



# **Kansas SWS Field Guide**

## **Version 2018.1**



**Standard Work Specifications**

**Field Guide for**

**Single-Family Homes**

**created by**

**Kansas Housing Resources Corporation and  
the Kansas Weatherization Network**



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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.

## 2.0100.1e - Carbon monoxide (CO)

### Desired Outcome:

Work completed safely without injury or hazardous exposure

### Specification(s):

All homes will have a carbon monoxide alarm

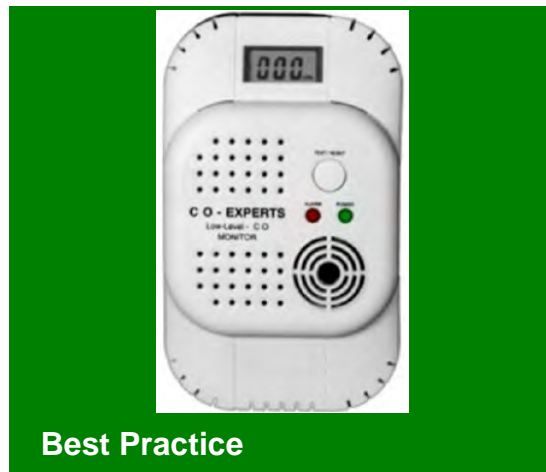
Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm)

### Objective(s):

Protect worker and occupant health



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



Install carbon monoxide alarms

### Tools:

1. CO meter

## 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.

## 2.0100.1g - Confined space safety

**Desired Outcome:**

Work completed safely without injury or hazardous exposure

**Specification(s):**

Spaces with limited ingress and egress and restricted work area will be considered confined space

Access and egress points will be located before beginning work

Inspection will be conducted for hazards, such as damaged or exposed electrical conductors, mold, sewage effluent, friable asbestos or fiberglass, pests, and other potential hazards

Adequate ventilation will be provided

Use of toxic material will be reduced

**Objective(s):**

Prevent build-up of toxic or flammable contaminants

Reduce risk to the workers in the confined space

Provide adequate access and egress points

Prevent electrical shock



👍 After

Locate all access and egress points of confined spaces before entering



Perform visual inspection of confined spaces before beginning work



Check for frayed or worn electrical wires



In confined spaces, use a ventilator

CHEMICAL NAME	
HEALTH HAZARDS	
PHYSICAL HAZARDS	
PHYSICAL HAZARDS	
TARGET ORGAN EFFECTS	
PERSONAL PROTECTIVE EQUIPMENT	
SEE SAFETY DATA SHEET	

Check GHS labels and Safety Data Sheets for all materials to minimize hazards



## 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.

## 2.0100.1p - Lead paint assessment

**Desired Outcome:**

Work 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 rulemaking or any more stringent state or federal standards

**Objective(s):**

Protect workers and occupants from potential lead hazards

Follow all applicable KDHE requirements.

## 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

**Before**

If materials that may contain asbestos are found in the home, do not disturb the material or run the blower door

**Best Practice**

If asbestos is suspected, call an EPA-accredited professional.

**Materials:**

1. Containment shroud
2. Caution tape

See the Health and Safety Plan for additional information.



Do not disturb ACM by drilling, sanding, scraping, sawing, etc.



Do not disturb ACM by vacuuming, dusting, or sweeping

## 2.0102.1 - Insulation Worker Safety

### Desired Outcome:

Work is completed safely without injury or hazardous exposure

## 2.0102.1c - Materials

### Desired Outcome:

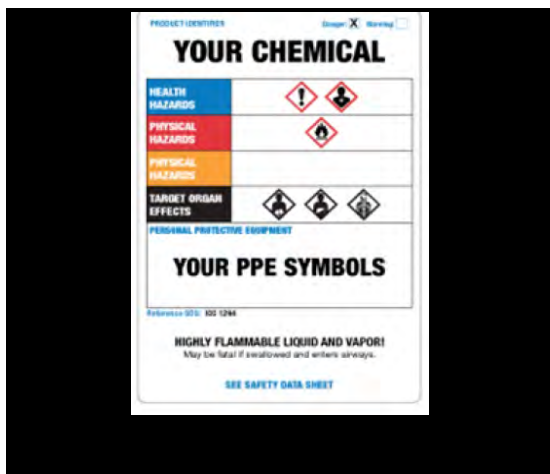
Work is completed safely without injury or hazardous exposure

### 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



New Safety Data Sheet and GHS label formatting is easier to quickly interpret

## 2.0103.1 - Combustion Worker Safety

### Desired Outcome:

Work completed safely without injury or hazardous exposure

## 2.0103.1c - Raw fuel

### Desired Outcome:

Work completed safely without injury or hazardous exposure

### Specification(s):

Raw fuel leaks will be monitored for before entering building spaces

If leaks are found, testing will be discontinued and condition reported to occupant immediately

### Objective(s):

Protect worker and occupant health



Fuel leaks need to be repaired by appropriate professional



Notify occupant of any leaks

### Tools:

1. Gas sniffer
2. Bubble solution



Check all raw fuel lines for leaks



Use multiple methods to test for leakage--bubble solution



If bubbles develop, leak is present. Notify occupant



Any leaks found should be reported to occupant and work stopped



Any leaks found should be reported to occupant and work stopped



## 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**

Mercury thermostats should be replaced and disposed of properly



**Bad Practice**

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](http://thermostat-recycle.org) or [earth911.org](http://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

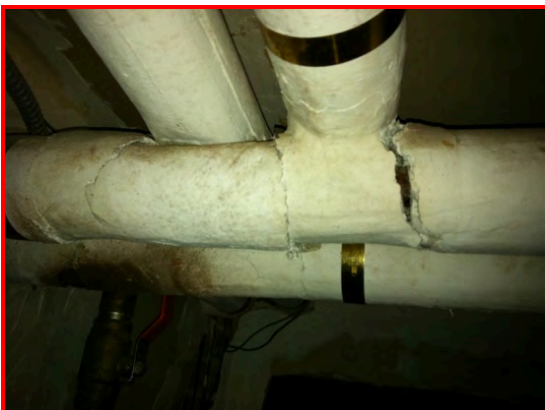
### Specification(s):

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

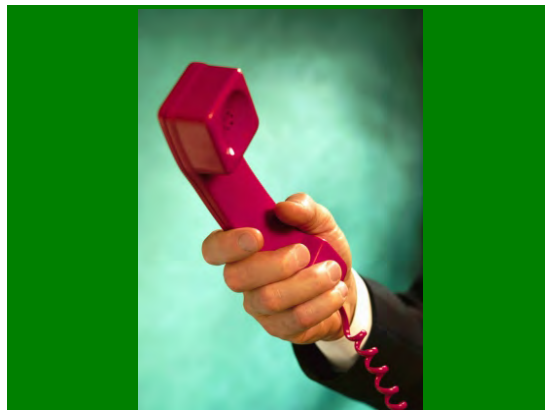
### Objective(s):

Protect worker and occupant from asbestos exposure



**Unsafe**

Suspicious pipe insulation may contain asbestos



**Best Practice**

When asbestos is suspected, call in EPA-accredited professionals.

Refer to Kansas Health and Safety Plan for asbestos guidance. If vermiculite is found, refer to the Procedure Manual for guidance.



## 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**

Workers should dress appropriately for working with refrigerant and be aware of any addition risks in their surroundings

## **2.0107.2 - Basements and Crawl Spaces—Pre-Work Qualifications**

**Desired Outcome:**

Site properly prepared for upgrade

### **2.0107.2c - Mold**

**Desired Outcome:**

Site properly prepared for upgrade

**Specification(s):**

Appropriate remediation will be completed before upgrade

**Objective(s):**

Ensure site is safe and ready for upgrade

Refer to the Health and Safety Plan for additional information.

## **2.0107.2 - Basements and Crawl Spaces—Pre-Work Qualifications**

**Desired Outcome:**

Site properly prepared for upgrade

### **2.0107.2d - Plumbing and water leaks**

**Desired Outcome:**

Site properly prepared for upgrade

**Specification(s):**

Plumbing leaks will be repaired before crawl space upgrade in accordance with the IRC

**Objective(s):**

Prepare site for upgrade

Refer to the Health and Safety Plan for additional information.

## **2.0107.2 - Basements and Crawl Spaces—Pre-Work Qualifications**

**Desired Outcome:**

Site properly prepared for upgrade

### **2.0107.2e - Pest and termite work**

**Desired Outcome:**

Site properly prepared for upgrade

**Specification(s):**

Pest and termite treatment will be completed before crawl space upgrade and inspected in accordance with the IRC

**Objective(s):**

Prepare site for upgrade

Refer to the Health and Safety Plan for additional information.

Inspectors should be attentive to evidence of pests and termites. If conditions warrant, review the Health and Safety Policy for pest control options, and/or notify the client of required action steps prior to weatherization.

## **2.0107.2 - Basements and Crawl Spaces—Pre-Work Qualifications**

### **Desired Outcome:**

Site properly prepared for upgrade

## **2.0107.2i - Non-correctable standing water**

### **Desired Outcome:**

Site properly prepared for upgrade

### **Specification(s):**

Spaces with non-correctable standing water will not be considered for a closed crawl space

### **Objective(s):**

Prevent possible damage to house

Measures will not be installed where standing water is present. Refer to the Health & Safety policy for additional information.

## 2.0107.3 - Basements and Crawl Spaces—Debris Removal

### Desired Outcome:

Clean, safe, and easily accessible crawl space created

### 2.0107.3a - Debris removal

### Desired Outcome:

Clean, safe, and easily accessible crawl space created

### Specification(s):

Under-floor grade will be removed of all vegetation and organic material, as necessary and feasible.

Debris that can cause injury or puncture ground covers (e.g., nails, glass, sheet metal screws, etc.) will be removed from the crawl space

### Objective(s):

Minimize punctures in ground liner

Minimize habitat for pests (Integrated Pest Management—IPM) and contaminant sources



**Before**

Crawl spaces with trash and overgrowth need to be made clean and safe.



**After**

Rake up and clear away trash and overgrowth.

### Tools:

1. Rake
2. Shop vacuum
3. PPE

## 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



Fuel lines should be inspected for leakage



If leaks are found, notify occupant immediately to facilitate repair

### Tools:

1. Gas sniffer
2. Spray bottle

### Materials:

1. Bubble solution



Inspect exterior gas and oil lines for leaks and damage



Inspect flex lines for damage, and check date on ring for pre-1973 hardware



## 2.0201.1 - Combustion Appliance Zone (CAZ) Testing

### Desired Outcome:

Accurate information about appliance safe operation is gathered

## 2.0201.1c - Venting

### Desired Outcome:

Accurate information about appliance safe operation is gathered

### Specification(s):

For oil systems that require a draft regulator, the presence and operability of it (that draft regulator) will be verified and tested

Combustion venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards

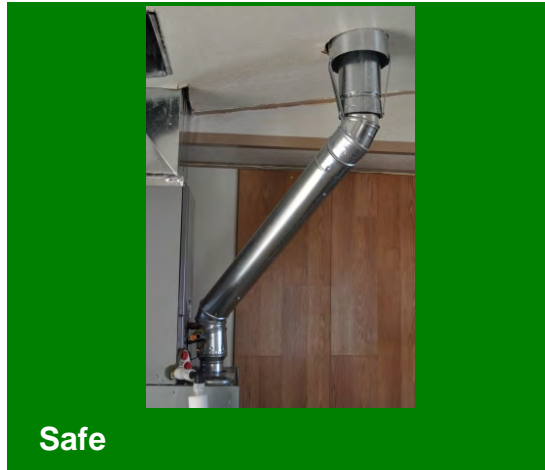
### Objective(s):

Determine if a regulator is present and working

Determine whether vent system is in good condition and installed properly



If vent system puts occupants at risk, it needs immediate attention



Properly vented appliances make a house healthier and more efficient

Refer to Local Codes for additional information. Adequate slope is generally a 1/4 inch per foot or greater. Inspect for proper flue clearance to combustibles. B-vent is typically 1 inch minimum clearance, single wall is typically 6 inches minimum clearance.



Determine if a draft regulator is installed and working



Inspect vent systems for damage



Inspect vent systems for disconnected pipes



Inspect vent systems for inadequate slope



Inspect for missing draft diverter

## 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



Natural conditions--Winter set-up, Exhaust fans off, Interior doors open

### Tools:

1. Manometer

## 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):

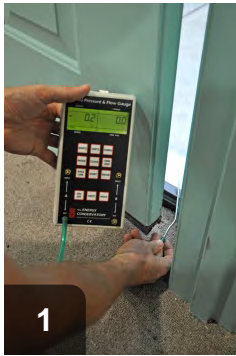
Determine worst-case depressurization in combustion zone due mechanical system fans



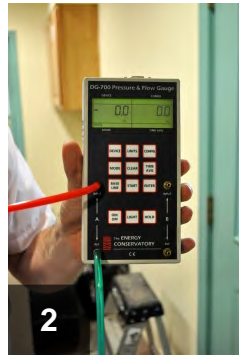
Exhaust fans on, Check interior doors, Air handler on?

