface

**Tools:**
1. Utility knife
2. Spray bottle
3. Putty knife

**Materials:**
1. Mastic
2. Fiberglass mesh tape
3. Spray foam sealant
4. Caulk
Remove grill to expose duct boot and gaps

Wet the edges of the drywall to ensure a good bond

Cut mesh tape to fit around duct boot and cover gaps

Apply mastic over mesh tape to create heat resistant, durable bond

Once mastic is set, grill can be replaced and mastic should not show
3.1602.12 - Air Sealing System Components

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Note:**

3.1602.12b - Air handler cabinet outside conditioned space

**Desired Outcome:**
Ducts and plenums sealed to prevent leakage

**Specification(s):**
Joints will be sealed and cracks/holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape)

**Objective(s):**
Reduce air leakage while maintaining accessibility

**Materials:**
1. Foil tape

---

Unnecessary holes in the air handler cabinet need to be sealed

Use removable foil tape to seal holes
Unnecessary holes in the air handler cabinet should be sealed.

Removable foil tape should be used to seal.

Fully cover holes with tape to seal completely.
### 3.1602.13 - Return—Framed Platform

**Desired Outcome:**
The return duct is installed to prevent air leakage

**Note:**

### 3.1602.13a - Preparation

**Desired Outcome:**
The return duct is installed to prevent air leakage

**Specification(s):**
Debris and dirt will be cleaned out of the return platform

**Objective(s):**
Allow for the application of rigid materials and sealants

#### Tools:
1. Shop vacuum
3.1602.13 - Return—Framed Platform

Desired Outcome:
The return duct is installed to prevent air leakage

Note:

3.1602.13b - Infill and backing

Desired Outcome:
The return duct is installed to prevent air leakage

Specification(s):
Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space

Backing or infill will not bend, sag, or move once installed

Material will be rated for use in return duct systems

Objective(s):
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

Before

Leakage from air return into wall cavities should be eliminated

In Progress

Only materials rated for use in higher temperature areas should be used
Tools:
1. Tape measure
2. Utility knife
3. Drill
4. Caulk gun

Materials:
1. Drywall
2. Fire-resistant caulk
3. Fasteners

Do NOT use EPS or XPS foam board in air returns.
3.1602.13 - Return—Framed Platform

**Desired Outcome:**
The return duct is installed to prevent air leakage

**Note:**

3.1602.13c - Sealant selection

**Desired Outcome:**
The return duct is installed to prevent air leakage

**Specification(s):**
Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

**Objective(s):**
Select permanent sealant

Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

---

**Best Practice**
Sealants, like mesh and UL 181 mastic, meet IRC, ASTM, and UL specs

**Caulk sealants**
Caulk sealants will be continuous and compatible with surface

**Tools:**
1. Caulk gun
2. Utility knife
3. Taping knife

**Materials:**
1. Fiberglass mesh
2. Siliconized caulk
3. UL 181 mastic

Wall and ceiling finishes will have a flame spread index of 200 or less and a smoke-developed index of 450 or less
3.1701.1 - Holes, Penetrations, and Connection Seam

**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.

3.1701.1g - Sealant selection

**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.

**Specification(s):**
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.

**Objective(s):**
Create a permanent seal.

Ensure sealant meets or exceeds the performance characteristics of the surrounding materials.

---

**Bad Practice**
Avoid sealants that do not allow for expansion between dissimilar materials.

**Best Practice**
Flexible sealants compensate for differential expansion and maintain a seal.
Tools:
1. Caulk gun
2. Spray foam gun

Materials:
1. Caulk
2. Spray foam

Caulking can be used to span gaps up to 1/4 inch
Spray foam can be used to span gaps up to 3 inches
Check manufacturer specifications to verify spanning capabilities

Also check manufacturer specs for incompatibility with intended surfaces
3.1701.1 - Holes, Penetrations, and Connection Seam

**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

3.1701.1h - Floor repair

**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

**Specification(s):**
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

**Objective(s):**
Ensure floor is structurally sound

Minimize air leakage

![Before](image_url)

Holes in the floor should be repaired
3.1701.1 - Holes, Penetrations, and Connection Seam

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.

3.1701.1j - Ceiling hole repair

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.

Specification(s):
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.

Objective(s):
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.
Before

Replace any missing insulation and repair holes in vapor barrier

After

Drywall patch before final sand and prime

Tools:

1. 6-inch and 12-inch drywall taping knives
2. Sanding block or sanding sponge
3. Utility knife
4. Keyhole saw
5. Screw gun

Materials:

1. Drywall or paneling
2. Fiberglass joint tape
3. Joint compound
4. Drywall screws or nails
5. Support material if needed (typically 1X4, 1X6, or 2X4 dimensional lumber)

For small holes, enlarge to a rectangular shape and install 1 X 4 blocks above two edges of the hole. For larger holes, enlarge opening to centers of nearest trusses and fasten the patch to the framing.
Add joint tape and coat of joint compound
3.1701.1 - Holes, Penetrations, and Connection Seam

**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.

3.1701.1k - High temperature application

**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.

**Specification(s):**
Only noncombustible materials will be used in contact with chimneys, vents, and flues.

**Objective(s):**
Prevent a fire hazard.

**Tools:**
1. Caulk gun
2. Metal snips
3. Drill/screwdriver

**Materials:**
1. High-temperature caulk
2. Non-combustible material such as aluminum or galvanized steel flashing or cement board
3. Appropriate fasteners

Use non-combustible materials, like aluminum, steel, cement board, and high-temp caulk.

Gaps around floor penetrations allow air and moisture movement.

Before: Gaps around floor penetrations allow air and moisture movement

After: Use non-combustible materials, like aluminum, steel, cement board, and high-temp caulk.
Spray foam sealant is not allowed in high-temperature applications, even if labeled as fire block or fire foam, and regardless of being colored pink or orange.

1. Prepare work area by removing any insulation and debris
2. Use high-temperature caulking (600°F min)
3. Apply first ring of caulking to match shape of opening
4. Apply second ring of caulking to size and shape of rigid material
5. Fasten rigid material and apply additional caulking
6. Fasten rigid material to cover penetration and seal against flue with caulk
4.1002.1 - Above Roof Deck Insulation: Preparation

Desired Outcome:
Roof covering removed and replaced to expose roof deck for installation of above roof deck insulation

4.1002.1b - Roof covering replacement

Desired Outcome:
Roof covering removed and replaced to expose roof deck for installation of above roof deck insulation

Specification(s):
New roof covering will be installed in accordance with manufacturer specifications and local building code requirements after installation of above roof deck insulation

Objective(s):
Install roof covering correctly

Meet local code requirements
4.1002.2 - Above Deck Roof Deck Insulation: Installation

Desired Outcome:
Properly installed roof deck insulation

4.1002.2a - Sealing

Desired Outcome:
Properly installed roof deck insulation

Specification(s):
Holes, gaps, and penetrations in existing roof deck will be sealed

Objective(s):
Prevent air leaks
4.1002.2 - Above Deck Roof Deck Insulation: Installation

Desired Outcome:
Properly installed roof deck insulation

4.1002.2b - Installation

Desired Outcome:
Properly installed roof deck insulation

Specification(s):
Insulation will be installed according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):
Install insulation properly
4.1002.2 - Above Deck Roof Deck Insulation: Installation

Desired Outcome:
Properly installed roof deck insulation

4.1002.2c - Occupant education

Desired Outcome:
Properly installed roof deck insulation

Specification(s):
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)

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17
4.1003.8 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Roof Side Lift)

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

4.1003.8a - Attic, ceiling, and roof verification

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

 Specification(s):  
 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

**Objective(s):**

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

**Tools:**

1. Scaffolding and ladders
2. Screw gun
3. Long, flat prybar
4. 5-in-one paint scraper tool
5. Flashlights and headlamps
6. Digital camera

**Materials:**

1. Wooden blocks

Inspect and correct each of the specified items: flues terminated to outside, 2" clearance to combustibles from flues, ventilation ducts terminated outdoors, non-airtight, non-IC rated recessed lighting replaced with airtight, IC-rated recessed units, broken mushroom vents replaced or removed, plumbing vents terminated outdoors, ceiling penetrations sealed, structural defects in roof, attic, and ceiling assemblies corrected, ponds on roof remedied, and all roof leaks repaired.
Inspect roof for evidence of water pooling, leaks, or damage. Verify proper vent terminations.

Inspect ceiling for weakness, leaks, clearance to combustibles, loose panels, and penetrations.

Verify presence of rain caps on all vents.

Inspect all patches and repairs, and correct deficiencies if necessary.

Verify at least 2" clearance to combustibles, unless flue is designed for zero clearance. Repair if needed.

Use temporary supports to avoid ceiling collapse during insulation install.

Add fasteners wherever needed to firmly attach ceiling to the trusses.

Investigate all water stains and sources of moisture. Repair before insulating the attic.

After opening the roof edge, verify proper clearance to combustibles and inspect vent connections.
4.1003.8 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Roof Side Lift)

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

4.1003.8d - Fiberglass blown insulation installation

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

**Specification(s):**
- 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

**Objective(s):**
- 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
After gaining access to the roof cavity, use supports to hold the roof material in place while blowing the insulation.
4.1003.9 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Exterior Access from Top of Roof)

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

4.1003.9a - Attic, ceiling, and roof verification

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

**Specification(s):**
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 not 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 installing installation

**Objective(s):**

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

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**Tools:**

1. 2-1/2" hole saw
2. Power drill
3. Borescope
4. Inspection mirror
5. Flashlight

**Materials:**

1. Material requirements will vary based on conditions
2. Drywall or paneling
3. IC/Airtight recessed lights
4. Fire caulk
5. Vent terminations
6. Silicone caulk
7. Galvanized sheet metal and screws
8. Roof cement
9. Temporary ceiling bracing

Inspect and correct each of the specified items: flues terminated to outside, 2" clearance to combustibles from flues, ventilation ducts terminated outdoors, non-airtight, non-IC rated recessed lighting replaced with airtight, IC-rated recessed units, broken mushroom vents replaced or removed,
plumbing vents terminated outdoors, ceiling penetrations sealed, structural defects in roof, attic, and ceiling assemblies corrected, ponds on roof remedied, and all roof leaks repaired.

1. Inspect roof for evidence of water pooling, leaks, or damage. Verify proper vent terminations.
2. Inspect all patches and repairs, and correct deficiencies if necessary.
3. Verify presence of rain caps on all vents.
4. Inspect ceiling for weakness, leaks, clearance to combustibles, loose panels, and penetrations.
5. Verify at least 2" clearance to combustibles, unless flue is designed for zero clearance. Repair if needed.
6. Repair and refasten sagging or unsecured ceiling panels. Caulk and seal seams to prevent insulation spilling into house.
7. Use temporary supports to avoid ceiling collapse during insulation install.
4.1003.9 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Exterior Access from Top of Roof)

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

4.1003.9b - Attic access

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

Specification(s):
Access to the attic cavity will be created through the gable vents.
Attic will be visually inspected for the location of existing insulation, wiring, flues, obstructions, hazards, and construction type

Objective(s):
Create access to the full attic cavity
Maintain the integrity of the roof truss
Determine technique for installing insulation

Manufactured home attic access by slicing along ridgeline
**Tools:**
1. 7-1/4" circular saw
2. Electric drill
3. Carbide-tipped hole saw bits
4. Insulation blowing machine
5. 2" PVC pipe, 10 feet long
6. 4-1/2" or 7" angle grinder with flexible sanding wheels
7. Tape measure and chalk lines
8. Scaffolding

**Materials:**
1. Abrasive or carbide-toothed cutting wheels

If attic has both flat and vaulted ceilings, access may be gained through the gable ends for the flat ceilings.