### Tools:

1. Manometer



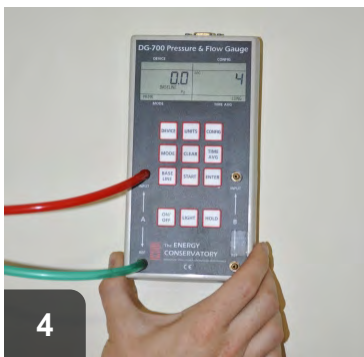
1 Place manometer reference hose to exterior of house



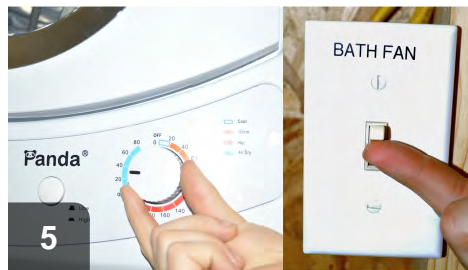
2 Attach test hose to be used in the interior of the house



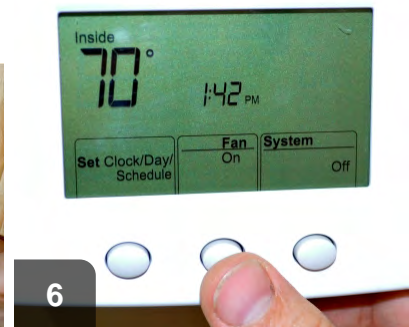
3 Place test hose by combustion appliance



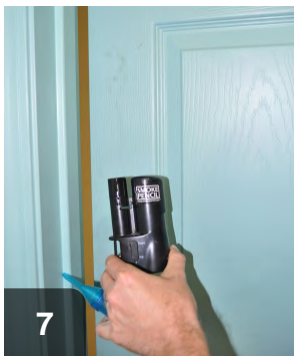
4 Take baseline reading



5 Turn on interior exhaust fans, including any clothes dryers



6 Is the air handler on?



7 Check interior doors for pressure differential either using smoke pencil or hand



8 Conduct spillage and draft test under worst case CAZ depressurization

## 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

Image 1: For homes with one permanent opening, see 2012 IRC: G2407.6.2 (304.6.2): a minimum free area of 1 in<sup>2</sup> per 3,000 Btu/h (734 mm<sup>2</sup>/kW) of total input rating of all appliances

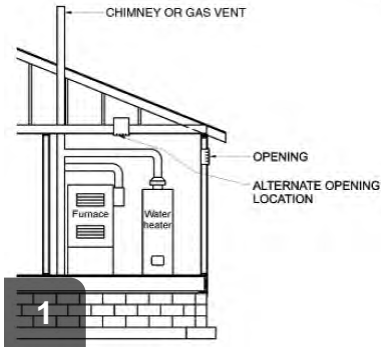
Image 2: For homes with two permanent vertical duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in<sup>2</sup> per 4,000 Btu/h (550 mm<sup>2</sup>/kW) of total input rating of all appliances

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 in<sup>2</sup> per 2,000 Btu/h (1,100 mm<sup>2</sup>/kW) of total input rating of all appliances.

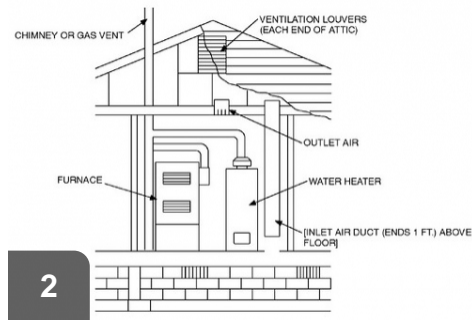
The preference is to draw combustion air from the conditioned area of the dwelling where applicable and allowed by local code.

See Subrecipient Procedures Manual.

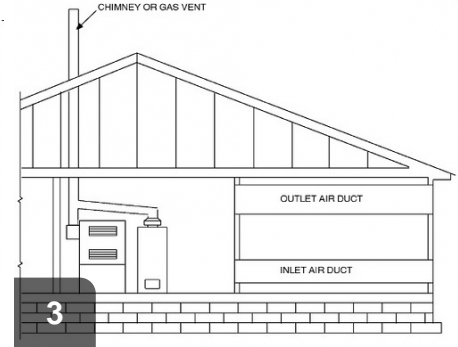




min free area of 1 sqin per 3,000 Btu/h (734 mm<sup>2</sup>/kW) of total input rating



min free area of 1 sqin per 4,000 Btu/h (550 mm<sup>2</sup>/kW) of total input rating



min free area of 1 sqin per 2,000 Btu/h (1100 mm<sup>2</sup>/kW) of total input rating

## 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

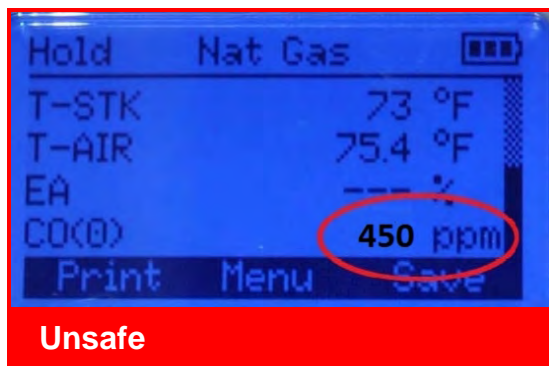
### Specification(s):

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 450 ppm air-free.

### Objective(s):

Ensure clean burn of gas ovens



If air-free CO reading exceeds 450 ppm, order a clean and tune



Test gas oven for carbon monoxide using a combustion gas analyzer

Clients will be notified if units do not improve after a clean and tune. Client education will be provided on how to minimize CO exposure such as running exhaust fans or opening a window. A CO alarm will be installed in the kitchen if the post clean and tune CO exceeds 450 ppm air-free.



## 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



Discoloration is a clear sign that a gas range needs a clean and tune



A properly operating gas range burner should have an even blue flame

CO measurement is not required. Action is based on a visual inspection only.



Gas ranges should be cleaned and tuned if improper operation is evident

## 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. KANSAS will use 2 minutes.

### Objective(s):

Detect excessive spillage of combustion gases



Test natural draft furnace or water heater for spillage in excess of 2min



Test all sides of natural draft flues since draft may not be uniform

### Tools:

1. Smoke pencil
2. Timer

A cold vent pertains to an appliance for which the heat setting is turned to OFF. Warm vent pertains

to an appliance for which the heat setting is turned to ON. Kansas will limit spillage to two minutes for either a warm or a cold vent.

## 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)

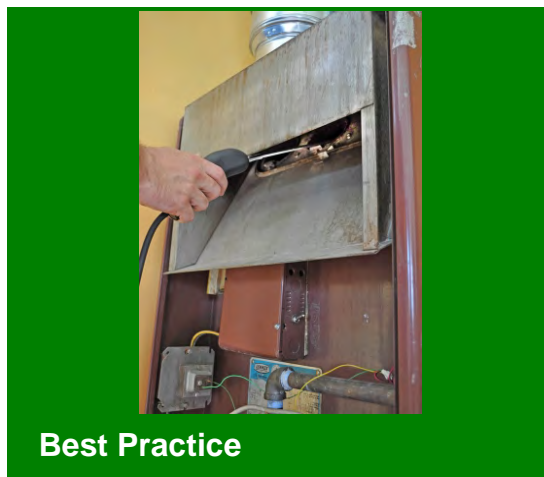
### Objective(s):

Measure CO and report excessive levels



**Unsafe**

CO levels cannot exceed 400ppm air free, unless to manufacturer specs



**Best Practice**

Test CO levels in undiluted flue gases and exhaust outlets, when accessible

## Tools:

1. Combustion analyzer with probe

Note the air free measurement requirement. Verify that the selected monoxor setting displays air free measurement.



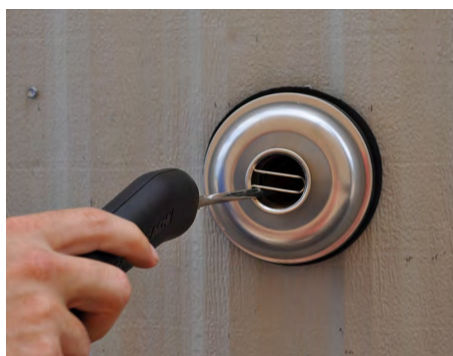
CO levels cannot exceed 400ppm air-free CO



Test undiluted flue gases in induced-draft furnaces--check local codes before drilling



Test undiluted flue gases in natural draft water heaters--check local codes before drilling



Test accessible exhaust outlets for direct-vent appliances



Test accessible exhaust outlets for power-vented appliances

## 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



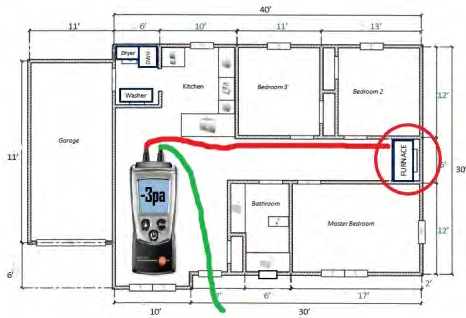
Conduct spillage testing at the end of the work day

### Tools:

1. Manometer
2. Smoke pencil
3. Timer
4. Combustion analyzer with probe

Best practice is to do daily test out after air sealing measure installations. HVAC work must be completed before air sealing measures to minimize risk. Potential depressurization and drafting issues shall be identified and corrected before air sealing measures.





Set up CAZ under worst case depressurization



Complete spillage test using chemical smoke pencil



Test for spillage on all sides of draft diverter



Complete spillage testing on all combustion appliances



## 2.0203.2 - Combustion Flue Gas—Orphaned Water Heaters

### Desired Outcome:

Flue gasses successfully removed from the house

## 2.0203.2b - Flue gas removal (chimney liner or approved methods)

### Desired Outcome:

Flue gasses successfully removed from the house

### Specification(s):

A chimney liner will be installed in accordance with the IRC or applicable NFPA standard

### Objective(s):

Allow water heater to vent properly

Prevent damage to the chimney



Unlined masonry chimney



Flue liner with rain cap

### Tools:

1. Hammer drill
2. Disposable brushes
3. Tin snips
4. 5/16" nut driver
5. Pulling cone
6. Rope
7. Caulking gun
8. Tape measure
9. 4 1/2" angle grinder with metal cutoff wheel

### Materials:

1. Flexible chimney liner
2. Rain cap
3. Top plate
4. B-vent adjustable elbows
5. Tees (if required to connect multiple appliances)
6. Refractory cement
7. Bricks
8. Mortar

Connect chimney liner to appliance in accordance with applicable codes.

Flue liners should be galvanized-steel vent pipe, stainless steel pipe, Type B-vent, or a flexible metal liner and sized appropriately. A liner used to vent solid fuel may not also be used to vent liquid or gaseous fuel.

See Subrecipient Procedure Manual for additional information.



Measure from the bottom termination to the chimney crown. Add one foot to the measurement and cut the liner to length



Pull chimney liner into position (from top or bottom, whichever is easier) with a rope and pulling cone



Measure and mark the flexible chimney liner at 4 inches above the chimney



Cut the flexible chimney liner to length

Install top plate over opening and attach it to the liner

Fasten the rain cap to the chimney liner



Seal around penetrations in chimney with refractory (furnace) cement



Connect appliance vent to the chimney liner



Use refractory (furnace) cement to seal metal water heater or furnace vents to the masonry chimney



## 2.0203.2 - Combustion Flue Gas—Orphaned Water Heaters

### Desired Outcome:

Flue gasses successfully removed from the house

## 2.0203.2d - Required combustion air

### Desired Outcome:

Flue gasses successfully removed from the house

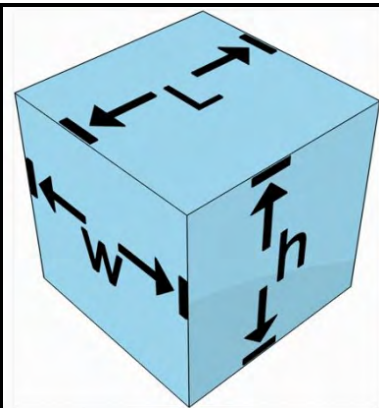
### Specification(s):

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

If measured volume is less than 50cuft per 1000Btuh, additional combustion air is needed.



If appliances have passed combustion safety testing per BPI 1200, no additional combustion air is needed.

### Tools:

1. Measuring tape
2. Calculator

Where applicable, combustion air will be provided from the inside and installed in accordance with IRC for the type of appliance installed.



Measure the CAZ width.



Measure the CAZ length.



Measure the CAZ height.

## 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



**Best Practice**

ALL houses must have carbon monoxide detectors installed near sleeping areas



**Best Practice**

Compare indoor and outdoor CO levels. If case of elevated indoor CO levels, locate the source and fix the problem

### Tools:

1. Combustion analyzer with probe
2. Personal CO monitor



Test all combustion appliances for co exhaust and check against appropriate action levels for appliance type



Do not forget to test gas ovens as a potential source of CO -- check results against action levels



If combustion appliances are source of elevated CO levels, repair or replace as necessary



Could CO infiltration be coming from outdoor sources? Air seal and weatherstrip to minimize outdoor pollutants



## 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

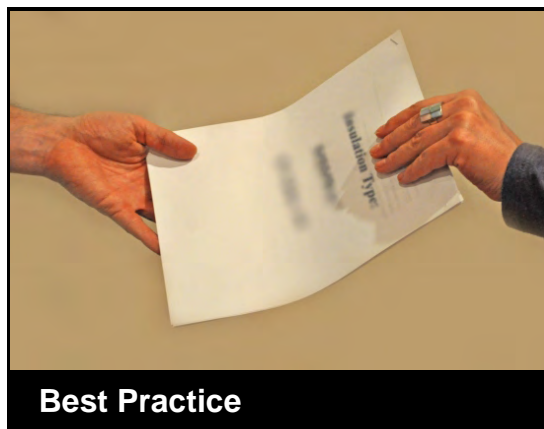
### Objective(s):

Ensure occupant can operate and maintain installations

Inform occupant regarding possible CO hazards



Review CO alarm maintenance with occupant



Provide occupant with information about CO sources, risks, and symptoms

## 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

One UL 217 listed smoke alarm will be installed outside sleeping areas AND on each habitable floor within in every weatherized home. Alarms shall have non-removable, non-replaceable 10 year lithium batteries.

## **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

Every weatherized home shall have at least 1 CO alarm per habitable floor. Alarms shall have non-removable, non-replaceable 10 year lithium batteries. An alarm should be installed outside the primary sleeping area.

## 2.0403.1 - Vented Crawl Spaces—Ground Moisture Barrier

### Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

## 2.0403.1b - Coverage

### Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

### Specification(s):

A ground moisture barrier that covers the exposed crawl space floor will be installed

### Objective(s):

Reduce ground moisture entering the crawl space



Uncovered crawl space floors can cause moisture damage



Ground moisture barrier to cover 100% of floor is installed last

Foundation vents will not be modified where local codes prevent modification. Ground moisture barriers and foundation insulation will not be installed where bulk water intrusion/standing water is a concern. Floor airsealing and insulation should be used in these applications, as applicable and audit approved. Where crawlspaces are to be included in the conditioned volume, foundation vents are to be sealed from the interior with rigid board. Where floors are insulated and vents are left operable, leave floor insulation back a few inches to allow full operation of vents.

Foundation insulation will not be installed where foundation vents remain operable.

## 2.0403.2 - Closed Crawl Spaces—Ground Moisture Barriers

### Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

### 2.0403.2b - Coverage

### Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

### Specification(s):

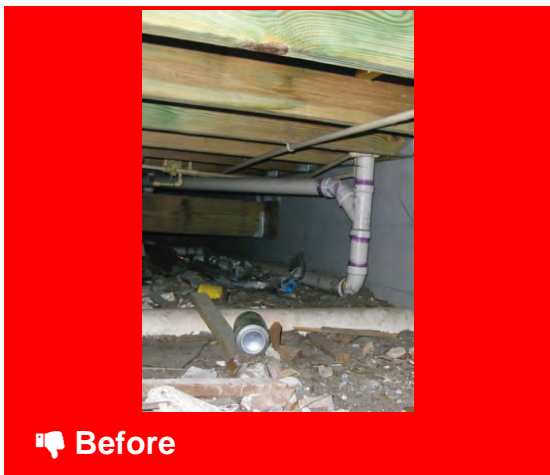
An air barrier and ground moisture barrier, covering the exposed crawl space floor, will be installed and sealed to the wall's air and moisture barrier in accordance with ASTM E1643 and manufacturer's recommendations

Ground moisture barrier will be fastened to ground in accordance with manufacturer's recommendations and extend a minimum of 6 inches up the foundation wall

### Objective(s):

Reduce ground moisture entering the crawl space

Create a continuous and durable connection between the wall and ground air and moisture barriers



Uncovered crawl space floors can lead to moisture issues



Ground moisture barrier should cover 100% of floor and at least 6" of walls

**Materials:**

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

Ground moisture barrier shall extend a minimum of 6 inches up the foundation walls and pillars and must be mechanically fastened or sealed with bonding agents. Best practice is to extend the moisture barrier up the foundation wall to above the exterior grade, without contact with the sill plate or any wood. This allows for a termite inspection and keeps moisture vapor from contacting wood. Barrier must be attached with a durable connection. Best practices include adhesive and mastic together, or mechanically fastened. Debris that can cause injury or puncture ground covers (e.g nails, glass, screws, etc) will be removed from the crawl space as feasible. When ground moisture barrier is installed on sloping ground, it will be fastened to ground with durable fasteners or ballast. The ground moisture barrier will not interfere with the established drainage pattern. Interior drainage collection points will be accessible from above and below the ground moisture barrier.

## 2.0403.2 - Closed Crawl Spaces—Ground Moisture Barriers

### Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

### 2.0403.2c - Material specification

### Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

### Specification(s):

A ground moisture barrier with a rating of no more than 0.1 perm will be used

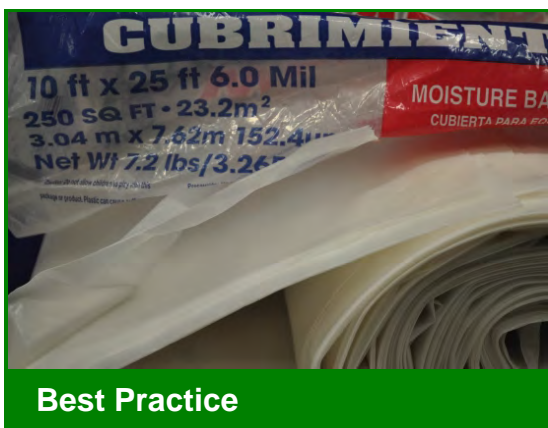
A ground moisture barrier will be used that meets tear and puncture resistance standard ASTM E1745

Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home, and it will need replacing to remain effective

### Objective(s):

Reduce ground vapor entering the crawl space

Ensure crawl space is accessible for service and maintenance without destroying the integrity of the moisture barrier



### Best Practice

Barrier must be at least 6 mil, able to withstand puncture and last 10 yrs



**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 6 mil 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).

A ground moisture barrier will be used that meets tear and puncture resistance of 6 mil or greater.

## 2.0403.2 - Closed Crawl Spaces—Ground Moisture Barriers

### Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

## 2.0403.2f - Sealing seams

### Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

### Specification(s):

A durable sealant compatible with the air barrier and ground moisture barrier will be used

### Objective(s):

Maintain continuous air barrier and ground moisture barrier



 Before

Crawl spaces lacking moisture barrier risk moisture penetration of floor



 After

Ground moisture barriers in unvented spaces should be sealed

### Tools:

1. Utility knife

### Materials:

1. Moisture-resistant adhesive tape

Seams should be overlapped 12 inches utilizing a reverse or upslope technique and be permanently sealed.



Tape wall seams and press to ensure airtight bonding of adhesive



Tape (overlapped) floor seams to prevent movement and water leakage

## 2.0601.1 - Knob and Tube Wiring

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Note:

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

## 2.0601.1a - Knob and tube identification

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Specification(s):

Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring

### Objective(s):

Ensure occupant safety

Preserve the integrity and safety of the house



Knob and tube wiring should be identified before work begins



Distinctive "knobs" are highlighted. This wiring can be a safety hazard

## 2.0601.1 - Knob and Tube Wiring

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Note:

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

## 2.0601.1b - Live wire testing

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Specification(s):

Non-contact testing method will be used to determine if wiring is live

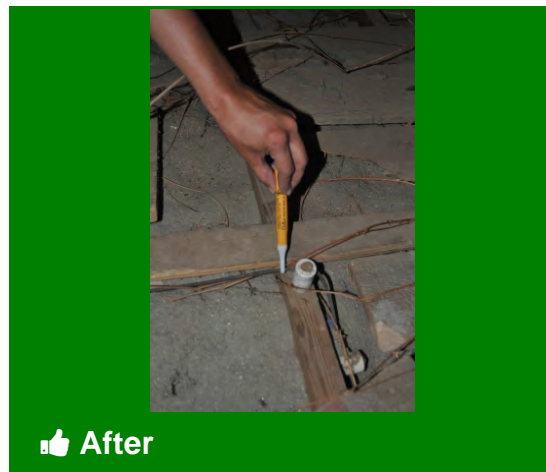
### Objective(s):

Protect occupant safety

Preserve the integrity and safety of the house



Knob & tube wiring needs to be tested to determine if still live. Red=live



Live wiring should be dammed or professionally disabled before insulating

### Tools:

1. Non-contact wire tester

## 2.0601.1 - Knob and Tube Wiring

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Note:

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

## 2.0601.1c - Isolation and protection

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Specification(s):

Proper clearance will be maintained around live knob and tube as required by the National Electrical Code ( NEC ) or authority having jurisdiction

When required, a dam that does not cover the top will be created to separate insulation from the wire path

### Objective(s):

Ensure occupant safety

Preserve the integrity and safety of the house



 Before

Live knob & tube wiring may get hot and should not be insulated over



 After

Dams should be installed to hold back loose fill insulation



**Tools:**

1. Drill
2. Tape measure
3. Non-contact wire tester

**Materials:**

1. Plywood
2. Drywall
3. Fasteners

NEC guidelines and local jurisdictions are very particular on the treatment of knob & tube wiring. A licensed electrician is not required to inspect and certify Knob and Tube wiring unless there is concern about the safety of it's condition or it's required by local code. Insulation may be applied under K&T as long as a 1 inch air gap is maintained. Batt insulation as a dam is allowed. The practice of using a batt to cover K&B during blowing and then removing it to create an air gap is allowed. Best Practice includes adding attic entrance signage that states "CAUTION Live Knob & Tube Wiring Present"



1 Have a certified electrician verify that wiring is safe to work around



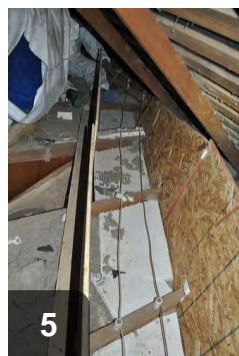
2 A sign should be posted at all entrances to warn of knob & tube wiring



3 Warning sign should remind to contact certified electrician for repairs



4 Many jurisdictions require a sign in Spanish as well



5 Damming should extend above installed height of insulation



6 With dams in place, insulation can begin



## 2.0601.1 - Knob and Tube Wiring

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Note:

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

## 2.0601.1d - Replacement

### Desired Outcome:

Live unsafe wiring identified and brought to local codes

### Specification(s):

Wiring will be replaced with new appropriate wiring in accordance with the NEC National Electrical Code and local codes

Old wiring will be rendered inoperable by licensed electrician in accordance with the NEC National Electrical Code and local codes

### Objective(s):

Ensure occupant safety

Preserve the integrity and safety of the house



 Before

Knob and tube wiring may get hot and cannot be insulated over



 After

If possible, k&t wiring should be disabled and replaced with modern wiring

### Tools:

1. Non-contact wire tester

### Materials:

1. Romex as needed

NEC guidelines and local jurisdictions have many codes dealing with the treatment of knob & tube wiring. Check your local codes. K&T replacement is an option if necessary and cost allowable. Note that sidewall dense pack insulation is not allowable if K&T is present in the cavity to be insulated.



The entire knob and tube system should be disabled



Many electricians will remove old exposed wiring to prevent reactivation



Exposed knob and tube should be replaced with modern wiring



With modern wiring in place and old k&t disabled, insulation can begin

## 2.0701.2 - Crawl Space Information Sign

### Desired Outcome:

Posted signs inside of the crawl space provide essential safety and maintenance information to occupant and users of the crawl space

### Note:

## 2.0701.2a - Sign specifications

### Desired Outcome:

Posted signs inside of the crawl space provide essential safety and maintenance information to occupant and users of the crawl space

### Specification(s):

A durable, easily seen sign will be installed at all accesses inside of the crawl space (minimum 8 ½" x 11")

A minimum expected service life of 10 years will be ensured

### Objective(s):

Prevent damage to the crawl space after upgrade



Crawl space access points should have signage to alert occupant and workers



Sign should be highly-visible, securely-fastened, and durable

## 2.0701.2 - Crawl Space Information Sign

### **Desired Outcome:**

Posted signs inside of the crawl space provide essential safety and maintenance information to occupant and users of the crawl space

### **Note:**

## 2.0701.2b - Sign content

### **Desired Outcome:**

Posted signs inside of the crawl space provide essential safety and maintenance information to occupant and users of the crawl space

### **Specification(s):**

Those entering the crawl space will be cautioned not to damage the air barrier, ground moisture barrier, insulation, and mechanical components specific to the crawl space type

Anyone entering the crawl space will be alerted that immediate repairs are needed in case of damage

Installer contact information will be included on the sign in case there are questions or needs for repairs

### **Objective(s):**

Prevent damage to the crawl space after upgrade

Educate anyone entering the crawl space

Provide occupants with a way to contact the installer

**Best Practice**

Mount sign where clearly visible to anyone entering crawl space

**Caution, do not damage:**

**If Damaged, the following must be repaired immediately:**

**If repairs are needed, contact:**

Be sure sign includes relevant information to aid occupant in repairs

**Tools:**

1. Printer
2. Staple gun

**Materials:**

1. Paper
2. Laminant
3. Staples

Agency contact information should be easily identifiable. Add "PROHIBITED: Do not store hazardous or flammable material in this space"