**Option 1:** Drill a 4" hole in each truss cavity two to three feet down from the ridge

**Option 2:** Cut a hole into each truss cavity, big enough to inspect the opening and admit the fill tube

**Option 3:** Cut the roof open along the highest point from end to end. Make crosswise cuts at each end if needed

Regardless of access method, visually inspect attic for existing insulation, wiring, flues, obstructions, and hazards
4.1003.9 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Exterior Access from Top of Roof)

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

4.1003.9d - Fiberglass blown insulation installation

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

Specification(s):
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

Insulation will be filled no higher than the top of the truss

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

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

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

4.1003.9e - Patching and sealing openings

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

**Specification(s):**
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

**Objective(s):**
Effectively patch and seal all openings

Create a durable patch that will prevent roof leaks

**Tools:**
1. Roller
2. Self adhering patch
3. Sheet metal
4. 6" duct cap(to match 6" hole)
5. Heat gun
6. Drill

*In Progress*  
Rough cut hole that will need to be sealed.

*In Progress*  
Placing sealant around the exposed edges of the roof patch ensures a watertight seal.
Insert 6” plug and seal around the perimeter of the opening.

Firmly push the plug into place, until it is flush with the roof surface.

Use a 10”x10” sheet metal patch to mark the center of the hole.

Apply sealant to the underside of the sheet metal patch.

Secure the metal patch to the roof being sure to place mechanical fasteners through the sealant.

Apply a 14”x14” self adhering roof patch on top of the sheet metal patch.

Use a heat gun to make the adhesive pliable to get the best possible seal.

Forcefully roll the patch into place, starting from the center and working toward the edge.
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10a - Attic, ceiling, and roof verification

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

**Specification(s):**
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

**Objective(s):**
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
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10b - Construction prep

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

Specification(s):
Special precautions will be taken to limit fiberglass and construction dust exposure to the occupant and occupant belongings

Objective(s):
Protect occupant health and safety

Protect occupant belongings
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10c - Attic access

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

**Specification(s):**
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

**Objective(s):**
Create access to the full attic cavity

Determine insulation installation technique

Prevent damage to ceiling
Create a professionally finished ceiling
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10d - Blowing machine set up

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

**Specification(s):**
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

**Objective(s):**
Ensure machine is capable of delivering uniform insulation density and coverage
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

**4.1003.10e - Fiberglass blown insulation installation**

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

**Specification(s):**
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

**Objective(s):**
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

Fire safety will be maintained
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10f - Patching and sealing holes

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

**Specification(s):**
Holes will be plugged or covered and sealed to be aesthetically pleasing

If existing trim was removed, it will be reinstalled

**Objective(s):**
Create an airtight seal

Create a visually acceptable ceiling finish
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10g - Verification of details

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

**Specification(s):**
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

**Objective(s):**
Verify the integrity of the house has been maintained
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10h - Onsite Documentation

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

Specification(s): 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

Objective(s): 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

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

4.1003.11a - Roof-over overview

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

Specification(s):
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
Objective(s):
Gain access to the combined attic spaces
Address thermal bridging
Correctly insulate the combined attic spaces
4.1003.11 - Installing Fiberglass Blown Insulation in Roof-Over Constructions

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

4.1003.11b - Onsite documentation

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

Specification(s):
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

Objective(s):
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
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15a - Attic, ceiling, and roof verification

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

Specification(s):
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 not 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 installing installation

**Objective(s):**
- 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
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15b - Attic access

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

Specification(s):
Access to the attic cavity will be created through the gable vents.

Attic will be visually inspected for the location of existing insulation, wiring, flues, obstructions, hazards, and construction type

Objective(s):
Create access to the full attic cavity

Maintain the integrity of the roof truss

Determine technique for installing insulation
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15c - Blowing machine set up

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

Specification(s):
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

Objective(s):
Ensure machine is capable of delivering uniform insulation density and coverage
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15d - Fiberglass blown insulation installation

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

**Specification(s):**
Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot

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

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

**Objective(s):**
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

Fire safety will be maintained
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15e - Replace Gable End Vent Covers

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

Specification(s):
Reinstall the gable end vents

Objective(s):
Prevent pest intrusion into attic

Protect installed insulation
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15f - Verification of details

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

Specification(s):
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

Objective(s):
Verify the integrity of the house has been maintained
4.1003.15 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Gable End Access)

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

4.1003.15g - Onsite documentation

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

Specification(s):
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

Objective(s):
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

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

4.1088.6a - Insulation installation verification

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

Specification(s):
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

Objective(s):
Verify the height and the accessibility of the attic
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6b - Access attic

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

**Specification(s):**
Attic will be accessed through the location that allows the most efficient and effective insulation coverage

**Objective(s):**
Gain access to the flat and cathedral ceiling transition wall
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6c - Blowing

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

**Specification(s):**
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

**Objective(s):**
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
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6d - Spray two-part foam

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

Specification(s):
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

Objective(s):
Insulate and seal transition wall
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6e - Batt

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

**Specification(s):**
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

**Objective(s):**
Insulate to prescribed R-value
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6f - Patching and sealing access points

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

**Specification(s):**
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

**Objective(s):**
Create an airtight seal

Create an aesthetically pleasing finish
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6g - Verification of details

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

**Specification(s):**
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

**Objective(s):**
Verify the integrity of the house has been maintained
4.1088.6 - Installing Insulation at Flat and Cathedral Ceiling Transition Wall

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

4.1088.6h - Onsite Documentation

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

Specification(s):
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)

Objective(s):
Document job completion to contract specifications Confirm amount of insulation installed Comply with 16 CFR 460.17
4.1101.5 - Exterior Wall Dense Packing

Desired Outcome:
Walls properly prepared to receive dense pack insulation

Note:

4.1101.5a - Preparation

Desired Outcome:
Walls properly prepared to receive dense pack insulation

Specification(s):
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

Objective(s):
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
4.1101.5 - Exterior Wall Dense Packing

Desired Outcome:
Walls properly prepared to receive dense pack insulation

Note:

4.1101.5b - Exterior dense pack

Desired Outcome:
Walls properly prepared to receive dense pack insulation

Specification(s):
Using fill tube, 100% of each cavity will be filled to a consistent density:

- Blown fiberglass, mineral fiber, rock and slag wool, or spray foam used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit air flow that corresponds to an air permeance value of 3.5 cubic feet per minute per square foot at 50 pascals
- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot when the wall sheathing and interior cladding will endure this level of pressure
- Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density in accordance with manufacturer specifications
- The number of bags installed will be confirmed and will match the number to achieve 1.5-1.6 pounds per cubic foot
- Insulation will be verified to prevent visible air movement using chemical smoke at 50 pascals of pressure difference

Objective(s):
Eliminate voids and settling
Minimize framing cavity air flows
4.1104.1 - Stuffing Wall Cavities with Fiberglass Batts

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

4.1104.1a - Access wall cavities

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

**Specification(s):**
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.

**Objective(s):**
Gain access to the wall cavity without damaging or separating the siding.
4.1104.1 - Stuffing Wall Cavities with Fiberglass Batts

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

### 4.1104.1b - Exterior wall cavity inspection

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

**Specification(s):**
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

**Objective(s):**
- Prepare wall cavity for insulation
- Prevent water leaks from occurring
4.1104.1 - Stuffing Wall Cavities with Fiberglass Batts

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

4.1104.1c - Fiberglass batt installation tool (stuffer)

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

**Specification(s):**
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

**Objective(s):**
Create a tool to install a fiberglass batt into the cavity

Ensure worker safety
4.1104.1 - Stuffing Wall Cavities with Fiberglass Battss

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

4.1104.1d - Fiberglass batt installation

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

**Specification(s):**
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

**Objective(s):**
Maintain integrity of the batt

Aid in the installation process
4.1104.1 - Stuffing Wall Cavities with Fiberglass Battts

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

4.1104.1e - Sub-sheathing patch and repair

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

**Specification(s):**
Subsheathing will be patched or repaired as necessary

**Objective(s):**
Ensure the integrity of the drainage plane
4.1104.1 - Stuffing Wall Cavities with Fiberglass Batts

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

4.1104.1f - Reattachment

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

**Specification(s):**
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

Return siding to existing conditions without damage
4.1104.1 - Stuffing Wall Cavities with Fiberglass Batts

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

4.1104.1g - Onsite documentation

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

Specification(s):
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
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2a - Access wall cavities

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

Specification(s):
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

Objective(s):
Gain access to the wall cavity without causing damage or separation of the siding
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2b - Exterior wall cavity inspection

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

Specification(s):
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
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2c - Blowing machine set up

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

Specification(s):
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
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2d - Fiberglass blown insulation installation

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

**Specification(s):**
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
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2e - Subsheathing patch and repair

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

Specification(s):
Subsheathing will be patched or repaired as necessary

Objective(s):
Ensure the integrity of the drainage plane
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2f - Reattachment

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

**Specification(s):**
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
4.1104.2 - Fiberglass Blown Insulation Installation (Lifting Siding)

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

4.1104.2g - Onsite documentation

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

Specification(s):
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)

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

4.1104.3a - Access wall cavities

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

**Specification(s):**
With T-111, OSB, or plywood type siding:

- 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
- Drilled holes will be large enough to accommodate an appropriately sized fill tube
- Holes will be drilled around the perimeter of the home, parallel to the bottom plate and an equal distance apart
- The line of holes will be located under the lowest window sill when possible

With lap siding:

- Course of siding will be unhooked or removed
- Holes sufficiently large for the fill tube will be drilled in every wall cavity

**Objective(s):**
Gain access to the wall cavity

Ensure holes are easily covered with an aesthetically pleasing trim strip
4.1104.3 - Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

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

4.1104.3b - Exterior wall cavity inspection

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

Specification(s):
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
4.1104.3 - Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

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

4.1104.3c - Blowing machine set up

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

Specification(s):
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

Objective(s):
Ensure machine is capable of delivering uniform insulation density and coverage
4.1104.3 - Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

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

4.1104.3d - Fiberglass blown insulation installation

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

**Specification(s):**
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

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 top of the cavity between the interior paneling and any existing insulation

**Objective(s):**
Fill entire wall cavity to the prescribed R-value to reduce air infiltration

Avoid clogging of the cavity and the fill tube

Fire safety will be maintained
4.1104.3 - Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

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

4.1104.3e - Plug and seal holes

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

**Specification(s):**
Holes will be plugged and sealed

**Objective(s):**
Ensure the integrity of the drainage plane
4.1104.3 - Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

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

4.1104.3f - Final wall assembly

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

Specification(s):
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

Objective(s):
Ensure the integrity of the drainage plane

Return siding to existing conditions without damage
4.1104.3 - Fiberglass Blown Insulation Installation (via Penetrations Through or Behind the Siding)

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

4.1104.3g - Onsite documentation

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

**Specification(s):**
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
4.1104.4 - Spray Foam Insulation Installation in Cavities above Doors and Windows

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

4.1104.4a - Access wall cavities above doors and windows

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

**Specification(s):**
All interior surfaces of the cavities planned to be insulated will be inspected for loose paneling joints, occupant wall hangings, and other wall obstructions

Objects will be removed from the interior surfaces of the exterior walls as needed

Interior paneling will be repaired and secured as necessary

Holes will be drilled from the interior of the house

A hole no larger than the spray nozzle will be drilled in each cavity above the door or window

When possible, the hole will be drilled in the panel groove

**Objective(s):**
Prepare wall cavity for insulation

Prevent damage from overspray to occupant possessions
4.1104.4 - Spray Foam Insulation Installation in Cavities above Doors and Windows

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

4.1104.4b - Cavity inspection

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

Specification(s):
Cavity will be probed to assess conditions and volume of cavity

Objective(s):
Determine the approximate amount of foam to be installed in the cavity
4.1104.4 - Spray Foam Insulation Installation in Cavities above Doors and Windows

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

4.1104.4c - Insulation installation

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

**Specification(s):**
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

**Objective(s):**
Fill entire wall cavity to the prescribed R-value to reduce air infiltration

Fire safety will be maintained
4.1104.4 - Spray Foam Insulation Installation in Cavities above Doors and Windows