**Cuidado, no dañar:**

**Si está dañado, estos deben ser reparados inmediatamente:**

**Si es necesario realizar alguna reparación, ponerse en contacto con:**

Hacer la señal en español también

## 3.1001.1 - Penetrations and Chases

**Desired Outcome:**

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

### 3.1001.1a - Pre-inspection

**Desired Outcome:**

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**

An inspection will be conducted for mold, water leaks, and water damage before sealing a chase

Repairs will be completed before work

**Objective(s):**

Repair moisture-related issues

## 3.1001.1 - Penetrations and Chases

**Desired Outcome:**

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.1b - Backing and infill

**Desired Outcome:**

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic 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 hole

The infill or backing will not bend, sag, or move once installed

**Objective(s):**

Minimize hole size to ensure successful use of sealant

Ensure closure is permanent and supports any load (e.g., wind, insulation)

Ensure sealant does not fall out



## 3.1001.1 - Penetrations and Chases

**Desired Outcome:**

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

### 3.1001.1c - Sealant selection

**Desired Outcome:**

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction

**Objective(s):**

Select permanent sealant

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

## 3.1001.1 - Penetrations and Chases

### Desired Outcome:

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.1d - High temperature application

### Desired Outcome:

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Only non-combustible sealant will be used in contact with chimneys, vents, and flues

Local codes will be referenced

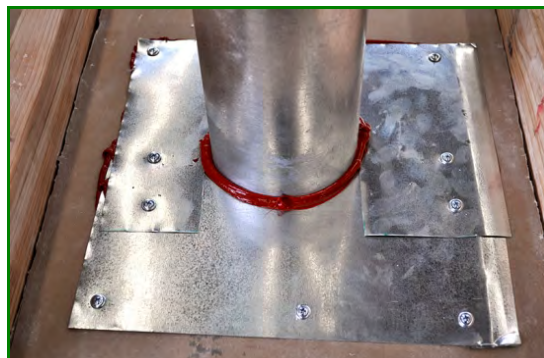
### Objective(s):

Prevent a fire hazard



 Before

Gaps around combustion exhaust flues need to be sealed



 After

Sealed penetrations and chases should utilize high-temperature materials

### Tools:

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

### Materials:

1. High-temperature caulking
2. 26-gauge steel sheeting

Refer to local codes. Adequate slope is generally a 1/4 inch per foot or greater. Inspect for proper flue clearance to combustibles. Refer to Local Codes. B-vent is typically 1 inch, single wall is typically

6 inches.

See 3.1402.1c for Clearance Requirements.



1 Prepare work area by removing any insulation and debris



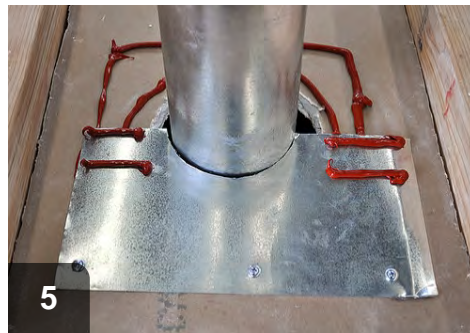
2 Use high-temperature caulking (600F min)



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 (26-gauge steel) and apply additional caulking



6 Fasten rigid material to cover penetration and seal against flue with caulk

## 3.1001.2 - Chase Capping

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.2a - Pre-inspection

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a chase

Repairs will be completed before work begins

### Objective(s):

Repair moisture-related issues



Investigate under insulation in chases to verify they are undamaged



Water damage in chase due to hole to the outside

**Tools:**

1. flashlight
2. headlamp
3. hammer
4. prybar
5. circular saw
6. reciprocating saw
7. borescope
8. mirror

Removing the batt over this chimney chase provided access to see a large hole and water damage in the chimney wall.



1  
Locate and expose chases to prepare for inspection and capping/sealing



2  
Clear away insulation and debris to allow inspection



3  
Carefully investigate areas with high potential for water leaks



## 3.1001.2 - Chase Capping

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.2b - Standard chase (interior walls covered with drywall or plaster)

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Entire opening will be spanned with rigid material

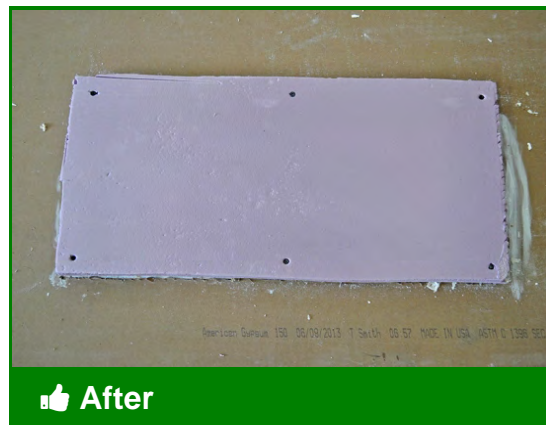
Material will be cut to fit and fastened as required

### Objective(s):

Reduce opening to what can be sealed with sealant



Unsealed standard chases covered with drywall can be leakage points



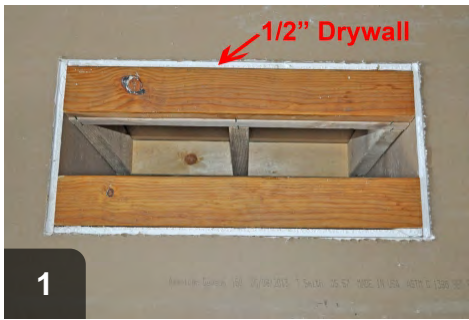
The air barrier is maintained by capping chases with rigid material

### Tools:

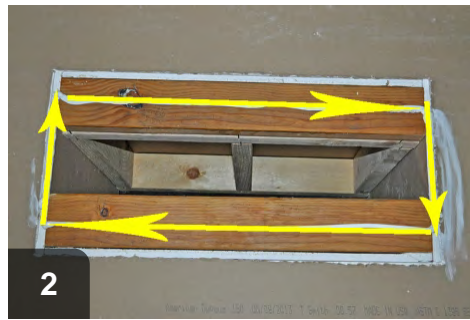
1. Drill/screwdriver
2. Caulk gun

### Materials:

1. XPS
2. Drywall
3. Caulk
4. Sheet metal
5. OSB or plywood



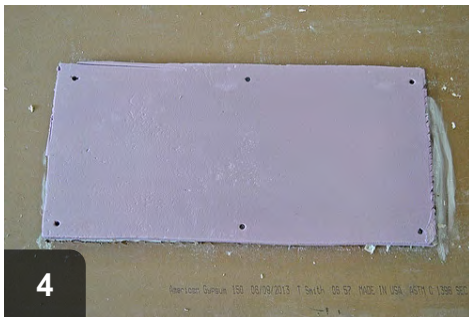
Clear area of debris and insulation in preparation for work



Apply sealant all the way around opening



Trim rigid material, such as drywall or XPS, to size and place over sealant



Fasten rigid material appropriately, such as with screws



## 3.1001.2 - Chase Capping

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.2c - Non-standard chase (interior walls covered with wood or paneling)

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Material will be used that can be exposed to the interior of the house and meet the flame and smoke spread indexes as required in IRC

### Objective(s):

Prevent a fire hazard



Paneled drop soffits typically are more combustibile than plain drywall



When sealing on attic side, drywall and XPS are viable materials

### Tools:

1. Drywall saw
2. Tape measure
3. Caulk gun
4. Drill

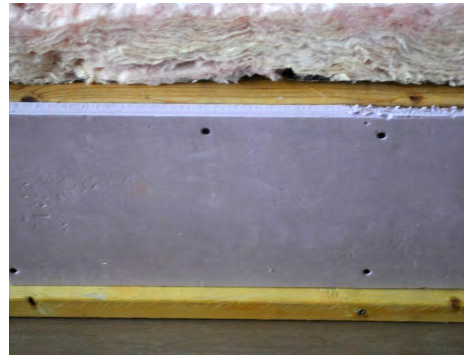
### Materials:

1. Drywall
2. XPS
3. Fire-block sealant
4. Fasteners

EPS or bead-board are not acceptable materials.



Sealing with drywall reduces overall combustibility of paneled chases



Sealing with XPS also reduces overall combustibility of paneled chases

## 3.1001.2 - Chase Capping

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.2d - Support

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)

### Objective(s):

Ensure seal stays in place and does not sag



Spans greater than 24 inches require additional bracing before capping



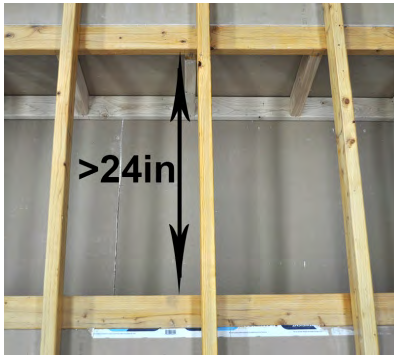
Support should prevent cap from sagging or moving

### Tools:

1. Drill
2. Saw
3. Tape measure

### Materials:

1. Lumber
2. Drywall
3. Fasteners



Create bracing to support spans larger than 24", either from above or below



When supporting from above, apply adhesive between drywall and bracing



Bracing can be screwed to drywall before capping chase



Ensure new bracing is secure by using screws to fasten to joist



Once chase is capped, it is now ready to be sealed along framing

## 3.1001.2 - Chase Capping

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.2e - Joint seal

### Desired Outcome:

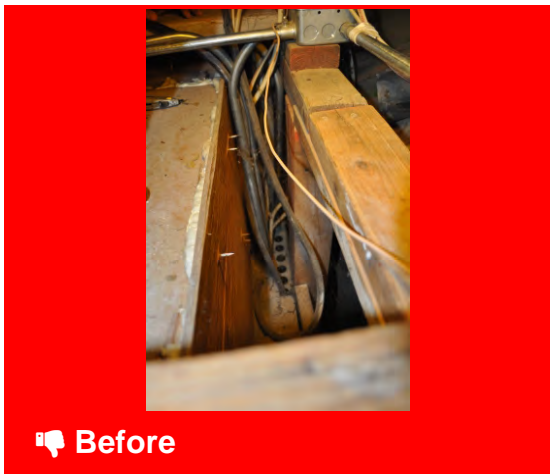
Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

### Objective(s):

Provide airtight, durable seal that does not move, bend, or sag



Chases need to be capped and sealed to prevent leakage



Chase is sealed along all cracks, gaps, and penetrations

### Tools:

1. Spray foam gun
2. Caulk gun

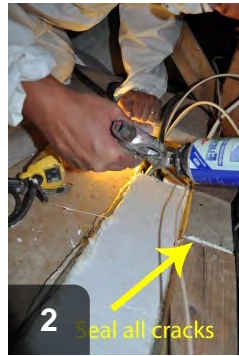
### Materials:

1. Spray foam
2. Caulk

Always wear protective gloves when working with sealants.



Chase has been capped but needs to be sealed



Sealant is used to fill in all cracks and gaps along edges of chase cap



Cap is sealed



## 3.1001.2 - Chase Capping

### Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

## 3.1001.2f - Adjacent framing

### Desired Outcome:

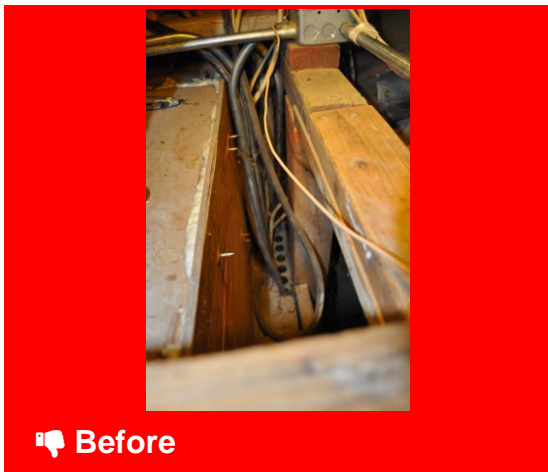
Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

All remaining gaps at the top of the chase will be sealed

### Objective(s):

Ensure airtight seal from one finished side of the chase to the other



Chases need to be capped and sealed to prevent leakage



Chase is sealed along all cracks, gaps, and penetrations

### Tools:

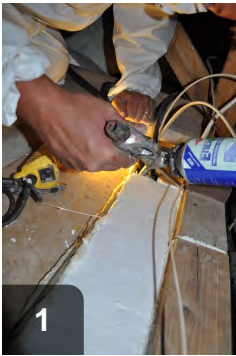
1. Spray foam gun
2. Caulk gun

### Materials:

1. Spray foam
2. Caulk

Always wear gloves when working with sealant.