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

4.1104.4d - Final wall assembly

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

**Specification(s):**
A color-corresponding sealant will be applied to the access hole

**Objective(s):**
Ensure wall is aesthetically pleasing
4.1104.4 - Spray Foam Insulation Installation in Cavities above Doors and Windows

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

4.1104.4e - Onsite documentation

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

**Specification(s):**
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
4.1302.1 - Prepare Belly Floor Cavity for Insulation

Desired Outcome:
Belly floor cavity ready for insulation

Note:

4.1302.1a - Work assessment

Desired Outcome:
Belly floor cavity ready for insulation

Specification(s):
Gas, water, waste, and electrical lines will be checked for:

- Plumbing leaks
- Gas/oil leaks
- Attachment
- Standing water
- Raw sewage
- Pests

Objective(s):
Ensure that floor space is safe and ready for work

Verify scope of work
4.1302.1 - Prepare Belly Floor Cavity for Insulation

**Desired Outcome:**
Belly floor cavity ready for insulation

**Note:**

4.1302.1b - Preparation

**Desired Outcome:**
Belly floor cavity ready for insulation

**Specification(s):**
Where bottom board/rodent barrier is missing or damaged and accessible, the following will be ensured:

- Duct sealing completed
- Gas, water, and electrical lines secured at least every 4' to a floor joist or framing member
- Water line will be located on the warm side of the insulation; if not, the water lines will be insulated appropriately
- No water or gas leaks are present
- Waste lines are sloped to ¼" per foot
- Bottom board/rodent barrier is sound/strong enough to support insulation

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

**Objective(s):**
Ensure problems are corrected before floor cavity insulation work begins

Keep pipes from freezing
4.1303.1 - Insulation of Floor Cavity with Blown Material

**Desired Outcome:**
Consistent thermal boundary between conditioned and unconditioned space that reduces heat flow

4.1303.1e - Occupant education

**Desired Outcome:**
Consistent thermal boundary between conditioned and unconditioned space that reduces heat flow

**Specification(s):**
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

**Objective(s):**
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
Best Practice

Provide occupant with signed, dated receipt documenting information about insulation installed.

Documentation shall include:
- insulation type,
- coverage area,
- R-value,
- installed thickness,
- and number of bags installed.

Provide occupant with copies of all documentation.

Communicate professionally with occupant to provide information and support.
4.1303.2 - Insulation of Floor Cavity with Batt Material

Desired Outcome:
Consistent thermal boundary between conditioned and unconditioned space that reduces heat flow

4.1303.2e - Occupant education

Desired Outcome:
Consistent thermal boundary between conditioned and unconditioned space that reduces heat flow

Specification(s):
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

Best Practice
Provide occupant with signed, dated receipt documenting information about insulation installed
Documentation shall include: coverage area, thickness of insulation installed, and R-value

Provide occupant with copies of all documentation

Communicate professionally with occupant to provide information and support
4.1402.2 - Basement Wall Insulation—No Groundwater Leakage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.2a - R-value

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

**Specification(s):**
Regional IECC will be followed for required R-values

**Objective(s):**
Improve thermal performance of the basement and living space
4.1402.2 - Basement Wall Insulation—No Groundwater Leakage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.2a - R-value

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

**Specification(s):**
Regional IECC will be followed for required R-values

**Objective(s):**
Improve thermal performance of the basement and living space

<table>
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</tr>
<tr>
<td>Zone 6-8</td>
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</table>

**Best Practice**
Find your regional zone and insulation application to determine r-value
4.1402.2 - Basement Wall Insulation—No Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.2b - Air barrier

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
A continuous air barrier will be installed on the warm side of the insulation

Objective(s):
Prevent condensation on the basement wall
4.1402.2 - Basement Wall Insulation—No Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.2b - Air barrier

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
A continuous air barrier will be installed on the warm side of the insulation

Objective(s):
Prevent condensation on the basement wall

Tools:
1. Utility knife
2. Tape measure
3. Drill
4. Taping knife

Materials:
1. XPS insulation board
2. Kraft-faced fiberglass batts
3. Drywall
4. Spackle
5. Seam tape
6. Fasteners
XPS insulation board is a non-absorbent insulation option. The drywall still provides an air barrier to keep moisture build up on wall. OR Kraft-faced fiberglass batts can be used with paper toward living space. Both kraft-face and drywall create air barrier, but batts are absorbent.
4.1402.2 - Basement Wall Insulation—No Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.2c - Vapor permeability

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
When absorbent insulation materials are installed, assembly will remain vapor semi-impermeable to the interior in all climate zones except Zone 7

Objective(s):
Provide drying potential to the basement

Tools:  
1. Utility knife  
2. Tape measure  
3. Drill  
4. Taping knife

Materials:  
1. XPS insulation board  
2. Drywall  
3. Kraft-faced fiberglass batts  
4. Spackle  
5. Seam tape  
6. Fasteners
The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50.

In zones 7 & 8 (AK, parts of MN, ND, WI, MI, WY, CO, and ME), vapor retarders should be used to minimize freezing. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of <0.5 (which translates to 4mil or thicker). From 2007 IRC definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).

Determine in which zone you are working before selecting work materials

In zones 7&8, vapor permeability is undesirable. Use a vapor retarder

Many lightweight wallboard brands have higher perm ratings for humid zones
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3a - Drainage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
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

Objective(s):
Remove moisture on the surface of the exterior basement wall
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3a - Drainage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

**Specification(s):**
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

**Objective(s):**
Remove moisture on the surface of the exterior basement wall
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3b - Rough finish walls (e.g., rubble walls)

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
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

Objective(s):
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
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3b - Rough finish walls (e.g., rubble walls)

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

**Specification(s):**
- Drainage plane will be replaced with a waterproof membrane
- Only a non-absorbent 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

**Objective(s):**
- 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
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3c - Thermal barrier, insulation

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
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

Objective(s):
Improve thermal performance of the basement and the living space
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3c - Thermal barrier, insulation

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
A non-absorbent 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

Objective(s):
Improve thermal performance of the basement and the living space
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Baseline insulation improves thermal performance and ensures sufficient drying potential

4.1402.3d - Location

Desired Outcome:
Baseline insulation improves thermal performance and ensures sufficient drying potential

 Specification(s):
Insulation will be installed continuously from the top of the band joist to the top of the slab

 Objective(s):
Maintain a continuous thermal boundary on the interior side of the exterior basement wall
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3d - Location

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
Insulation will be installed continuously from the top of the band joist to the top of the slab

Objective(s):
Maintain a continuous thermal boundary on the interior side of the exterior basement wall
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3e - Termite protection

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
Where termite pressure exists, if sub-slab drainage is installed, termite treatment will be performed before re-installing the slab

Objective(s):
Provide termite protection
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3e - Termite protection

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

**Specification(s):**
Where termite pressure exists, if subslab drainage is installed, termite treatment will be performed before reinstalling the slab

**Objective(s):**
Provide termite protection
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3f - Insulation attachment

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
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

Objective(s):
Secure thermal boundary without compromising the insulation
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3f - Insulation attachment

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
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

Objective(s):
Secure thermal boundary without compromising the insulation
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3g - R-value

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
Regional IECC will be followed for required R-value

Objective(s):
Improve thermal performance of the basement and living space
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3g - R-value

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
Regional IECC will be followed for required R-value

Objective(s):
Improve thermal performance of the basement and living space

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Best Practice
Find your regional zone and insulation application to determine r-value
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3h - Sealing

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
A continuous air barrier on the warm side of the thermal boundary will be installed, including floor-to-wall and wall-to-ceiling connections

Objective(s):
Prevent convective air leakage from the basement, through the drainage plane, and back into the basement
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3h - Sealing

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
A continuous air barrier on the warm side of the thermal boundary will be installed, including floor-to-wall and wall-to-ceiling connections

Objective(s):
Prevent convective air leakage from the basement, through the drainage plane, and back into the basement
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3i - Finish wall requirements

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
International Residential Code (IRC) will be followed for finished wall details in basements

Objective(s):
Install a durable, finished wall
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3i - Finish wall requirements

**Desired Outcome:**
Basement insulation improves thermal performance and ensures sufficient drying potential

**Specification(s):**
IRC will be followed for finished wall details in basements

**Objective(s):**
Install a durable, finished wall
4.1402.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.3j - Onsite documentation

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
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
4.1488.1 - Climate Considerations for Insulating Water Lines Located Between Bottom Board and Ground

**Desired Outcome:**
Water supply line does not freeze in cold climates

**Note:**

4.1488.1b - Installation

**Desired Outcome:**
Water supply line does not freeze in cold climates

**Specification(s):**
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

**Objective(s):**
Ensure fire safety

Protect supply pipe from freezing

---

![In Progress](image1)
Properly installed freeze protection heat tape

![After](image2)
Insulated, freeze protected water line
Tools:
1. Utility knife
2. Rags

Materials:
1. Heat tape
2. Zip ties (to attach thermostat)
3. Electrical tape
4. 1/2" thick fiberglass insulation

To prevent pipe freezing and reduce the risk of fire, follow manufacturer's instructions carefully. Choose the proper length heat tape for the pipe to be protected. When using multiple lengths of heat tape on long pipes, start subsequent runs of heat tape one foot before the end of the previous run on opposite sides of the pipe. Never overlap or cross heat tape with itself. Complete heat tape installation instructions may be found here: https://www.foremost.com/mygreatesthome/mobile-home-repair/seasonal/how-to-install-heat-tape.asp

1. Install thermostat in firm contact with the pipe at the coldest point
2. Fasten heat tape to pipe with electrical tape every six inches.
3. Measure and cut insulation to fit water lines. Miter insulation at elbows and tees
4. Fasten insulation to water lines with zip ties
5. Cover all exposed portions of the water supply lines with insulation
4.1601.3 - Insulation and Vapor Barrier

**Desired Outcome:**
Minimize condensation

**Note:**

4.1601.3a - Ducts in unconditioned spaces (e.g., crawl space, attic, unconditioned basements)

**Desired Outcome:**
Minimize condensation

**Specification(s):**
Ducts will have continuous insulation and vapor barrier

Insulation will be sufficient to prevent dew point on surface of ducts

**Objective(s):**
Minimize condensation
4.1601.3 - Insulation and Vapor Barrier

Desired Outcome:
Minimize condensation

Note:

4.1601.3b - Ducts within floor assemblies

Desired Outcome:
Minimize condensation

Specification(s):
Inspection and/or testing will be conducted to determine whether ducts are within thermal, pressure, and vapor boundary

If ducts are within thermal, pressure, and vapor boundary, no action will be required

If ducts are not within thermal, pressure, and vapor boundary, continuous air barrier, insulation, and vapor retarder will be installed either on the ducts or at the belly liner

Objective(s):
Minimize condensation
4.1601.3 - Insulation and Vapor Barrier

Desired Outcome:
Minimize condensation

Note:

4.1601.3c - Exposed metal

Desired Outcome:
Minimize condensation

Specification(s):
All exposed metal will have continuous insulation and vapor retarder

Objective(s):
Minimize condensation
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4a - Removal of existing flexible ducting

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
All accessible low R-value flexible ducting will be removed from premises

Objective(s):
Ensure installation of proper R-value ducts
4.1601.4 - Insulating Flex Ducts

**Desired Outcome:**
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

**Note:**

4.1601.4b - Selection of new flexible ducting

**Desired Outcome:**
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

**Specification(s):**
All flexible ducting will have a minimum of R-8

**Objective(s):**
Minimize thermal conductance through the duct system
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4c - Sizing of new flex

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Duct-sizing procedures will be conducted when replacing flex duct

Objective(s):
Improve comfort in rooms

Improve fan performance
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4d - Installation of flex

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Flex duct will be supported in accordance with flex duct manufacturer’s directions or local codes

Beaded rigid elbow or equivalent will be installed in duct runs whenever change in direction is required

Objective(s):
Prevent sags, drops, or other bends that may interfere with correct air flow