Sealant is used to fill in all cracks and gaps along edges of chase cap



Extend seal along adjacent framing

## **3.1003.1 - New Ceiling Below Original—Old Ceiling Intact or Repairable**

### **Desired Outcome:**

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### **Note:**

## **3.1003.1a - Pre-inspection**

### **Desired Outcome:**

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### **Specification(s):**

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

### **Objective(s):**

Repair moisture-related issues

## 3.1003.1 - New Ceiling Below Original—Old Ceiling Intact or Repairable

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Note:

## 3.1003.1b - Sealing methods

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate

OR

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with SPF

Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference

### Objective(s):

Prevent air leakage from dropped ceiling to attic



**Before**

Damage to an older ceiling reveals the new ceiling below



**After**

Rigid material sealed in place creates an air barrier

### Tools:

1. Utility knife
2. Saw
3. Drill
4. Insulation machine
5. Caulk gun
6. Spray foam gun
7. Tape measure

### Materials:

1. Caulk sealant
2. Rigid material -- XPS or Drywall
3. Spray foam
4. Fasteners
5. Dense packable insulation
6. Wrapped fiberglass batts



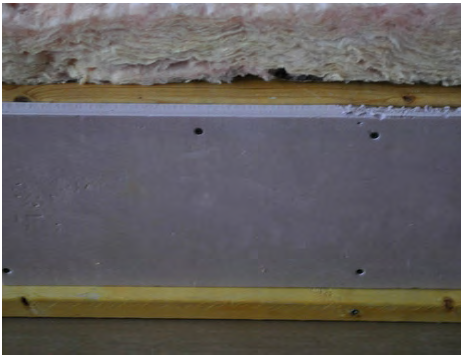
Prepare work area by removing existing insulation and debris



Option 1, Step 1: Run a bead of sealant around damage in old ceiling



Option 1, Step 2: Cover openings with rigid material, either XPS or drywall



Option 2: Seal with rigid material along face of stud cavities



Option 3: Dense pack cavities through fastened wood plate



Option 4: Bridge cavities at new ceiling level with wrapped batts and SPF



Whatever option chosen, test with chemical smoke to verify no leakage

## 3.1003.1 - New Ceiling Below Original—Old Ceiling Intact or Repairable

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Note:

## 3.1003.1c - Support

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)

### Objective(s):

Ensure seal stays in place and does not sag



Spans greater than 24 inches require additional bracing before capping



Support should prevent cap from sagging or moving

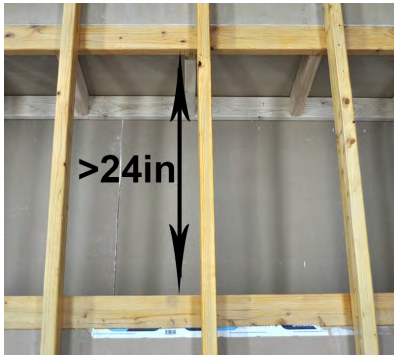
### Tools:

1. Saw
2. Drill
3. Tape measure

### Materials:

1. Lumber
2. Drywall
3. Fasteners





Create bracing to support spans larger than 24", either from above or below



When supporting from above, apply adhesive between drywall and bracing



Bracing can be screwed to drywall before capping chase



Ensure new bracing is secure by using screws to fasten to joist



Once chase is capped, it is now ready to be sealed along framing



## 3.1003.1 - New Ceiling Below Original—Old Ceiling Intact or Repairable

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Note:

## 3.1003.1d - Joint seal

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

### Objective(s):

Provide airtight, durable seal that does not move, bend, or sag



Damage to an old ceiling reveals a newer ceiling below



No gaps should remain after sealant is applied

### Tools:

1. Spray foam gun
2. Caulk gun

### Materials:

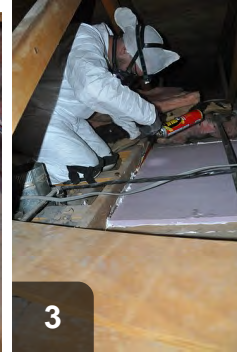
1. Caulk
2. Spray foam



Apply sealant to surrounding surfaces before setting cap in place



Sealant should extend along joists and into seams at top plates



Once cap is set, apply sealant to remaining gaps and along all seams

## 3.1003.1 - New Ceiling Below Original—Old Ceiling Intact or Repairable

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Note:

## 3.1003.1e - Adjacent framing

### Desired Outcome:

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

### Specification(s):

All remaining gaps will be sealed at the top of the dropped ceiling

OR

All remaining gaps at the top of the chase will be sealed

### Objective(s):

Provide airtight framing from one finished side of the dropped ceiling to the other



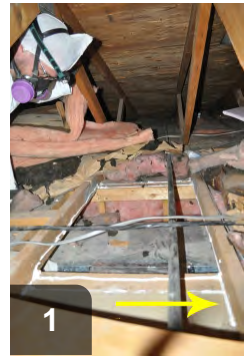
Damage to an older ceiling reveals the new ceiling below



No gaps should remain after spray foam is applied

**Tools:**

1. Caulk gun
2. Spray foam gun



Caulk along all joists before setting cap

**Materials:**

1. Spray foam
2. Caulk sealant



Use sealant to fill all remaining gaps

## 3.1003.6 - Dropped Soffits

**Desired Outcome:**

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

**Note:**

### 3.1003.6a - Pre-inspection

**Desired Outcome:**

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

**Objective(s):**

Repair moisture-related issues

## 3.1003.6 - Dropped Soffits

### Desired Outcome:

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### Note:

## 3.1003.6b - Soffit general

### Desired Outcome:

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Air flow will be blocked at soffit in locations where access allows

### Objective(s):

Provide continuous air barrier across soffit openings



 Before

Accessible drop soffits should be sealed to prevent heat gain/loss



 After

Completely sealed drop soffits and chases minimize heat transfer

### Tools:

1. Utility knife
2. Caulk gun
3. Saw
4. Drill

### Materials:

1. Caulk
2. Spray foam
3. XPS/Lumber/Sheetrock
4. Fasteners

See 3.1003.6c and 3.1003.6d for additional options.

## 3.1003.6 - Dropped Soffits

### Desired Outcome:

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### Note:

## 3.1003.6c - Option 1: bring soffit inside (seal at top)

### Desired Outcome:

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### Specification(s):

Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

### Objective(s):

Prevent air leakage from wall to attic

Reduce opening to what can be sealed with sealant

Ensure closure is permanent and supports any load (e.g., wind, insulation)

Bring soffit into thermal boundary



Standard soffits are often open to the attic and uninsulated



Rigid material encloses the soffit into the conditioned living space



**Tools:**

1. Drill/screwdriver
2. Caulk gun

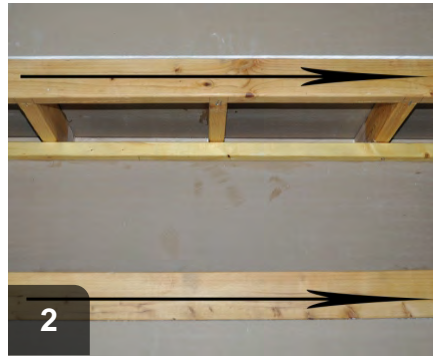
**Materials:**

1. Drywall
2. Sealant

Option 1, bringing the soffit into conditioned space, is preferred over sealing at the bottom or side.



1  
Soffits open to the attic need to be sealed to maintain air barrier



2  
Apply sealant along top plates



3  
Cap soffit with rigid material, such as drywall, cut to size



4  
Fasten cap with screws to set sealant and create air barrier



5  
Insulate over now-capped soffit

## 3.1003.6 - Dropped Soffits

### **Desired Outcome:**

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### **Note:**

## 3.1003.6d - Option 2: leave soffit outside (seal at bottom or side)

### **Desired Outcome:**

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### **Specification(s):**

Each stud bay will be spanned with rigid material will be cut to fit and fastened as required

OR

Backing at each stud bay will be provided and will be sealed

OR

Side of stud bays will be sealed with rigid material from bottom of soffit to top-plate

OR

A sealed rigid barrier will be installed at all transitions

### **Objective(s):**

Prevent air leakage from wall to soffit

Reduce opening to what can be sealed with sealant

Ensure soffit is outside of the thermal boundary



 **Before**

Wall cavities are open to attic and heat transfer due to dropped soffit



 **After**

Wall cavities capped and air-sealed in one of a variety of options

### Tools:

1. Tape measure
2. Utility knife
3. Saw
4. Insulation machine
5. Drill
6. Caulk gun
7. Spray foam gun

### Materials:

1. XPS
2. Drywall
3. Plywood
4. Lumber
5. Fasteners
6. Caulk
7. Spray foam
8. Dense packable insulation
9. Poly-wrapped insulation



Clear work area of insulation and debris



Option 1: Span each stud bay with rigid material at level of soffit



Option 2: Backing used to fill bays and sealed with spray foam



Option 3: Stud bay wall faced with rigid material, fastened and sealed

## 3.1003.6 - Dropped Soffits

### **Desired Outcome:**

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### **Note:**

## 3.1003.6e - Soffits containing non-IC rated recessed lights

### **Desired Outcome:**

Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

### **Specification(s):**

Insulation will be kept at least 3" away from the top and side of any fixtures

If dropped soffit is to be filled with insulation, then a sealed rigid barrier enclosure will be installed to maintain a 3" clearance around the entire fixture

Top of rigid barrier enclosure will be sealed with non-insulating rigid material (e.g., gypsum or equivalent perm rating and R-value)

### **Objective(s):**

Prevent light fixture from overheating

Bring light fixture inside of the air barrier

Do not insulate over enclosures containing non-IC rated recessed lights. Areas adjacent to recessed lights can be insulated over.

## 3.1201.1 - Double-Hung Wood Windows

**Desired Outcome:** Applies to all Window Types: Single, Metal, Vinyl, etc.  
Windows operable and weather tight; improved energy efficiency performance of fenestration

### 3.1201.1a - Lead paint assessment

**Desired Outcome:**  
Windows operable and weather tight; improved energy efficiency performance of fenestration

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

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

- Tools:**
1. Note: Mask must be worn during testing
  2. Utility knife
  3. Camera

Follow all applicable KDHE Lead regulations.

## 3.1201.1 - Double-Hung Wood Windows

### **Desired Outcome:**

Windows operable and weather tight; improved energy efficiency performance of fenestration

## 3.1201.1c - Sash locks

### **Desired Outcome:**

Windows operable and weather tight; improved energy efficiency performance of fenestration

### **Specification(s):**

Locks will be installed so that the rails of the upper and lower sashes are flush and in full contact

No gaps will be visible between the two sashes

Locks will be installed to achieve compression of the two sashes

### **Objective(s):**

Form a secure connection between the two sashes



## 3.1201.1 - Double-Hung Wood Windows

### Desired Outcome:

Windows operable and weather tight; improved energy efficiency performance of fenestration

## 3.1201.1d - Replacement sills

### Desired Outcome:

Windows operable and weather tight; improved energy efficiency performance of fenestration

### Specification(s):

Beveled sill will be flush with interior wall and sloped to the exterior

Seams will be continuously and completely sealed with sealant to the jambs and to the frame

Sill will be water-sealed and primed

### Objective(s):

Form a complete seal from the bottom of the lower sash to the sill

Maintain operability of the window

Allow for drainage to the exterior



 Before

Rot in and under a window sill is often a sign of a bigger problem



 After

Once repaired, this window is less leaky and better supported

**Tools:**

1. Saw
2. Drill
3. Pry bar
4. Sander
5. Caulk gun

**Materials:**

1. Lumber or metal sill
2. Caulk
3. Fasteners
4. Flashing



Remove sill to determine full extent of rot and necessary repairs



Once rotted materials are cut away, determine sizing of new materials



Cut new materials flush to surrounding surfaces and pitch toward exterior



For exterior repairs, replace flashing



Set new sill, then replace and prime trim

## 3.1201.1 - Double-Hung Wood Windows

### **Desired Outcome:**

Windows operable and weather tight; improved energy efficiency performance of fenestration

## 3.1201.1e - Sash replacement

### **Desired Outcome:**

Windows operable and weather tight; improved energy efficiency performance of fenestration

### **Specification(s):**

Lower sash will have the same bevel on the bottom rail as the sill

Sash will be water-sealed and primed

### **Objective(s):**

Ensure sash remains in a fixed position when open or partially open

Maintain operability of the window

Form a complete seal from the bottom of the lower sash to the sill

## 3.1201.3 - Exterior Doors

**Desired Outcome:**

Doors operable and weather tight

**Note:**

### 3.1201.3a - Lead paint assessment

**Desired Outcome:**

Doors operable and weather tight

**Specification(s):**

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

EPA's 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

Follow all applicable KDHE regulations.

## 3.1201.3 - Exterior Doors

### Desired Outcome:

Doors operable and weather tight

### Note:

## 3.1201.3b - Door operation and fit

### Desired Outcome:

Doors operable and weather tight

### Specification(s):

Door will be adjusted to properly fit the jamb and allow for ease of operation (e.g., hinge replacement, re-plane door, door strike adjustment)

### Objective(s):

Ensure proper operation of the door



Daylight visible around door can indicate it does not hang true and leaks



With proper adjustment, doors should hang true and minimize leakage

### Tools:

1. Screwdriver
2. Planer

### Materials:

1. Shims

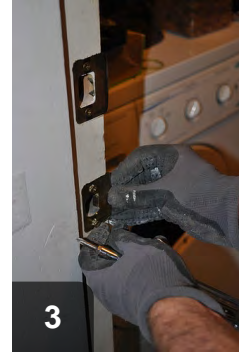
Exterior doors only. Follow all applicable KDHE regulations.