Maintain duct diameter around the turns

Maximize air flow and distribution
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4e - Interior liner attachment

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Interior liner of the flex-to-metal connection 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 fasteners will be used

Objective(s):
Create a strong, secure attachment
4.1601.4 - Insulating Flex Ducts

**Desired Outcome:**
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

**Note:**

4.1601.4f - Sealing of interior liner

**Desired Outcome:**
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

**Specification(s):**
UL 181 B-M-listed mastic product will be used to seal the connection

**Objective(s):**
Create an airtight connection
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4g - Attachment of exterior liner

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Liner will be pulled up onto the metal duct as far as possible before securing

The exterior liner of the flex duct will be fastened with tie bands using a tie band tensioning tool

Objective(s):
Create a strong, durable attachment
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4h - Sealing of all accessible ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
All accessible joints, seams, and connections will be sealed with UL 181 approved mastics

Objective(s):
Minimize duct leakage
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4i - Insulation of all fittings

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
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

Objective(s):
Minimize thermal conductance of the duct system
Minimize condensation
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4j - Completeness of vapor barrier

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
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

Vapor barrier will be sealed to the belly liner

Objective(s):
Ensure a complete vapor barrier
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4k - Vermin proofing

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Vermin access points will be identified and treated appropriately (e.g., seal access holes)

Objective(s):
Ensure long-term durability of the building materials
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4I - CAZ testing

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
CAZ testing will be performed where combustion appliances are utilized

Objective(s):
Identify unsafe equipment operating conditions
4.1601.5 - Insulating Metal Ducts

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Note:

4.1601.5a - Selection of duct insulation material

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
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

Objective(s):
Decrease heat loss and condensation problems

In mixed or hot/humid climates, ensure that ducts are properly sealed, wrapped in insulation, and have an intact, sealed vapor barrier (typically kraft-backed foil or shiny Mylar material) before blowing loose fill insulation over them. The duct wrap and vapor barrier minimizes condensation forming on the ducts.
Ducts in unconditioned areas should have R-8 insulation with vapor barrier. OR ducts can be buried in loose fill in attic spaces in drier climates. Burying ducts is discouraged in warm coastal and hot humid regions.
4.1601.5 - Insulating Metal Ducts

**Desired Outcome:**
Lowered thermal conductance of duct system and minimized condensation on the duct system

**Note:**

4.1601.5b - Duct sealing

**Desired Outcome:**
Lowered thermal conductance of duct system and minimized condensation on the duct system

**Specification(s):**
All accessible ducts will be sealed with a UL-181 mastic before insulation is applied

**Objective(s):**
Minimize duct leakage

![Before](image1.png) **Before**
Unsealed joints and connections need to be sealed to prevent health risks

![After](image2.png) **After**
Sealed ductwork connections help prevent leakage

**Tools:**
1. Putty knife

**Materials:**
1. UL-181 mastic
2. Fiberglass mesh tape

**test text**
Prepare work area by assessing any safety concerns

Wrap joint with fiberglass mesh tape

Apply UL 181 mastic to seal joint
4.1601.5 - Insulating Metal Ducts

**Desired Outcome:**
Lowered thermal conductance of duct system and minimized condensation on the duct system

**Note:**

4.1601.5c - Attachment of duct insulation

**Desired Outcome:**
Lowered thermal conductance of duct system and minimized condensation on the duct system

**Specification(s):**
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

**Objective(s):**
Ensure a secure connection between the duct system and the duct insulation

Ensure performance of the installed material

Minimize condensation
Materials holding insulation in place should not compress or kink duct

Before

Durable materials can be attached without compressing insulation

After

Tools:
1. Scissors
2. Metal snips

Materials:
1. Nylon twine
2. Wire
3. Tie bands
4.1601.5 - Insulating Metal Ducts

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Note:

4.1601.5d - Taping of the vapor barrier

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
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

Objective(s):
Prevent gaps in the vapor barrier of the insulation

Tools:  
1. Utility knife

Materials:  
1. UL-181 tape  
2. R-8 duct insulation with vapor barrier
4.1601.5 - Insulating Metal Ducts

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Note:

4.1601.5e - Vermin proofing

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
Vermin access points will be identified and treated appropriately (e.g., seal access holes)

Objective(s):
Ensure long-term durability of the building materials
5.3001.1 - Load Calculation and Equipment Selection

Desired Outcome:
Equipment sized properly and operates efficiently

5.3001.1a - Load calculation

Desired Outcome:
Equipment sized properly and operates efficiently

Specification(s):
Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J (Residential Load Calculation) and manufacturer specifications

Objective(s):
Properly size equipment for load
5.3001.1 - Load Calculation and Equipment Selection

*Desired Outcome:*
Equipment sized properly and operates efficiently

5.3001.1b - Equipment selection

*Desired Outcome:*
Equipment sized properly and operates efficiently

*Specification(s):*
Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications

*Objective(s):*
Ensure equipment is able to heat, cool, and dehumidify the house
5.3001.1 - Load Calculation and Equipment Selection

Desired Outcome:
Equipment sized properly and operates efficiently

5.3001.1c - Air filtration

Desired Outcome:
Equipment sized properly and operates efficiently

Specification(s):
New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters

Objective(s):
Particle removal to protect equipment and help maintain indoor air quality
5.3001.3 - Replace Return Air Systems that Incorporate Floor Cavity (Belly) and/or Attic as the Return Air Pathway

Desired Outcome:
Effective, efficient, safe, and durable return air system

Note:

5.3001.3d - Combustion Appliance Zone (CAZ) testing

Desired Outcome:
Effective, efficient, safe, and durable return air system

Specification(s):
CAZ testing will be performed where combustion appliances are utilized

Objective(s):
Identify unsafe equipment operating conditions

Best Practice

Tools:
1. Manometer
2. Mirror
3. Chemical smoke pencil
4. Stopwatch or watch with second hand
5. Combustion analyzer
6. 1/4" air line tubing
7. Gas leak detector

At the end of each day in which duct sealing or repair is performed, conduct Combustion Appliance Zone (CAZ) testing
5.3003.1 - Data Plate Verification

Desired Outcome:
Data for commissioning and future service work is recorded

5.3003.1a - Data plate verification

Desired Outcome:
Data for commissioning and future service work is recorded

Specification(s):
Equipment will be visually inspected
Information will be recorded from the equipment data plates indoors and outdoors where available

Objective(s):
Ensure technician has equipment data necessary for commissioning and future service work
5.3003.3 - Evaluating Air Flow

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.

5.3003.3a - Total air flow

Desired Outcome:
Air flow is properly tested

Specification(s):
Total system air flow will be measured by one of the following methods:

- Temperature rise
- Flow plate
- Fan depressurization device (e.g., Duct Blaster®, DucTester®)

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.3 - Evaluating Air Flow

**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.

5.3003.3b - External static pressure

**Desired Outcome:**
Air flow is properly tested

**Specification(s):**
External static pressure will be in accordance with manufacturer specifications

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.3 - Evaluating Air Flow

**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.

5.3003.3c - Pressure

**Desired Outcome:**
Air flow is properly tested

**Specification(s):**
Pressure drop across cooling coils will be in accordance with manufacturer specifications

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.3 - Evaluating Air Flow

**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.

5.3003.3d - Filter Inspection

**Desired Outcome:**
Air flow is properly tested

**Specification(s):**
Visual inspection to verify filter type is per manufacturer specifications, and is clean

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.3 - Evaluating Air Flow

**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.

5.3003.3e - Balancing room flow: new ductwork

**Desired Outcome:**
Air flow is properly tested

**Specification(s):**
Proper air flow delivery to each room will be ensured by one of the following:

Measuring air flow at each register

OR

Measuring heat rise, room pressures, and interviewing residents to ensure their comfort.

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.3 - Evaluating Air Flow

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.

5.3003.3f - Supply wet bulb and dry bulb

Desired Outcome:
Air flow is properly tested

Specification(s):
Supply and return wet bulb (wet bulb temperature is measured for cooling systems only) and dry bulb air temperatures will be recorded

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.3 - Evaluating Air Flow

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.

5.3003.3h - Temperature rise: gas and oil furnaces only

Desired Outcome:
Air flow is properly tested

Specification(s):
Temperature rise between the supply and return will be in accordance with manufacturer specifications

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable
5.3003.5 - Refrigerant Line Inspection

Desired Outcome:
Refrigerant lines properly installed

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

5.3003.5a - Insulation

Desired Outcome:
Refrigerant lines properly installed

Specification(s):
All suction or vapor refrigerant lines, will be insulated to a minimum of R-4

High-side or liquid refrigerant lines will not be insulated unless specified by the equipment's manufacturer

Objective(s):
Ensure refrigerant lines do not gain excessive heat, or cause condensation to occur inside the building envelope
5.3003.5 - Refrigerant Line Inspection

Desired Outcome:
Refrigerant lines properly installed

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

5.3003.5b - Ultraviolet (UV) protection of insulation

Desired Outcome:
Refrigerant lines properly installed

Specification(s):
If exposed to sunlight, refrigerant line insulation will be protected from UV degradation in accordance with manufacturer specifications, IRC or local code

Objective(s):
Install insulation so it does not degrade
5.3003.5 - Refrigerant Line Inspection

Desired Outcome:
Refrigerant lines properly installed

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

5.3003.5c - Sizing

Desired Outcome:
Refrigerant lines properly installed

Specification(s):
Refrigerant lines will be sized to meet manufacturer specifications for the installed equipment

Objective(s):
Ensure system moves appropriate volume of refrigerant
5.3003.5 - Refrigerant Line Inspection

Desired Outcome:
Refrigerant lines properly installed

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

5.3003.5d - Installation quality

Desired Outcome:
Refrigerant lines properly installed

Specification(s):
Refrigerant lines will be installed without kinks, crimps, or excessive bends

Objective(s):
Ensure system moves appropriate volume of refrigerant
5.3003.5 - Refrigerant Line Inspection

Desired Outcome:
Refrigerant lines properly installed

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

5.3003.5e - Support

Desired Outcome:
Refrigerant lines properly installed

Specification(s):
Refrigerant lines will be routed, supported, and secured to house in a manner that protects the line from damage by workers or occupants

Objective(s):
Ensure refrigerant lines do not move, vibrate, or sag

Protect lines from damage
5.3003.6 - Evaluating Sequence of Operation

Desired Outcome:
Sequence of operation of the system verified

5.3003.6a - Verification

Desired Outcome:
Sequence of operation of the system verified

Specification(s):
The sequence of operation of the system will be verified in accordance with the manufacturer installation, operation, and maintenance manual. If every effort to secure the manufacturer's manual proves unsuccessful, the technician will rely on standard industry testing protocols.

Objective(s):
Ensure system components function and operate in the correct sequence
5.3003.7 - Occupant Education

**Desired Outcome:**
Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

5.3003.7h - Carbon monoxide (CO)

**Desired Outcome:**
Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

**Specification(s):**
A carbon monoxide (CO) alarm will be installed

**Objective(s):**
Occupant will be made aware of operation of CO alarm

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**Best Practice**
Carbon Monoxide alarms should be installed according to local codes

**Best Practice**
Alarms should be mounted near sleeping areas—such as the one marked in red
5.3003.11 - Heating and Cooling Controls

Desired Outcome:
Heating and cooling controls installed and set properly

5.3003.11a - Removal of mercury-based thermostats

Desired Outcome:
Heating and cooling controls installed and set properly

Specification(s):
Mercury-based thermostat will be removed safely and disposed of in accordance with EPA regulations

Objective(s):
Protect workers and occupants from injury

Protect environment from damage

Paraphrased from 40 CFR 273.14: A universal waste mercury-containing thermostat or container containing only universal waste mercury-containing thermostats should be labeled or marked clearly with any of the following phrases: "Universal Waste-Mercury Thermostat(s)," "Waste Mercury Thermostat(s)," or "Used Mercury Thermostat(s)." **Contact thermostat-recycle.org or earth911.org for recycling options.
5.3003.12 - Package Units—Repair and Service

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

5.3003.12a - Work assessment

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

Specification(s):
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 HVAC Quality Installation Specification will be followed

Objective(s):
Determine the scope of repair, service, and level of expertise required to perform the work
5.3003.12 - Package Units—Repair and Service

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

5.3003.12b - Remove existing system components

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

Specification(s):
Nonsalvageable components and waste will be removed and disposed of properly
Refrigerant will be removed in accordance with EPA requirements

Objective(s):
Prepare for installation of new equipment or components
Ensure environmental and legal compliance
5.3003.12 - Package Units—Repair and Service

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

5.3003.12c - Repairs

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

Specification(s):
Repairs will be performed by qualified specialist as identified in the assessment

Maintenance will be done in accordance with ANSI/ACCA 4

Maintenance of Residential HVAC Systems and ANSI/ACCA 6 HVAC System Cleanliness

Objective(s):
Optimize performance of the system
5.3003.12 - Package Units—Repair and Service

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

5.3003.12d - Service existing components

Desired Outcome:
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

Specification(s):
Service will be performed by qualified personnel as identified in the assessment

Maintenance will be done in accordance with ANSI/ACCA 4

Maintenance of Residential HVAC Systems and ANSI/ACCA 6 HVAC System Cleanliness

Objective(s):
Optimize performance of the system
5.3003.12 - Package Units—Repair and Service

**Desired Outcome:**
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

5.3003.12e - Commissioning

**Desired Outcome:**
Maximize efficiency and performance of existing system, when required by the authority having jurisdiction

**Specification(s):**
Equipment will be fully tested for proper operation following procedures outlined in ANSI/ACCA 5 QI

Property manager/occupant will be educated on how to operate and maintain system, including thermostat operation and system changes

**Objective(s):**
Ensure proper system operation

Ensure property manager/occupant is educated
5.3003.13 - Refrigerant Charge Evaluation

Desired Outcome:
Properly charged system

5.3003.13a - Prerequisite

Desired Outcome:
Properly charged system

Specification(s):
Leak detection, air flow, and refrigerant line inspection will be checked and repaired to determine need for refrigerant charge

Objective(s):
Eliminate possible sources of other problems before addressing refrigerant charging
5.3003.13 - Refrigerant Charge Evaluation

Desired Outcome:
Properly charged system

5.3003.13b - Qualified contractor

Desired Outcome:
Properly charged system

Specification(s):
Charge will be tested and work performed by a qualified contractor
Refrigerant charge will be in accordance with ANSI/ACCA 5 QI HVAC Quality Installation Specification refrigerant charging requirements for mixed humid, hot humid, marine, and hot dry climates

Objective(s):
Ensure compliance with codes and environmental regulations
Ensure proper equipment charge
5.3003.13 - Refrigerant Charge Evaluation

Desired Outcome:
Properly charged system

5.3003.13c - Documentation

Desired Outcome:
Properly charged system

Specification(s):
Contractor will provide documentation of work performed

Objective(s):
Maintain record of work performed
5.3003.13 - Refrigerant Charge Evaluation

**Desired Outcome:**
Properly charged system

5.3003.13d - Quality assurance

**Desired Outcome:**
Properly charged system

**Specification(s):**
External static pressure will be measured and documented

EPA refrigerant charge log will be provided

**Objective(s):**
Ensure external static pressure is within range in accordance with manufacturer specifications

Ensure quality workmanship
5.3003.14 - Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

**Desired Outcome:**
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14a - Gas Pressure

**Desired Outcome:**
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

**Specification(s):**
Measurement will be verified by a certified professional in accordance with fuel type and manufacturer specifications

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable
5.3003.14 - Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14b - Place appliance in operation

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
Heating equipment will be placed in operation in accordance with applicable NFPA standards and manufacturer specifications when available

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable
5.3003.14 - Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14c - Carbon dioxide (CO2) and oxygen (O2)

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
Measurement will be verified in accordance with industry manuals (e.g., Testo, Bacharach)

Objective(s):
Ensure equipment:

• Operates as designed
• Operates safely
• Operates efficiently
• Is durable
5.3003.14 - Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

**Desired Outcome:**
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14d - Carbon monoxide (CO) in flue gas

**Desired Outcome:**
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

**Specification(s):**
CO in the undiluted flue gas will be less than 400 ppm air-free

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable
5.3003.14 - Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14e - Testing/inspection holes

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
All testing and inspection holes will be sealed with manufacturer approved materials

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16a - Service entrance

Desired Outcome:
Electrical components properly tested

Specification(s):
Homes will have a four-wire service entrance to the panel box to ensure a wiring system that is nominally rated at 120/240 volts and allows for proper grounding

Grounding at the service entrance will be checked to determine proper grounding of the home

Objective(s):
Ensure occupant and worker safety
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16b - Polarity

Desired Outcome:
Electrical components properly tested

Specification(s):
Polarity of equipment will be verified by a qualified technician if wiring is to be modified or repaired

Objective(s):
Ensure equipment:

• Operates as designed
• Operates safely
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16c - Voltage: incoming power

Desired Outcome:
Electrical components properly tested

Specification(s):
Voltage will be in accordance with manufacturer specifications

Objective(s):
Ensure equipment operates as designed
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16d - Voltage: contactor

Desired Outcome:
Electrical components properly tested

Specification(s):
Voltage drop will be within acceptable range in accordance with manufacturer specifications

Objective(s):
Ensure contactor does not overheat

Ensure equipment operates as designed
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16e - Grounding

Desired Outcome:
Electrical components properly tested

Specification(s):
Grounding will be connected in compliance with local code requirements, ANSI/NEMA GR 1-2007, and NFPA 70 National Electric Code

Frames of home sections will be bonded with copper wire

Bonding lug will be selected to prevent corrosion due to dissimilar metals

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely

Ensure ground continuity among sections
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16f - Blower amperage

Desired Outcome:
Electrical components properly tested

Specification(s):
Amperage will not exceed manufacturer full load amperage

Objective(s):
Ensure equipment:

• Operates as designed
• Operates efficiently
• Operates safely
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16g - Compressor amperage

Desired Outcome:
Electrical components properly tested

Specification(s):
Amperage will not exceed manufacturer full load amperage

Objective(s):
Ensure equipment:

• Operates as designed
• Operates efficiently
• Operates safely
5.3003.16 - Evaluating Electrical Service

Desired Outcome:
Electrical components properly tested

Note:

5.3003.16h - Door switch operation

Desired Outcome:
Electrical components properly tested

Specification(s):
Blower compartment safety switch operation will be verified, if present

Objective(s):
Ensure blower:

- Does not operate during service
- Cannot backdraft a flue when the door is off
5.3003.16 - Evaluating Electrical Service

**Desired Outcome:**
Electrical components properly tested

**Note:**

5.3003.16i - Heat pump: emergency heat

**Desired Outcome:**
Electrical components properly tested

**Specification(s):**
Emergency heat circuit functions will be verified

**Objective(s):**
Ensure system delivers heat in case of compressor failure
5.3202.1 - Reflective Coatings on Metal Roofs

Desired Outcome:
Reduce solar heat gain for manufactured homes

Note:

5.3202.1a - Assessment

Desired Outcome:
Reduce solar heat gain for manufactured homes

Specification(s):
Existing roof coating will be assessed for hazardous material

Objective(s):
Ensure worker and occupant safety
5.3202.1 - Reflective Coatings on Metal Roofs

**Desired Outcome:**
Reduce solar heat gain for manufactured homes

**Note:**

5.3202.1b - Preparation

**Desired Outcome:**
Reduce solar heat gain for manufactured homes

**Specification(s):**
Roof will be stripped of all debris, algae, and peeled and loose coating

Repairs to roof and penetrations will be made before application

**Objective(s):**
Ensure roof is clean, dry, and structurally sound for proper adhesion of new coating
5.3202.1 - Reflective Coatings on Metal Roofs

Desired Outcome:
Reduce solar heat gain for manufactured homes

Note:

5.3202.1c - Materials selection

Desired Outcome:
Reduce solar heat gain for manufactured homes

Specification(s):
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

Objective(s):
Provide proper reflective coating
5.3202.1 - Reflective Coatings on Metal Roofs

Desired Outcome:
Reduce solar heat gain for manufactured homes

Note:

5.3202.1d - Application

Desired Outcome:
Reduce solar heat gain for manufactured homes

Specification(s):
Roof-coating material will be applied in accordance with manufacturer specifications

Objective(s):
Ensure proper application
5.3202.1 - Reflective Coatings on Metal Roofs

Desired Outcome:
Reduce solar heat gain for manufactured homes

Note:

5.3202.1e - Occupant education

Desired Outcome:
Reduce solar heat gain for manufactured homes

Specification(s):
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
6.6002.3 - Exhaust-Only Ventilation—Fan Intake Grille Location

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

**Note:**

6.6002.3a - Primary whole house ventilation

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

**Specification(s):**
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

**Objective(s):**
Provide whole house air exchange
6.6002.3 - Exhaust-Only Ventilation—Fan Intake Grille Location

Desired Outcome:
Exhaust grille location optimizes either primary or local ventilation

Note:

6.6002.3b - Local ventilation

Desired Outcome:
Exhaust grille location optimizes either primary or local ventilation

Specification(s):
Fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are generated

Objective(s):
Remove contaminated air at the source
6.6002.4 - Ducts (Exhaust Fans)

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Note:

6.6002.4a - Duct design and configuration

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
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

Objective(s):
Effectively move the required volume of air
6.6002.4 - Ducts (Exhaust Fans)

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Note:

6.6002.4b - Duct insulation

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or in accordance with local codes

Objective(s):
Prevent condensation from forming or collecting inside or outside of the ductwork
6.6002.4 - Ducts (Exhaust Fans)

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Note:

6.6002.4c - Duct support

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
Horizontal runs will be supported in accordance with flex duct manufacturer specifications and local codes

Supports with a width of at least 1 ½” will be used or adequate metal support

Objective(s):
Effectively move the required volume of air

Preserve the integrity of the duct system
6.6002.4 - Ducts (Exhaust Fans)

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Note:

6.6002.4d - Duct connections

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
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

Objective(s):
Effectively move the required volume of air

Preserve the integrity of the duct system
6.6002.4 - Ducts (Exhaust Fans)

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

**Note:**

6.6002.4e - Duct materials

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

**Specification(s):**
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

**Objective(s):**
Effectively move the required volume of air

Preserve the integrity of the duct system
6.6002.4 - Ducts (Exhaust Fans)

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

**Note:**

6.6002.4f - Total exhaust airflow

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

**Specification(s):**
Total exhaust system ventilation airflow will be measured

**Objective(s):**
Ensure air flow is as designed
6.6003.1 - Surface-Mounted Ducted

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.

6.6003.1a - Hole through interior surface

Desired Outcome:
Surface-mounted ducted fans installed to specification

Specification(s):
A hole no greater than a 1/4" greater than the assembly will be cut to accommodate fan assembly

Objective(s):
Minimize repair work

Ensure a secure installation

Tools:
1. Tape measure
2. Saw
3. Writing utensil

In Progress
Determine size to cut hole by measuring fan assembly and ducting

After
A snug fit should be ensured to minimize weatherproofing required
Measure the termination fitting to determine proper hole diameter (in this case, 4"").

Hole should be no more than 1/4" larger than assembly diameter.

Clear wall surface and mark hole size 1/4" larger than termination fitting.

Since opening is larger than most hole saws, precision cutting is important.
6.6003.1 - Surface-Mounted Ducted

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.

6.6003.1d - Backdraft damper

Desired Outcome:
Surface-mounted ducted fans installed to specification

Specification(s):
A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):
Prevent reverse air flow when the fan is off

Best Practice
Damper will be installed to maintain exterior air barrier
6.6003.1 - Surface-Mounted Ducted

**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.

6.6003.1j - Combustion safety

**Desired Outcome:**
Surface-mounted ducted fans installed to specification

**Specification(s):**
Pressure effects will be assessed and corrected on all combustion appliances

**Objective(s):**
Ensure safe operation of combustion appliances
6.6003.2 - Inline

 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.