1  
After examining how door hangs, remove door from hinges



2  
Adjust hinge plates to bring door back into true



3  
Adjust strike plate to allow for secure and smooth operation



4  
Rehang door to verify adjustments worked and door operates smoothly



## 3.1201.3 - Exterior Doors

### Desired Outcome:

Doors operable and weather tight

### Note:

## 3.1201.3c - Air infiltration

### Desired Outcome:

Doors operable and weather tight

### Specification(s):

Details that reduce air infiltration will be repaired, replaced, sealed, or installed in accordance with State Energy Conservation Code or local code—whichever is more stringent (e.g., weather stripping, door bottoms, trim replacement with foam)

### Objective(s):

Reduce air infiltration



 Before

Daylight visible around an exterior door indicates air infiltration



 After

Weatherstripping and a door bottom minimize air infiltration around doors

### Tools:

1. Screwdriver
2. Saw
3. Utility knife
4. Caulk gun
5. Drill
6. Tape measure

### Materials:

1. Weatherstripping (Q-lan)
2. Door bottom
3. Fasteners
4. Caulk

Follow all applicable KDHE lead regulations.





1 Remove leaky door in order to affix door bottom



2 Measure and trim door, if necessary, to allow for door bottom



3 Trimming to allow for door bottom



4 Cut door bottom to width of door



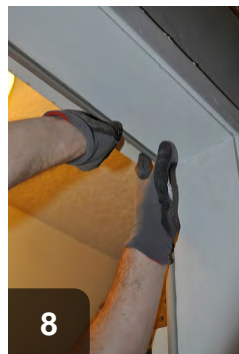
5 Ensure door bottom fits snugly around door and fasten into place



6 Measure doorway for weatherstripping



7 Notch upper ends of side weatherstripping to allow for top piece



8 Weatherstripping should fit snugly into rabbit and against other pieces



9 Rehang door and verify fit, operation, and lack of air infiltration

## 3.1201.3 - Exterior Doors

### Desired Outcome:

Doors operable and weather tight

### Note:

## 3.1201.3d - Water infiltration

### Desired Outcome:

Doors operable and weather tight

### Specification(s):

Details that reduce water infiltration will be repaired, replaced, sealed, or installed (e.g., adjust threshold, caulk jamb to threshold, caulk trim, flashing)

### Objective(s):

Reduce water infiltration



Daylight visible under exterior doors indicate water can leak in



By adjusting the threshold and sealing along it, water should be kept out

### Tools:

1. Caulk gun
2. Screwdriver
3. Pry bar

### Materials:

1. Caulk sealant

Follow all applicable KDHE lead regulations.



Adjust threshold to minimize gap and keep water out



Caulk along threshold from inside and outside to prevent water infiltration

## **3.1201.3 - Exterior Doors**

**Desired Outcome:**

Doors operable and weather tight

**Note:**

## **3.1201.3e - Occupant education and maintenance**

**Desired Outcome:**

Doors operable and weather tight

**Specification(s):**

Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain weather stripping and caulk around door and trim

**Objective(s):**

Ensure long-term weather tightness

## **3.1202.1 - Fixed Frame with Wood Sash—Older House**

**Desired Outcome:**

Applies to all types of window repairs

Glass complete and intact; improved energy efficiency performance of fenestration

### **3.1202.1a - Lead paint assessment**

**Desired Outcome:**

Glass complete and intact; improved energy efficiency performance of fenestration

**Specification(s):**

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

EPA's 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

Follow all applicable KDHE regulations.

## 3.1202.1 - Fixed Frame with Wood Sash—Older House

### Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

## 3.1202.1b - Broken glass removal

### Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

### Specification(s):

Putty and push points will be removed

Broken or cracked glass will be removed

### Objective(s):

Safely remove old glass



Broken glass with failed repairs needs to be replaced



Large pieces of glass have been removed but sash still needs preparation

### Tools:

1. Putty knife
2. Chisel
3. Utility knife
4. Shop vacuum
5. Tape measure

### Materials:

1. Tape

Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.

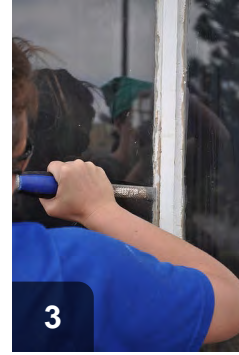




1  
Always wear heavy work gloves when working with glass



2  
Cut through caulk bead and glazing to ease removal



3  
Remove old putty and glazing to expose metal points holding glass in place



4  
With points and glass removed, measure opening for replacement pane



5  
Cut replacement glass 1/8" smaller than measured opening



## 3.1202.1 - Fixed Frame with Wood Sash—Older House

### Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

### 3.1202.1c - Sash preparation

### Desired Outcome:

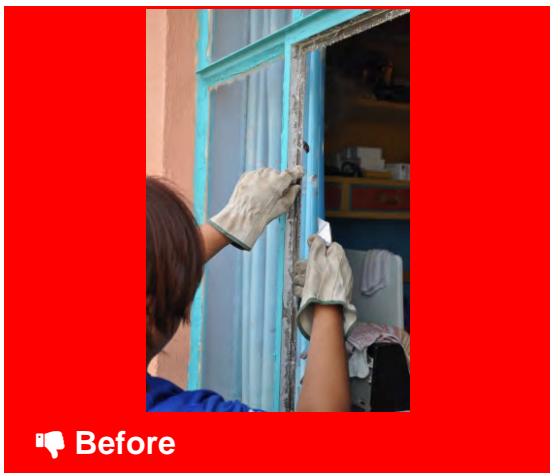
Glass complete and intact; improved energy efficiency performance of fenestration

### Specification(s):

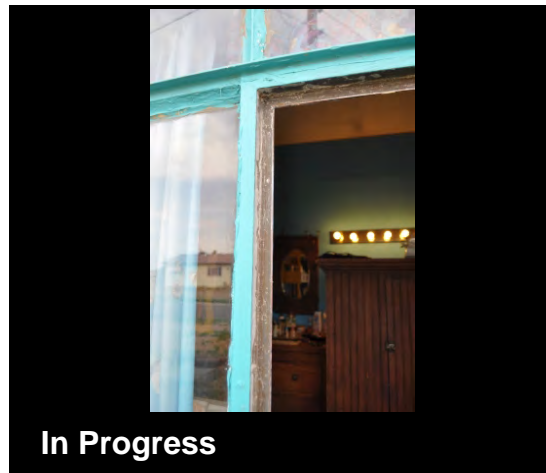
Opening will be cleaned

### Objective(s):

Prepare opening for new glass



Remove all debris from sash either by sand paper, knife, or chisel



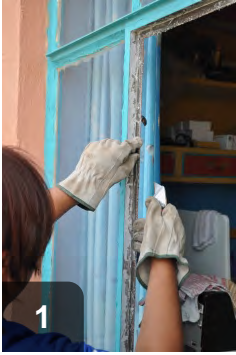
Mount new glass onto a clean surface

### Tools:

1. Chisel
2. Utility knife

### Materials:

1. Sand paper
2. Cleaning solution
3. Rags



1  
Debris in the sash can cause new glass to seal improperly



2  
Check closely to remove all pieces of broken glass and debris



3  
With sash cleaned, glass will fit properly and glazing will seal

## 3.1202.1 - Fixed Frame with Wood Sash—Older House

### Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

## 3.1202.1d - New glass installation

### Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

### Specification(s):

Glass will be sized 1/8" to 3/16" smaller than opening to allow for movement of frame

Safety glass will be installed in accordance with local codes

Push points will be provided on each side to secure glass in frame

Glazing compound will be added in accordance with manufacturer specifications

### Objective(s):

Ensure glazing compound will adhere to sash

Install, seal, and secure new glass in place

Allow glazing compound to harden to ensure secure installation



With sash prepared, installation of new pane can begin



Replacement glass should be securely fixed with points and glazing

**Tools:**

1. Caulk gun
2. Tape measure
3. Paint brush

**Materials:**

1. Primer
2. Window glazing
3. Push points
4. Shims
5. Replacement glass
6. Tape

Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.



1 Always wear heavy work gloves when working with glass



2 With broken glass removed, measure opening for replacement glass



3 Cut replacement glass 1/8" smaller than measured opening



4 Use shims to center glass while installing push points



5 With push points in place, glaze to air seal new glass pane in sash



6 Secure pane in place with tape to hold until glazing sets

## 3.1203.1 - Replacement Window in Existing Window Frame

### **Desired Outcome:**

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

## 3.1203.1a - Lead paint assessment

### **Desired Outcome:**

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### **Specification(s):**

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

EPA's 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

Follow all applicable KDHE regulations. Ensure SHPO approval in homes 50 years old or older.

## 3.1203.1 - Replacement Window in Existing Window Frame

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

## 3.1203.1c - Replacement window installation

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Specification(s):

Replacement window will be installed in accordance with manufacturer specifications, ensuring that the exterior stops are caulked

### Objective(s):

Ensure replacement window operates properly

Ensure replacement window has a weather tight fit



Window opening ready to receive replacement window



Replacement window installed, with stop molding replaced and caulked



**Tools:**

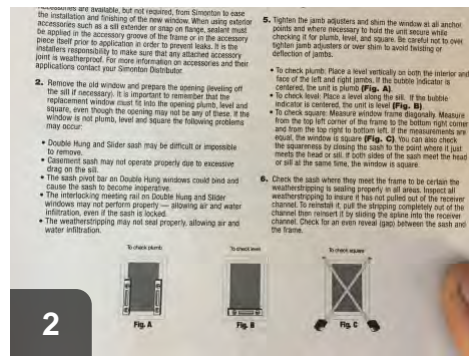
1. Utility knife
2. Hammer
3. Sharp-bladed prybar
4. Nail set punch
5. Cordless driver/drill
6. Caulking gun
7. HEPA vacuum (for lead-based paint work)

**Materials:**

1. Window, door, and trim caulk
2. 6-mil polyethylene plastic



1  
Prepare and clean opening before installing new window



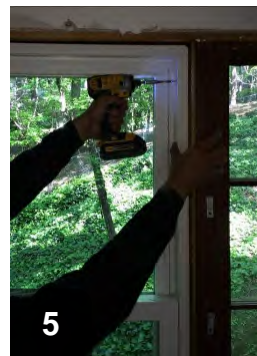
2  
Check opening for plumb, level, and square



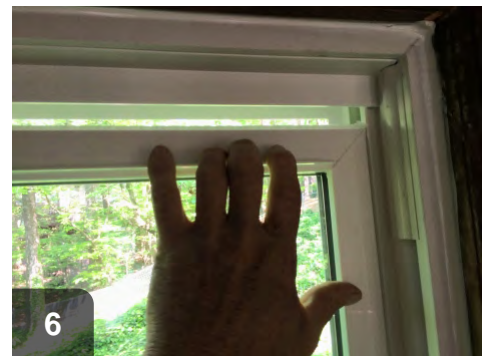
3  
Measure diagonally both ways across opening. If measurements are equal, the opening is square



4  
Apply caulk to stop molding and install the new window in accordance with manufacturer's instructions.



5  
Tighten jamb adjusters and shim as necessary to achieve plumb, level, and square. Fasten window into opening



6  
Make sure the sashes open, close, and lock properly. Check that the sashes are parallel with the frame as shown





Caulk new window to existing stop molding



Reinstall and caulk interior stop molding



Completed installation

## **3.1203.2 - Single-Unit Window, Mounted on Rough Opening—Newer House**

### **Desired Outcome:**

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### **Note:**

## **3.1203.2a - Lead paint assessment**

### **Desired Outcome:**

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### **Specification(s):**

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

EPA's 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

Follow all applicable KDHE regulations. Ensure SHPO approval in homes 50 years old or older.