6.6003.2a - Wiring

 Desired Outcome:
Inline fans installed to specification

 Specification(s):
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

 Objective(s):
Prevent an electrical hazard
6.6003.2 - Inline

**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.

6.6003.2b - Access

**Desired Outcome:**
Inline fans installed to specification

**Specification(s):**
Fan and service switch will be accessible for maintenance according to NFPA 70 National Electric Code or local authority having jurisdiction

**Objective(s):**
Fan and service switch will be accessible for maintenance
6.6003.2 - Inline

**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.

6.6003.2c - Fan mounting

**Desired Outcome:**
Inline fans installed to specification

**Specification(s):**
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

**Objective(s):**
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
6.6003.2 - Inline

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.

6.6003.2d - Backdraft damper

Desired Outcome:
Inline fans installed to specification

Specification(s):
A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):
Prevent reverse air flow when the fan is off
6.6003.2 - Inline

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.

6.6003.2e - Duct connections

Desired Outcome:
Inline fans installed to specification

Specification(s):
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

Objective(s):
Exhaust from desired location to outside

Preserve integrity of the duct system and building envelope
6.6003.2 - Inline

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.

6.6003.2f - Boot to interior surface seal

Desired Outcome:
Inline fans installed to specification

Specification(s):
Sealants will be compatible with their intended surfaces
Sealants will be continuous and meet fire barrier specifications

Objective(s):
Prevent air leakage around intake housing
Prevent a fire hazard
6.6003.2 - Inline

**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.

6.6003.2g - Air flow

**Desired Outcome:**
Inline fans installed to specification

**Specification(s):**
Air flows in CFM will be measured and adjusted to meet the design requirements

**Objective(s):**
Exhaust sufficient air from desired locations to outside
6.6003.2 - Inline

**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.

6.6003.2h - Preventing air leakage caused by exhaust fans

**Desired Outcome:**
Inline fans installed to specification

**Specification(s):**
Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics)

**Objective(s):**
Ensure occupant health and safety
6.6003.2 - Inline

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.

6.6003.2i - Combustion safety

Desired Outcome:
Inline fans installed to specification

Specification(s):
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

Objective(s):
Ensure safe operation of combustion appliances
6.6003.6 - Fan Placement (Whole House/Common Space Exhaust Only)

Desired Outcome:
Provide primary ventilation for common spaces

Note:

6.6003.6a - Clearance

Desired Outcome:
Provide primary ventilation for common spaces

Specification(s):
Clearance for size of the fan recommended will be determined
Consideration will be given for adequate head clearance

Objective(s):
Ensure access for installation, operation, and maintenance
Ensure occupant safety
6.6003.6 - Fan Placement (Whole House/Common Space Exhaust Only)

**Desired Outcome:**
Provide primary ventilation for common spaces

**Note:**

6.6003.6b - Power source

**Desired Outcome:**
Provide primary ventilation for common spaces

**Specification(s):**
Power source load will be determined as adequate

Consideration will be given to power source location

**Objective(s):**
Provide accessible and adequate power source
6.6003.6 - Fan Placement (Whole House/Common Space Exhaust Only)

**Desired Outcome:**
Provide primary ventilation for common spaces

**Note:**

6.6003.6c - Location

**Desired Outcome:**
Provide primary ventilation for common spaces

**Specification(s):**
No resistance greater than 3 pascals will exist between fan intake location with reference to the common area

**Objective(s):**
Allow fresh air distribution to common areas
6.6003.6 - Fan Placement (Whole House/Common Space Exhaust Only)

Desired Outcome:
Provide primary ventilation for common spaces

Note:

6.6003.6d - Duct/vent

Desired Outcome:
Provide primary ventilation for common spaces

Specification(s):
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(s):
Effectively move the required volume of air
6.6003.6 - Fan Placement (Whole House/Common Space Exhaust Only)

Desired Outcome:
Provide primary ventilation for common spaces

Note:

6.6003.6e - Attachment

Desired Outcome:
Provide primary ventilation for common spaces

Specification(s):
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(s):
Maintain structural integrity

Maintain fan attachment
6.6003.6 - Fan Placement (Whole House/Common Space Exhaust Only)

Desired Outcome:
Provide primary ventilation for common spaces

Note:

6.6003.6f - Total exhaust airflow

Desired Outcome:
Provide primary ventilation for common spaces

Specification(s):
Total exhaust system airflow will be measured

Objective(s):
Ensure exhaust airflow is as designed
6.6005.1 - Clothes Dryer

Desired Outcome:
Dryer air exhausted efficiently and safely

6.6005.1a - Clothes dryer ducting

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
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, except where allowed by the authority having jurisdiction

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(s):
Preserve integrity of building envelope
Effectively move air from clothes dryer to outside
6.6005.1 - Clothes Dryer

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

6.6005.1a - Clothes dryer ducting

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

**Specification(s):**
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, except where allowed by the authority having jurisdiction

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(s):**
Preserve integrity of building envelope
Effectively move air from clothes dryer to outside
6.6005.1 - Clothes Dryer

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

6.6005.1b - Termination fitting

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

**Specification(s):**
Termination fitting manufactured for use with dryers will be installed

A backdraft damper will be included, as described in termination fitting detail

**Objective(s):**
Preserve integrity of building envelope

Effectively move air from clothes dryer to outside
6.6005.1 - Clothes Dryer

Desired Outcome:
Dryer air exhausted efficiently and safely

6.6005.1c - Make-up air

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
If natural draft combustion appliances are present and if worst-case CAZ and/or other performance based testing is conducted and indicates a need for make-up air, make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

If natural draft combustion appliances are present and if no performance based testing is conducted, make-up air will be provided prescriptively in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

Objective(s):
Preserve integrity of building envelope

Effectively move air from clothes dryer to outside
6.6005.1 - Clothes Dryer

Desired Outcome:
Dryer air exhausted efficiently and safely

6.6005.1d - Combustion safety

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Objective(s):
Ensure safe operation of combustion appliances

Ensure occupant health and safety
6.6005.1 - Clothes Dryer

Desired Outcome:
Dryer air exhausted efficiently and safely

6.6005.1e - Occupant education

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
Occupant will be instructed to keep lint filter and termination fitting clean

Occupant will be instructed to keep dryer booster fan clean, if present

Occupant will be instructed on clothes dryer operation safety including information on items that must not be placed in the clothes dryer (items with any oil or other flammable liquid on it, foam, rubber, plastic or other heat-sensitive fabric, glass fiber materials)

Objective(s):
Effectively move air from clothes dryer to outside
### 6.6005.2 - Kitchen Range

**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.

### 6.6005.2b - Fan venting

**Desired Outcome:**
Kitchen range fan installed to specification

**Specification(s):**
Kitchen range fans will be vented to the outdoors

Recirculating fans will not be used as a ventilating device

**Objective(s):**
Remove cooking contaminants from the house

Preserve integrity of building envelope

**Before**
Recirculating fans over ranges do not actually remove contaminants

**After**
Daylight visible through dampered kitchen exhaust proves venting access
6.6005.2 - Kitchen Range

**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.

6.6005.2c - Fan ducting

**Desired Outcome:**
Kitchen range fan installed to specification

**Specification(s):**
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

**Objective(s):**
Preserve integrity of building envelope

Effectively move air from range to outside
Before

Exhaust duct should be smooth-walled and in as short a run as possible.

After

Daylight visible through dampered kitchen exhaust proves outside access.

Tools:
1. Drill
2. Metal snips
3. Saw
4. Putty knife
5. Tape measure
6. Disposable brushes
7. Wire cutters
8. Scissors

Materials:
1. Round metal ducting
2. Mastic
3. Fiberglass mesh tape
4. Fasteners
5. Galvanized wire to secure insulation onto ductwork
6. Nylon webbing for hanging ducts
7. UL-181 foil or Mylar tape to seal seams in insulation vapor barrier

See also 6.6002.4d. Note: Only smooth-wall metal duct will be used, except for down-draft exhaust systems where PVC is acceptable as well. Flex duct is NOT acceptable for kitchen fan exhaust application.

From the Manufactured Housing SWS 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.
Coat joint with UL-181 mastic, at least 0.08" (2mm) thick

Wrap duct with R-8 insulation. Seal seams in insulation vapor barrier with UL-181 listed foil or Mylar tape
6.6005.2 - Kitchen Range

**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.

6.6005.2e - Makeup air

**Desired Outcome:**
Kitchen range fan installed to specification

**Specification(s):**
Makeup air will be provided for kitchen range fans exhausting more than 200 CFM

**Objective(s):**
Ensure safe operation of combustion appliances

Ensure occupant health and safety

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**Tools:**
1. Drill
2. Hole saw
3. Caulk gun

**Materials:**
1. Caulk sealant
2. Fasteners
6.6005.2 - Kitchen Range

**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.

6.6005.2f - Combustion safety

**Desired Outcome:**
Kitchen range fan installed to specification

**Specification(s):**
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

**Objective(s):**
Ensure safe operation of combustion appliances

Ensure occupant health and safety
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

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.

6.6102.4a - Forced air system requirements

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

Specification(s):
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

Objective(s):
Reduce migration of pollutants
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

**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.

**6.6102.4b - Wiring**

**Desired Outcome:**
Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

**Specification(s):**
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

**Objective(s):**
Prevent an electrical hazard
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

**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.

6.6102.4c - Access

**Desired Outcome:**
Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

**Specification(s):**
Motorized damper and service switch will be accessible for maintenance in accordance with required code or authority having jurisdiction

**Objective(s):**
Ensure accessibility for maintenance
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

**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.

6.6102.4d - Mounting intake duct

**Desired Outcome:**
Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

**Specification(s):**
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

**Objective(s):**
Ensure short duct run to achieve optimum air flow

Preserve integrity of the duct system and building envelope
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

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.

6.6102.4e - Motorized damper

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

Specification(s):
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

Objective(s):
Prevent air flow when none is desired
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

**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.

6.6102.4f - Intake filter

**Desired Outcome:**
Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

**Specification(s):**
An accessible filter will be installed

Filter will be able to remove contaminants consistent with at least minimum efficiency reporting value (MERV) 6 or better when tested in accordance with ANSI/ASHRAE 52.2

Filter or air cleaning systems that intentionally produce ozone will not be allowed

**Objective(s):**
Ensure occupant health and safety

Preserve integrity of the building envelope
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

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.

6.6102.4g - Occupant education

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

Specification(s):
Occupant will be educated on how and when to change filter

Objective(s):
Ensure occupant health and safety

Preserve integrity of the building envelope
6.6102.4 - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

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.

6.6102.4h - Intake ventilation airflow

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

Specification(s):
Total intake ventilation airflow will be measured

Objective(s):
Ensure airflow is as designed
6.6188.2 - Removing Supply Vents from Garages

Desired Outcome:
Safe removal of garage supply vents

Note:

6.6188.2g - CAZ testing

Desired Outcome:
Safe removal of garage supply vents

Specification(s):
CAZ testing will be performed where combustion appliances are utilized

Objective(s):
Identify possible conditions that can cause unsafe equipment operating conditions
6.6204.1 - Commissioning Ventilation Systems

Desired Outcome:
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

6.6204.1a - Identification

Desired Outcome:
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

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
6.6204.1 - Commissioning Ventilation Systems

**Desired Outcome:**
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

6.6204.1b - Equipment inspection

**Desired Outcome:**
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

**Specification(s):**
Visually inspect and document status of:

- Electrical connections
- Name plate (rated sone and flow)
- Motor cleanliness

**Objective(s):**
Evaluate equipment
6.6204.1 - Commissioning Ventilation Systems

**Desired Outcome:**
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

6.6204.1c - Pathway inspection

**Desired Outcome:**
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

**Specification(s):**
Visually inspect and document status of ducting or other airflow pathways to ensure proper:

- Connections (proper materials, sealed and connected)
- Insulation
- Support
- Sizing, and
- Termination locations and fittings

Verify proper damper operation

**Objective(s):**
Preserve integrity of building envelope

Effectively move air along selected pathways
6.6204.1 - Commissioning Ventilation Systems

Desired Outcome:
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

6.6204.1d - Measurement and Adjustment

Desired Outcome:
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

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 air flows per current ventilation standards
Verify suitable performance of installed ventilation strategy
6.6204.1 - Commissioning Ventilation Systems

Desired Outcome:
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

6.6204.1e - Work order

Desired Outcome:
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

Specification(s):
Develop work order as necessary to correct deficiencies identified during inspections and measurement

Objective(s):
Correct deficiencies

Ensure proper operation
6.6204.1 - Commissioning Ventilation Systems

**Desired Outcome:**
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

6.6204.1f - Occupant education

**Desired Outcome:**
Verify proper operation of existing system, installed system air flow meets required standard and provides continuous ventilation for background pollutant sources

**Specification(s):**
Instruct occupant on purpose, use and maintenance of ventilation, and typical signs that ventilation is needed, e.g., condensation on windows

**Objective(s):**
Occupant understands benefits of good indoor air quality and can operate ventilation equipment as needed
6.6205.1 - Manufactured Housing Exhaust-Only Strategies

Desired Outcome:
Provide primary ventilation for common spaces

6.6205.1e - Combustion Appliance Zone (CAZ) testing

Desired Outcome:
Provide primary ventilation for common spaces

Specification(s):
CAZ test will be performed where combustion appliances are utilized, where applicable

Objective(s):
Identify possible conditions that can cause unsafe equipment operating conditions
6.6206.1 - Decommissioning Existing Exhaust or Supply Ventilation Systems

Desired Outcome:
Safely and properly eliminate fan

Note:

6.6206.1d - Combustion Appliance Zone (CAZ) testing

Desired Outcome:
Safely and properly eliminate fan

Specification(s):
Combustion safety test will be performed where combustion appliances are utilized

Objective(s):
Identify possible conditions that can cause unsafe equipment operating conditions
6.6288.2 - Sound Ratings—New Fan Installation

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

**Note:**

6.6288.2a - Primary ventilation system/continuously operating fan

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

**Specification(s):**
System will be rated at a sound no greater than 1.0 sone

**Objective(s):**
Minimize noise

Maximize fan use
6.6288.2 - Sound Ratings—New Fan Installation

Desired Outcome:
Systems operate as quietly as possible

Note:

6.6288.2b - Intermittent spot ventilation system

Desired Outcome:
Systems operate as quietly as possible

Specification(s):
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

Objective(s):
Minimize noise

Maximize fan use
6.9901.1 - Supplemental Ventilation Information—ASHRAE 62.2

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

6.9901.1a - Ventilation fan flow rate

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

**Specification(s):**
ASHRAE Standard 62.2 and the calculation of the infiltration credit allow adjustments to primary ventilation fan flow rates for existing houses using a single fan.

**Objective(s):**
To provide supplemental ventilation information--ASHRAE 62.2
7.8001.1 - Refrigerator and Freezer Replacement

Desired Outcome:
A more energy efficient appliance installed

7.8001.1a - Selection

Desired Outcome:
A more energy efficient appliance installed

Specification(s):
Appliance shall be ENERGY STAR® qualified or at least as energy efficient
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

Objective(s):
Ensure occupant satisfaction with appliance
7.8001.1 - Refrigerator and Freezer Replacement

Desired Outcome:
A more energy efficient appliance installed

7.8001.1b - Installation

Desired Outcome:
A more energy efficient appliance installed

Specification(s):
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

Objective(s):
Achieve intended appliance function

Preserve food at low energy use

Educate occupant on how to operate and maintain the appliance
7.8001.1 - Refrigerator and Freezer Replacement

Desired Outcome:
A more energy efficient appliance installed

7.8001.1c - Decommissioning

Desired Outcome:
A more energy efficient appliance installed

Specification(s):
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

Objective(s):
Prevent reuse of inefficient equipment and components

Protect the environment

Protect worker safety
7.8001.2 - Cleaning and Tuning Existing Refrigerators and Freezers

Desired Outcome:
Energy used for food preservation reduced

7.8001.2a - Clean and tune

Desired Outcome:
Energy used for food preservation reduced

Specification(s):
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

Objective(s):
Reduce energy use

Improve performance

Educate occupant on how to operate and maintain the appliance
7.8003.1 - Lighting Upgrade

Desired Outcome:
Energy used for lighting reduced while maintaining adequate and safe lighting levels

7.8003.1b - Selection

Desired Outcome:
Energy used for lighting reduced while maintaining adequate and safe lighting levels

Specification(s):
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

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
7.8101.1 - Shower Head and Faucet Aerator

**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.

7.8101.1b - Selection

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

**Specification(s):**
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

**Objective(s):**
Reduce water and energy consumption

Ensure occupant satisfaction
7.8101.1 - Shower Head and Faucet Aerator

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.

7.8101.1c - Installation

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

Specification(s):
Equipment will be installed in accordance with manufacturer specifications and meet all applicable building codes

Water quality will be evaluated for debris that may clog the equipment

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

If needed, shower diverter will be repaired or replaced

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

Any damage done to the house during installation will be repaired

Specific information about 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

Water flow that satisfies the occupant will be provided by all shower heads and faucet aerators

Occupant's acceptance of the shower head and/or aerator will be documented

Objective(s):
Reduce water and energy consumption
Ensure occupant satisfaction with water flow

Eliminate water leakage

Prevent water damage

Before
Old, high flow shower nozzle

After
Leak testing a new shower aerator

Tools:
1. Tongue-and-groove pliers
2. Pipe wrench
3. Adjustable wrench

Materials:
1. Joint sealing tape
2. Rags

Interview occupant to document and verify their satisfaction with new shower and faucet aerators. Operate equipment after installation to ensure that it does not leak.

Remove old, high flow shower heads
Replace with 2.5 gpm maximum shower heads
Clean corrosion and old sealant from the threads on the shower nipple using a wire brush
Seal the threads on the shower nipple with two wraps of Teflon tape. Wrap tape clockwise so it won't peel off.

Install the new low-flow shower head.

Tighten the shower head using an adjustable wrench or tongue-and-groove pliers and a rag to protect the finish.

Turn on the water and check for leaks.

Make sure the client is happy with their new low-flow shower head. Document approval with their signature in the file.
7.8101.1 - Shower Head and Faucet Aerator

**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.

7.8101.1d - Decommissioning

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

**Specification(s):**
Replaced shower heads and faucet aerators will be recycled or disposed of properly

**Objective(s):**
Prevent the reuse of inefficient equipment and components

Recycle or dispose of removed shower faucets and sink aerators to prevent their reuse.
7.8102.1 - Water Heater Selection

Desired Outcome:
Safe, reliable, and efficient hot water source selected that meets occupant needs at lowest possible cost of ownership and operation

7.8102.1a - Selection parameters

Desired Outcome:
Safe, reliable, and efficient hot water source selected that meets occupant needs at lowest possible cost of ownership and operation

Specification(s):
Equipment will provide sufficient, affordable, safe, and healthy hot water for the occupant in accordance with IRC

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 rollout, obstructions) will be assessed in selecting equipment, and the cost of remedying 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

Objective(s):
Save energy and water

Protect the environment

Identify appliance options based on the needs and wants of the occupant
7.8102.1 - Water Heater Selection

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

7.8102.1b - Product selection

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

**Specification(s):**
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 IRC

**Objective(s):**
Ensure equipment meets the occupant's expectations while providing efficient energy and water use
7.8102.2 - Storage-Type Appliance

**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.

7.8102.2e - Expansion tank

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

**Specification(s):**
Expansion tanks will be installed where required and in accordance with the AHJ

**Objective(s):**
Protect the storage tank from expansion

**Bad Practice**
Need to eliminate the valves between the storage tank and expansion tank

**Best Practice**
Expansion tank is installed on the cold water supply side

Appropriate licensing for installer required. Expansion tanks are only required to be installed only when in conjunction with new and replacement water heaters.
7.8102.2 - Storage-Type Appliance

**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.

7.8102.2f - Temperature and pressure relief valve

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

**Specification(s):**
Correct temperature and pressure relief valve will be installed in compliance with IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

**Objective(s):**
Discharge excessive energy (pressure or temperature) from storage tank to safe location

**Tools:**
1. Pipe wrench
2. Hacksaw

**Materials:**
1. PVC
2. Plumber’s epoxy
Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage -- the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

GOOD: T&P discharge should be piped within 6" of the floor or to outdoors

BAD: T&P discharge should flow with gravity and be observable

BAD: T&P discharge should not be piped into drainage system
7.8102.2 - Storage-Type Appliance

**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.

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7.8102.2k - Discharge temperature

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

**Specification(s):**
Discharge temperature will be set not to exceed 120° or as prescribed by local code

**Objective(s):**
Ensure safe hot water supply temperature to fixtures

**Tools:**
1. Thermometer

---

[Images of temperature readings: Unsafe and Safe.]

 Unsafe

 Safe

Water heaters should produce water under 120 degrees to prevent scalding
Test temperature of hot water at faucets in house

Hot water temperatures should not exceed 120 degrees Fahrenheit

Adjust water heater settings and insulate as needed

After adjustment and insulation, retest to verify temp is under 120 degrees
7.8102.3 - On-Demand Appliance

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.

7.8102.3e - Temperature and pressure relief valve

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

Specification(s):
Correct temperature and pressure relief valve will be installed in compliance with IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

Objective(s):
Discharge excessive energy (pressure or temperature) from storage tank to safe location

Water heaters should be not capped of at t&p valve
T&P discharge should be piped to a safe and observable location

Tools:
1. Pipe wrench
2. Hacksaw

Materials:
1. PVC
2. Plumber’s epoxy
Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage -- the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

GOOD: T&P discharge should be piped within 6" of the floor or to outdoors
BAD: T&P discharge should flow with gravity and be observable
BAD: T&P discharge should not be piped into drainage system
7.8102.3 - On-Demand Appliance

**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.

7.8102.3h - Thermal efficiency

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

**Specification(s):**
Any accessible hot water lines at the appliance will be insulated to meet IRC or local requirements, whichever is greater

**Objective(s):**
Reduce line losses

**Materials:**
1. Foam pipe insulation
2. Spray adhesive
3. Zip ties

Hot water pipe insulation requirements are found in Chapter 11 of the International Residential Code, Section N1103.4.2 (R403.4.2). The code calls for a minimum of R-3. As a best practice, R-4 and R-5
Pipe insulation is available through mechanical and industrial suppliers.

Maintain proper clearances from the water heater vent when installing foam pipe insulation.
7.8102.3 - On-Demand Appliance

**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.

7.8102.3i - Required combustion air

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

**Specification(s):**
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 IRC

If needed, additional combustion air will be provided in accordance with IRC

**Objective(s):**
Ensure adequate combustion air for operation of the appliance
Best practice is to install on-demand water heaters as direct-vent units.

If not installed as direct vent, refer to notes and images on next page for required combustion air.

To determine adequate combustion air: add up the input Btus of all combustion appliances in the space and divide by 20. The result is the minimum required air volume in cubic feet (50 cubic feet per 1,000 input Btus). If the available volume is less than 50 cubic feet per 1,000 input Btus, provide additional combustion air as listed below for each circumstance, in accordance with the 2012 IRC G2407.

Image 1: For homes with one permanent opening, see 2012 IRC: G2407.6.2 (304.6.2): a minimum free area of 1 square inch per 3,000 Btu/h (734 mm²/kW) of total input rating of all appliances.

Image 2: For homes with two permanent vertical duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 square inch per 4,000 Btu/h (550 mm²/kW) of total input rating of all appliances.

Image 3: For homes with two permanent horizontal duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 square inch per 2,000 Btu/h (1,100 mm²/kW) of total input rating of all appliances.
7.8102.3 - On-Demand Appliance

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.