## 3.1203.2 - Single-Unit Window, Mounted on Rough Opening—Newer House

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Note:

## 3.1203.2b - Opening preparation

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Specification(s):

Replacement window will be laid out with trim

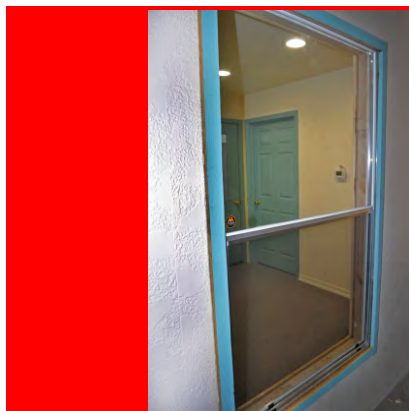
Exterior trim will be removed or exterior siding will be cut back to fit new window with trim

Existing window will be removed

Window opening will be flashed in accordance with accepted industry standards

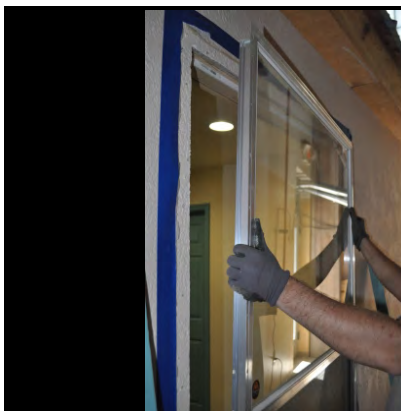
### Objective(s):

Provide a clean and properly flashed opening for replacement window unit



 **Before**

Single pane window in newer home



**In Progress**

Window is removed to allow for replacement with double pane unit

**Tools:**

1. Pry bar
2. Utility knife
3. Drill

**Materials:**

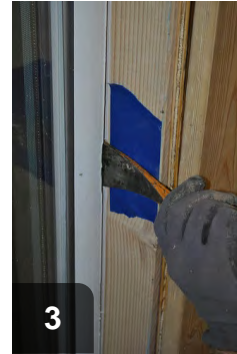
1. Window and door flashing



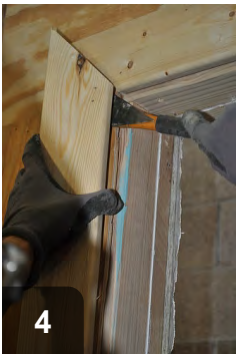
1  
Single pane window needs to be replaced with double pane



2  
Cut through caulk at stops to break seal



3  
Remove stops while attempting to keep damage to rough opening to minimum



4  
Remove interior trim



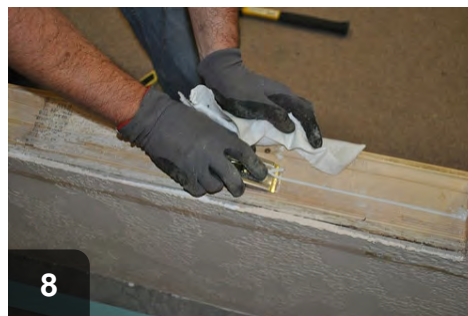
5  
Remove exterior trim



6  
Remove exterior fasteners to free window



7  
Remove window from rough opening



8  
Clean rough opening to remove old caulk and debris



9  
Install flashing along sides and bottom of rough opening

## 3.1203.2 - Single-Unit Window, Mounted on Rough Opening—Newer House

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Note:

## 3.1203.2c - Replacement unit preparation

### Desired Outcome:

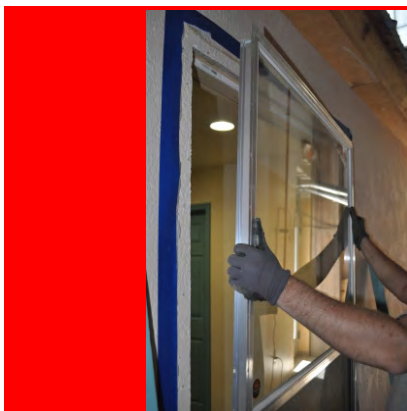
Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Specification(s):

Mounting detail will be determined based on depth of window and location of window liner

### Objective(s):

Allow for good fit and finish of replacement window



 Before

Single pane window is being removed

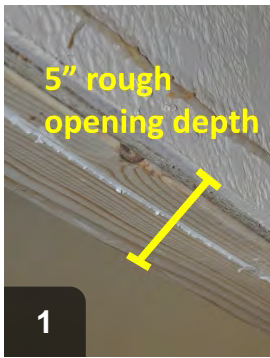


In Progress

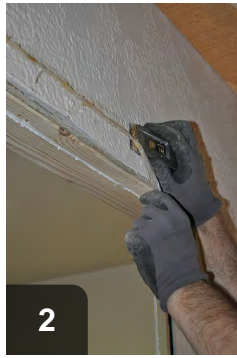
Double-pane unit replaces previous single-pane one

### Tools:

1. Tape measure
2. Utility knife



1  
Measure rough opening depth to determine best method of installation



2  
Clean old sealant off exterior surface to allow for flange installation



3  
Install unit following appropriate detail for rough opening and unit depth



## 3.1203.2 - Single-Unit Window, Mounted on Rough Opening—Newer House

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Note:

## 3.1203.2d - Replacement window installation

### Desired Outcome:

Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

### Specification(s):

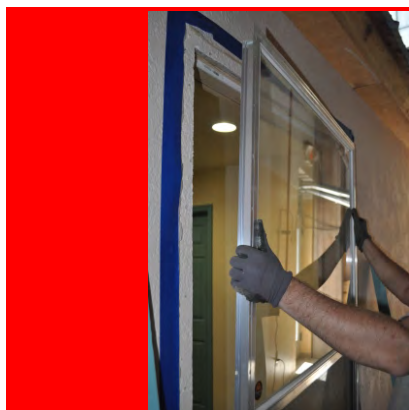
Replacement windows will be installed in accordance with manufacturer specifications and will be integrated with flashing

Gaps between the new window and existing frame will be sealed with low-expanding foam

### Objective(s):

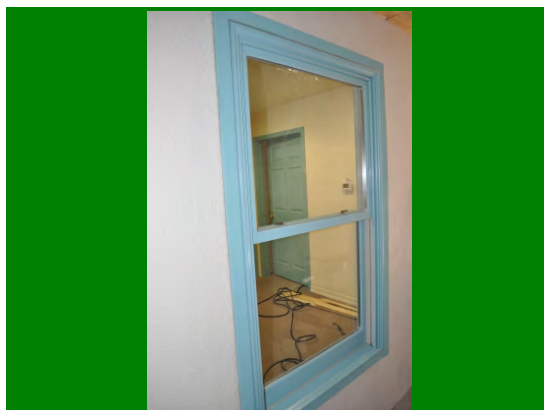
Ensure replacement window operates properly

Ensure replacement window is weather tight



 Before

Single pane window is being removed to install double pane unit



 After

Double pane unit installed with trim in place

### Tools:

1. Utility knife
2. Spray foam gun
3. Drill
4. Hammer
5. Saw

### Materials:

1. Fasteners
2. Flashing
3. Low-expansion spray foam
4. Backer rod
5. Primed trim



Install flashing to manufacturer specs and industry standards



Flanges have been folded out to allow for easy installation



Fasten window flange securely around exterior of entire window



With window secured in place, check for proper function



Check that sash locks align properly, indicating window is plumb



Fill interior gap with compressible foam or appropriate sealant



Prime and replace interior trim and, if needed, sill



Replace exterior trim and patch exterior siding or finish as needed

## 3.1402.1 - Crawl Spaces—Sealing Floor Penetrations

### Desired Outcome:

Air leakage prevented and indoor air quality protected

### Note:

## 3.1402.1a - Backing and infill

### Desired Outcome:

Air leakage prevented and indoor air quality protected

### 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 any load (e.g., insulation)

Ensure sealant does not fall out



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



Gaps should be sealed to maintain air barrier

### Tools:

1. Headlamp

### Materials:

1. Backer rod
2. Sealant



1  
Prepare work space by removing any insulation



2  
Infill with backer rod



3  
Apply appropriate caulking to ensure backing/infill does not move



4  
Visually inspect to verify no gaps remain



## 3.1402.1 - Crawl Spaces—Sealing Floor Penetrations

### Desired Outcome:

Air leakage prevented and indoor air quality protected

### Note:

## 3.1402.1b - Sealant selection

### Desired Outcome:

Air leakage prevented and indoor air quality protected

### Specification(s):

Sealants will be used to fill holes no larger than recommended by manufacturer specifications

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

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



**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

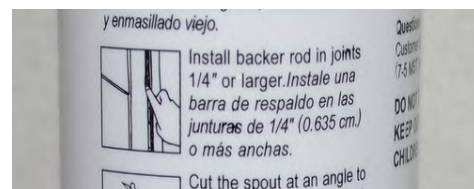
Best practice is to utilize paintable clear sealants if high temp is not required. Gaps or cracks larger than 1/4 inches may require backer.



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



## 3.1402.1 - Crawl Spaces—Sealing Floor Penetrations

### Desired Outcome:

Air leakage prevented and indoor air quality protected

### Note:

### 3.1402.1c - High temperature application

### Desired Outcome:

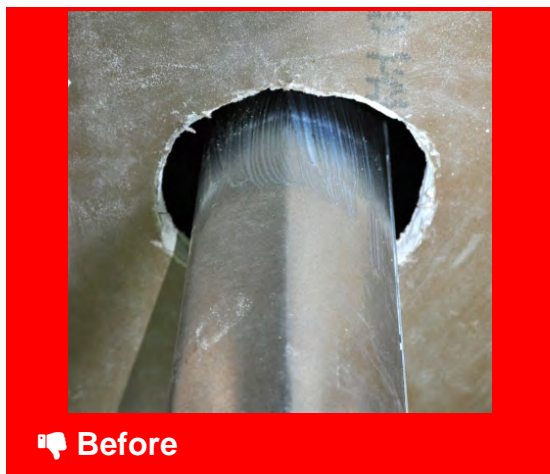
Air leakage prevented and indoor air quality protected

### Specification(s):

Only non-combustible materials will be used in contact with chimneys, vents, and flues in accordance with authority having jurisdiction

### Objective(s):

Prevent a fire hazard



Gaps around floor penetrations allow air and moisture movement



Use non-combustible materials, like 26-gauge steel and high-temp caulk

### Tools:

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

### Materials:

1. High-temperature caulk
2. 26-gauge steel sheeting



1 Prepare work area by removing any insulation and debris



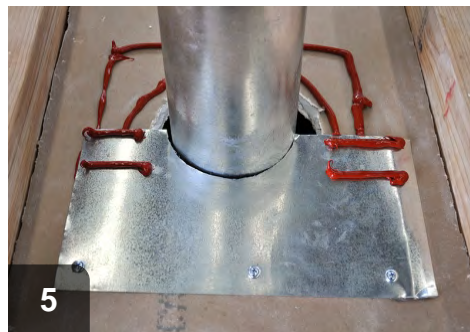
2 Use high-temperature caulking (600F min)



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 (26-gauge steel) and apply additional caulking



6 Fasten rigid material to cover penetration and seal against flue with caulk

## 3.1402.3 - Closed Crawl Spaces—Air Sealing Exterior Wall

### Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

### 3.1402.3a - Seal penetrations

### Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

### Specification(s):

Penetrations will be sealed with a durable material

A minimum expected service life of 10 years will be ensured

### Objective(s):

Prevent air and moisture penetration into crawl space



 Before

Light showing through penetration in exterior block wall



 After

Sealed with durable material to prevent air and water leakage, and pests

### Tools:

1. Caulk gun
2. Sprayfoam gun
3. Metal snips
4. Drill

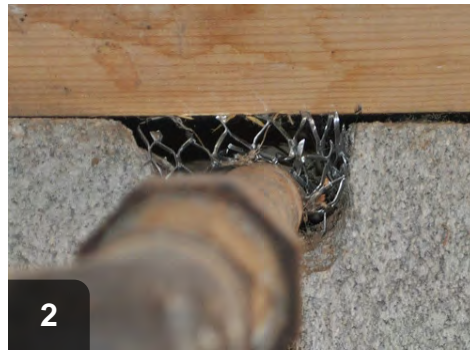
### Materials:

1. Caulk
2. Sprayfoam
3. Metal mesh
4. Fasteners

Spray foam should not be visible from conditioned space. If the penetration is greater than ¼ inches, caulking, steel wool, or other pest-proof material will be used to fill the penetration before sealing.



1 Measure holes to determine the best backing and fill strategy



2 In holes larger than 1/4 inch, wire mesh should be used for backing



3 Sprayfoam or caulk seal the hole



## 3.1501.1 - Penetrations, Cracks, and Doors Between Garage and House

### Desired Outcome:

Openings from garage sealed to prevent leakage

### 3.1501.1a - Penetrations

### Desired Outcome:

Openings from garage sealed to prevent leakage

### Specification(s):

All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations will be sealed

### Objective(s):

Prevent air leakage and pollutant entry



 Before

Penetrations between the garage and house can leak hazardous fumes



 After

Seal penetrations to minimize risks and air leakage

### Materials:

1. Backer Rod
2. Caulk
3. Spray foam

Attached garage homes are to meet ASHRAE 62.2-2016 standards.

## 3.1601.3 - Support

### Desired Outcome:

Ducts and plenums properly supported

## 3.1601.3a - 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 every 4' using a minimum of 1 ½" wide material

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); duct support must be installed in accordance with authority having jurisdiction

Metal ducts will be supported by 1/2 inch wide eighteen gauge metal straps or 12-gauge galvanized wire at intervals not exceeding 10 feet or other approved means

### Objective(s):

Eliminate falling and sagging



Ducts should not be allowed to droop and drag, adding distance to run



Properly supported ducts minimize heat loss and and maximize duct run



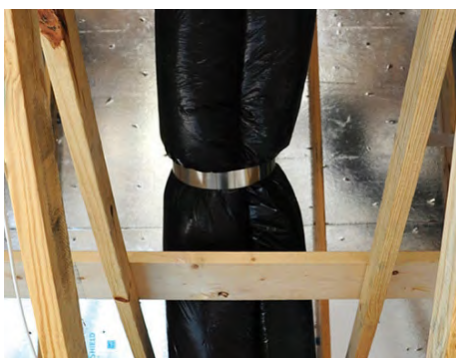
**Tools:**

1. Metal snips
2. Utility knife
3. Drill
4. Stapler

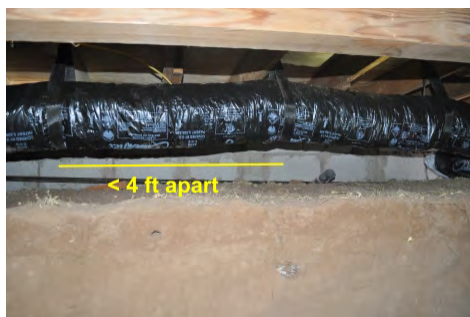
**Materials:**

1. 18 gauge metal strap (at least 1/2" wide)
2. 12 gauge galvanized wire
3. Fabric support straps (at least 1 1/2" wide)
4. Staples
5. Fasteners

Ductwork should be as straight as possible and where bends are necessary they should be as smooth and wide as possible. Best Practice is to use transitional pieces on angles 45 degrees or greater.