7.8102.3j - Venting of flue gases

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

Specification(s):
Combustion byproducts will be removed in accordance with IRC and manufacturer specifications

Objective(s):
Ensure the safety and durability of the venting system

Follow manufacturer's venting instructions for on-demand appliances. Local codes may be more stringent than the International Residential Code (Section G2407), which governs venting of gas appliances,

Do not locate vent terminals near dryer vents.
Leave 12" between a vent terminal and any non-mechanical building vent or combustion air inlet from another appliance.

Leave 12" between vent terminals and any operable door or window.

Allow 12" clearance from the edge of a vent to any inside corner of the building.

Allow 12" between any two vent terminals.

Install vent terminal at least 3 feet higher than any mechanical air inlet that is closer than 10 feet away horizontally.

Leave 60" between terminals that are in line vertically.

Install vent terminals at least 36" below any eave, soffit, porch, or deck within 24 horizontal inches of center of vent.

Install vent at least 36" above grade, porch, deck, veranda, or snow line.
7.8102.3 - On-Demand Appliance

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.

7.8102.3k - Flue gas testing

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

Specification(s):
Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T

If combustion is not in compliance with BPI-1100-T, diagnostics and adjustments will be done to manufacturer specifications or local codes

Objective(s):
Confirm that combustion is occurring safely with maximum efficiency

In Progress

Tools:
1. Properly calibrated combustion analyzer
The combustion analyzer shall be calibrated in accordance with the manufacturer’s recommendations with available documentation traceable to the individual device.

Verify that calibration date is current on combustion analyzer

Test flue gases for carbon monoxide at outlet of vent

Verify that carbon monoxide levels are within specifications
7.8102.3 - On-Demand Appliance

**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.

7.8102.3n - Discharge temperature

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

**Specification(s):**
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):**
Ensure safe hot water supply temperature to fixtures

**Tools:**
1. Thermometer
2. Cup or bowl

Use a thermometer to measure hot water temperature. 120°F is the recommended setting.
<table>
<thead>
<tr>
<th>7.8102.3n - Discharge temperature</th>
</tr>
</thead>
</table>

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7.8102.3 - On-Demand Appliance

**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.

7.8102.3n - Discharge temperature

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

**Specification(s):**
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):**
Ensure safe hot water supply temperature to fixtures

**Tools:**
1. Thermometer
2. Cup or bowl

Use a thermometer to measure hot water temperature. 120°F is the recommended setting
7.8102.3 - On-Demand Appliance

**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.

7.8102.3p - Ambient CO

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

**Specification(s):**
All homes with combustion appliances or an attached garage will have a carbon monoxide (CO) alarm

**Objective(s):**
Ensure occupant health and safety
7.8103.1 - Storage-Type Appliance

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.

7.8103.1a - Health and safety

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
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)

Objective(s):
Identify potential health and safety issues

Complete combustion safety testing to ensure healthy, safe work environment

When completed work, retest to verify home is still healthy and safe
<table>
<thead>
<tr>
<th>Tools:</th>
<th>Materials:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Personal CO monitor</td>
<td>1. CO alarm</td>
</tr>
<tr>
<td>2. Combustion analyzer with probe</td>
<td>2. Fasteners</td>
</tr>
<tr>
<td>3. Manometer</td>
<td></td>
</tr>
<tr>
<td>4. Smoke pencil</td>
<td></td>
</tr>
<tr>
<td>5. Mirror</td>
<td></td>
</tr>
<tr>
<td>6. Stopwatch, timer, or watch with second hand</td>
<td></td>
</tr>
</tbody>
</table>

See also SWS 2.0201.2a-2.0299.1i for all Combustion Safety details and SWS 2.0602.2c for Electrical Safety.
7.8103.1 - Storage-Type Appliance

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.

7.8103.1b - Visual inspection

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
Inspection will be conducted to show compliance with the IRC, including but not limited to:

- Water or fuel leaks
- 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

Objective(s):
Determine needed repairs or maintenance

In Progress
Inspect for rust, corrosion, and dust around draft diverter. Verify diverter is centered and fastened. Check T&P valve

In Progress
Inspect for signs of flame rollout, thermostat and gas valve condition, and proper T&P relief valve termination
Tools:

1. Flashlight
2. Inspection mirror

Check draft diverter alignment

Inspect for rust, corrosion, and leaks
7.8103.1 - Storage-Type Appliance

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.

7.8103.1c - Thermal efficiency

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
Water heater storage tanks shall have a minimum R-value of R-24

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

The first 6' of inlet and outlet piping will be insulated in accordance with IRC or local requirements, whichever is greater

Objective(s):
Reduce standby losses from near tank piping and storage tank

Ensure insulation does not make contact with flue gas venting

After
Insulated storage-type water heater
<table>
<thead>
<tr>
<th>Tools:</th>
<th>Materials:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scissors</td>
<td>1. Insulation blanket</td>
</tr>
<tr>
<td>2. Utility knife</td>
<td>2. Plastic zip ties</td>
</tr>
<tr>
<td>3. Outward clinching staple gun</td>
<td>3. Tape</td>
</tr>
<tr>
<td></td>
<td>4. Staples</td>
</tr>
</tbody>
</table>

GEFA has obtained a variance from DOE allowing R-5 tank insulation instead of R-24. Use R-5 tank wrap unless the manufacturer prohibits adding additional insulation.

Maintain at least 2" clearance between insulation and the draft diverter. Cut out around thermostats, pressure relief valves, and other items listed in the specification.
7.8103.1 - Storage-Type Appliance

**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.

### 7.8103.1e - Temperature and pressure relief valve

**Desired Outcome:**
Safe, reliable, and efficient operation of the appliance maintained

**Specification(s):**
Correct temperature and pressure relief valve will be installed in compliance with IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

**Objective(s):**
Discharge excessive energy (pressure or temperature) from storage tank to safe location

Before
Water heaters should be not capped of at t&p valve

After
T&P discharge should be piped to a safe and observable location

**Tools:**
1. Pipe wrench
2. Hacksaw

**Materials:**
1. PVC
2. Plumber's epoxy

Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure
relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage -- the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

GOOD: T&P discharge should be piped within 6" of the floor or to outdoors

BAD: T&P discharge should flow with gravity and be observable

BAD: T&P discharge should not be piped into drainage system
7.8103.2 - On-Demand Appliance

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.

7.8103.2a - Health and safety

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
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)

Objective(s):
Identify potential health and safety issues

On-demand water heater
Check carbon monoxide levels in the appliance vent
Tools:
1. Personal CO monitor
2. Combustion analyzer with probe
3. Manometer
4. Smoke pencil

Materials:
1. CO alarm
2. Fasteners

See also SWS 2.0201.2a-2.0299.1i for all Combustion Safety details and SWS 2.0602.2c for Electrical Safety.
7.8103.2 - On-Demand Appliance

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.

7.8103.2b - Visual inspection

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
Inspection will be conducted to show compliance with the 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

Objective(s):
Determine needed repairs or maintenance

Check installation and ensure it meets manufacturer's instructions and local codes
Inspect for rust, corrosion, and dust around draft diverter. Verify diverter is centered and fastened. Check T&P valve.

Check draft diverter alignment.

Inspect for rust, corrosion, and leaks.

Inspect for signs of flame rollout, thermostat and gas valve condition, and proper T&P relief valve termination.
7.8103.2 - On-Demand Appliance

**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.

7.8103.2c - Temperature and pressure relief valve

**Desired Outcome:**
Safe, reliable, and efficient operation of the appliance maintained

**Specification(s):**
Correct temperature and pressure relief valve will be installed in compliance with IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

**Objective(s):**
Discharge excessive energy (pressure or temperature) from storage tank to safe location

 Unsafe
Water heaters should be not capped off at T&P relief valve

 Safe
T&P discharge should be piped to a safe and observable location
Tools:
1. Pipe wrench
2. Hacksaw or tubing cutter
3. Propane or MAPP gas torch

Materials:
1. CPVC or copper piping and fittings
2. CPVC primer and cement
3. Flux, solder, and emery cloth for sweating copper fittings
4. Teflon tape or pipe thread sealing compound

Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage -- the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

GOOD: T&P discharge should be piped within 6" of the floor or to outdoors
BAD: T&P discharge should flow with gravity and be observable
BAD: T&P discharge should not be piped into drainage system
7.8103.2 - On-Demand Appliance

**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.

7.8103.2d - Flue gas testing

**Desired Outcome:**
Safe, reliable, and efficient operation of the appliance maintained

**Specification(s):**
Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T

If combustion is not in compliance with BPI-1100-T, diagnostics and adjustments will be done to manufacturer specifications or local codes

**Objective(s):**
Perform combustion testing

**Best Practice**
Test flue gases at outlet of vent to verify carbon monoxide levels are within specifications

**Tools:**
1. Properly calibrated combustion analyzer
1. Verify that calibration date is current on combustion analyzer
2. Test flue gases for carbon monoxide at outlet of vent
3. Verify that carbon monoxide levels are within specifications
7.8103.2 - On-Demand Appliance

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.

7.8103.2f - Venting of flue gases

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
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

Objective(s):
Verify proper venting of flue gases

Tools:
1. Flashlight
2. Inspection mirror

Check that all connections are secure, free of rust and corrosion, and that vents are made from the proper material. Verify that sealed combustion units are installed as direct vents, that is, with both combustion air intakes and exhaust gas vents connected.
Check that terminal locations are in accordance with the IRC, Section G2407, manufacturer's instructions, and/or local codes.

Verify 12" between a vent terminal and any non-mechanical building vent or combustion air inlet from another appliance.

Check that there is 12" between vent terminals and any operable door or window.

Ensure 12" clearance from the edge of a vent to any inside corner of the building.

Verify 12" between any two vent terminals.

Verify vent terminals are least 3 feet higher than any mechanical air inlet closer than 10 feet away horizontally.

Ensure there is 60" between terminals in line vertically.

Verify vent terminals are 36" below any eave, soffit, porch, or deck within 24 horizontal inches of center of vent.

Ensure that vents are at least 36" above grade, porch, deck, veranda, or snow line.
7.8103.2 - On-Demand Appliance

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.

7.8103.2g - Fuel supply

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
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

Objective(s):
Verify sufficient fuel to the water heater burner and element

Inspect fuel supply and verify that sizing and capacity are correct

Tools:
1. Flashlight
Inspect gas lines for corrosion, leaky fittings, worn flex lines, missing sediment traps, and kinked copper

Inspect LP gas tanks for corrosion, proper location, leaky fittings, and kinked or damaged copper
7.8103.2 - On-Demand Appliance

**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.

7.8103.2h - Cold water supply

**Desired Outcome:**
Safe, reliable, and efficient operation of the appliance maintained

**Specification(s):**
Water supplied to the appliance will be of sufficient volume and pressure to be in accordance with manufacturer specifications

**Objective(s):**
Verify sufficient volume and pressure of water to the appliance

**Best Practice**
Testing water supply pressure

**Tools:**

1. Water pressure gauge

Check manufacturer’s specifications for flow and pressure requirements. System pressure may be easily measured with a pressure gauge attached to a hose bib or faucet. Pipe sizing calculations (to ensure adequate flow rates) are best left to a licensed plumber or mechanical contractor.
7.8103.2 - On-Demand Appliance

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.

7.8103.2i - Discharge temperature

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
Discharge temperature will be set not to exceed 120°F or in accordance with local code, whichever is lower

Objective(s):
Ensure safe hot water supply temperature to fixtures

Unsafe
Water heaters producing water over 120 degrees raise heating costs

Safe
Water heaters should produce water under 120 degrees to prevent scalding

Tools:
1. Thermometer
Test temperature of hot water at faucets in house

Hot water temperatures should not exceed 120 degrees Fahrenheit

Adjust water heater settings and insulate as needed

After adjustment and insulation, retest to verify temp is under 120 degrees