**BAD:** Make sure supports DO NOT compress insulation or duct



Flex ducts should have supports no less than every 4 feet



Durable strap should be at least 1 1/2 inches wide



Metal ducts should be supported every 10 feet or less with straps or wire



Metal straps should be at least 18 gauge and 1/2 inch wide



Metal wire should be at least 12 gauge and galvanized

## 3.1602.1 - Air Sealing Duct System

### **Desired Outcome:**

Ducts and plenums sealed to prevent leakage

## 3.1602.1c - Existing component to existing component

### **Desired Outcome:**

Ducts and plenums sealed to prevent leakage

### **Specification(s):**

Seams, cracks, joints, holes, and penetrations less than 1/4" will be sealed using UL 181 fiber-embedded mastic

Seams, cracks, joints, holes, and penetrations between 1/4" and 3/4" will be sealed in two stages:

\* They will be backed using temporary tape (e.g., foil tape) as a support prior to sealing\* They will be sealed using fiberglass mesh and mastic

Seams, cracks, joints, holes, and penetrations larger than 3/4" will be repaired using rigid duct material

Mastic will overlap repair joint or existing temporary tape by at least 1" on all sides

### **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 fiberglass mesh and mastic during curing



 **Before**

Unsealed joints and connections need to be sealed to prevent health risks



 **After**

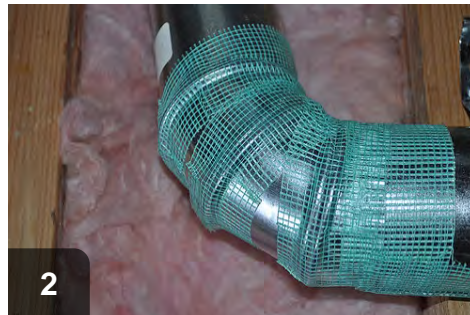
Sealed ductwork connections help prevent leakage

**Materials:**

1. Mastic
2. Fiberglass mesh tape



Prepare work area by assessing any safety concerns



Wrap joint with fiberglass mesh tape



Apply UL 181 mastic to seal joint

## 3.1602.4 - Air Sealing System Components

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

### 3.1602.4a - Duct boot to interior surface

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

### Specification(s):

All gaps between boot and interior surface that defines conditioned space will be air sealed

Gypsum edge will be wetted before applying water-based sealant

Sealants will be continuous and be in accordance with IRC

### Objective(s):

Prevent air leakage

Prevent a fire hazard



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



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. Mesh tape

An appropriate caulking to allow expansion may also be used. Examples may include paintable



silicon. Caulking should not be visible once the register/grill is replaced.



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

## 3.1602.4 - Air Sealing System Components

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

## 3.1602.4b - Wooden plenums and building cavities

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

### Specification(s):

Accessible connections and joints will be made airtight using approved material

### Objective(s):

Ensure ducts and plenums will not leak



Locate unsealed ducts constructed from building cavities



Return plenum lined with fiberglass duct board and sealed with mastic

### Tools:

1. disposable brushes
2. tape measure
3. utility knife
4. rubber gloves
5. framing square or T-square
6. tin snips

### Materials:

1. mastic
2. fiberglass duct board
3. UL 181 listed mastic tape
4. sheet metal
5. screws

Use approved materials to seal ductwork; cover organic materials with airtight, non-organic material such as mastic, metal, or duct board. No foam is allowed.



From NFPA 90B 4.2.1.3: "The interior of combustible ducts shall be lined with noncombustible material at points where there might be danger from incandescent particles dropped through the register or heater, such as directly under floor registers, the bottom of vertical ducts, or heaters having a bottom return."

From NFPA 90B 4.3.1.1: "Duct coverings, duct linings, and tapes used in duct systems shall have a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84 or ANSI/UL 723..."

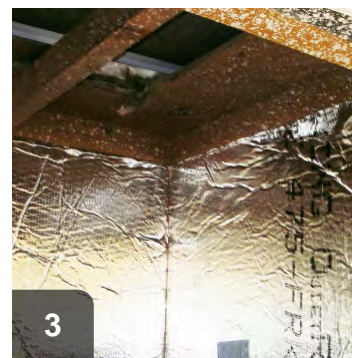
New furnace installations only.



Identify building cavities used as ducts



Seal penetrations around AC lineset and wiring



Cut and Install appropriate board material to create an airtight duct



Seal all seams and joints with duct mastic

## 3.1602.4 - Air Sealing System Components

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

### 3.1602.4c - Air handler cabinet

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

### Specification(s):

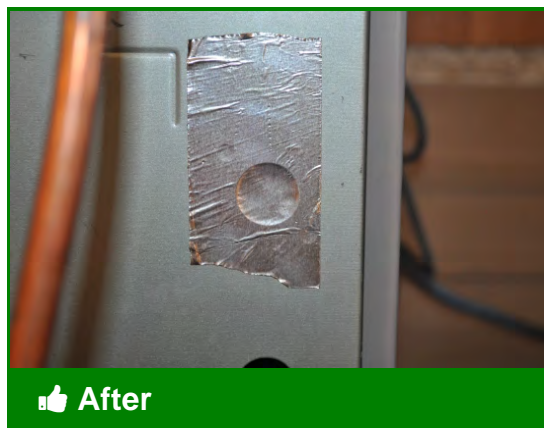
Joints will be closed and cracks and holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape) or in accordance with the original equipment manufacturer directions (if available)

### Objective(s):

Reduce air leakage while maintaining accessibility



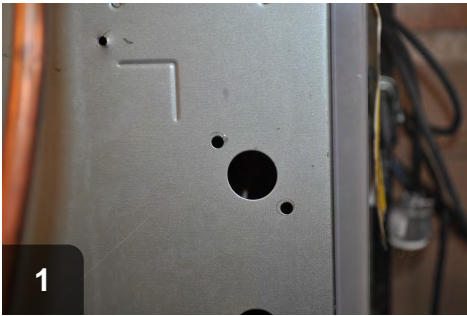
Unnecessary holes in the air handler cabinet need to be sealed



Use removable foil tape to seal holes

### Materials:

1. Foil tape



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

## 3.1602.4 - Air Sealing System Components

### Desired Outcome:

Ducts and plenums sealed to prevent leakage

## 3.1602.4d - Filter slot

### Desired Outcome:

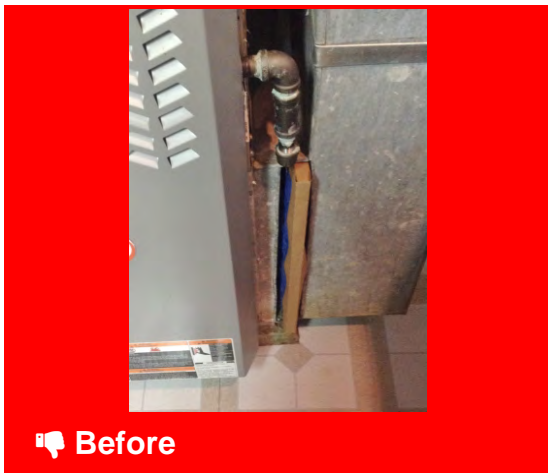
Ducts and plenums sealed to prevent leakage

### Specification(s):

A pre-manufactured or site manufactured durable filter slot cover will be installed

### Objective(s):

Reduce air leakage while maintaining accessibility



Uncovered filter slots are a point of leakage



Filter slots should be covered

A readily accessible and easy to use filter slot shall be installed when a unit is being newly installed. Best Practice is to include this on existing furnaces. Magnetic filter slot covers are a best practice for existing furnaces.

## 3.1602.5 - Return—Framed Platform

### Desired Outcome:

The return duct installed to prevent air leakage

## 3.1602.5a - Preparation

### Desired Outcome:

The return duct 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



Dirty, unsealed return platform needs to be cleaned out before sealing



Vacuum out debris and dirt from the return to prepare work area

### Tools:

1. Shop vacuum



## 3.1602.5 - Return—Framed Platform

### Desired Outcome:

The return duct installed to prevent air leakage

## 3.1602.5b - Infill and backing

### Desired Outcome:

The return duct 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 any load (e.g., return air pressure)

Ensure sealant does not fall out



Leakage from air return into wall cavities should be eliminated



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 in air returns due to proximity to combustion appliances

## 3.1602.5 - Return—Framed Platform

### Desired Outcome:

The return duct installed to prevent air leakage

## 3.1602.5c - Sealant selection

### Desired Outcome:

The return duct installed to prevent air leakage

### Specification(s):

Sealants will be continuous and be in accordance with IRC

### 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



**Best Practice**

Caulk sealants will be continuous

### Tools:

1. Caulk gun
2. Utility knife
3. Taping knife

### Materials:

1. Fiberglass mesh
2. Siliconized caulk
3. UL 181 mastic

Paraphrased from 2012 IRC R302.9: Wall and ceiling finishes will have a flame spread index of 200 or less and a smoke-developed index of 450 or less

## 4.1001.1 - Non-Insulation Contact (IC) Recessed Light

### **Desired Outcome:**

Ensure safety from fire and prevent air leakage

## 4.1001.1a - Air barrier system

### **Desired Outcome:**

Ensure safety from fire and prevent air leakage

### **Specification(s):**

A fire-rated air barrier system (i.e., equivalent to 5/8 fire code gypsum wallboard) will be used to separate non- IC rated recessed lights from insulation, using one of the methods below:

A fire-rated airtight closure taller than surrounding attic insulation will be placed over non- IC rated recessed lights

OR

The non- IC rated light fixture will be replaced with an airtight IC - rated fixture or insert

OR

The fixture(s) may be replaced with surface mounted fixture and opening sealed

OR Air sealing measures as approved by the authority having jurisdiction

### **Objective(s):**

Prevent a fire hazard

Prevent air leakage through fixture



👎 Before

Non-IC rated recessed light fixtures should be dammed from insulation



👍 After

Sealed box around non-IC light should be taller than surrounding insulation

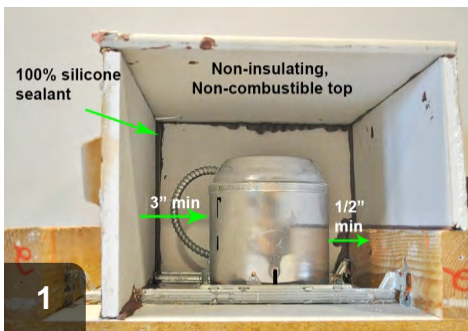
### Tools:

1. Utility knife
2. Tape measure

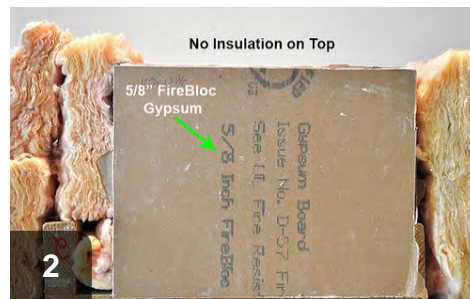
### Materials:

1. 5/8" fire-rated drywall
2. Fire-rated caulk sealant

For recessed or can lights see specifications 4.1001.1a, 4.1001.1b, 4.1001.1c, and 4.1001.1d. Commercially available fire-rated air barrier systems may also be used. A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top, meets the specifications.



Box should be constructed with clearances in mind



Sealed box should be constructed of fire-rated drywall



OR non-IC can light can be replaced with IC-rated recessed light

## 4.1001.1 - Non-Insulation Contact (IC) Recessed Light

### Desired Outcome:

Ensure safety from fire and prevent air leakage

## 4.1001.1b - Enclosure top

### Desired Outcome:

Ensure safety from fire and prevent air leakage

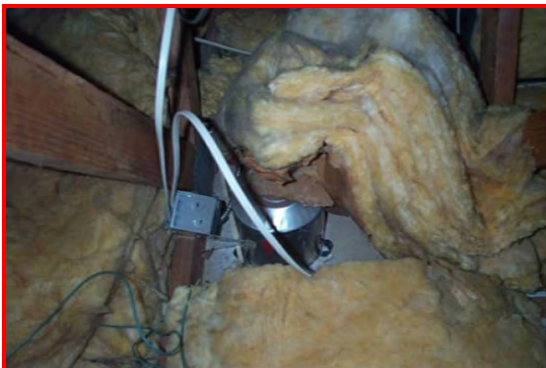
### Specification(s):

The top-fire rated enclosure material will have an R-value of 0.56 or less

The top of the enclosure will be left free of insulation

### Objective(s):

Prevent heat build up



 Before

Non-IC rated recessed lights create excess heat and are a fire risk



Once dammed from insulation, it should still not have insulation on top

### Tools:

1. Utility knife
2. Caulk gun

### Materials:

1. Drywall

For recessed or can lights see specifications 4.1001.1a, 4.1001.1b, 4.1001.1c, and 4.1001.1d. Commercially available fire-rated air barrier systems may also be used. A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top, meets the specifications.

## 4.1001.1 - Non-Insulation Contact (IC) Recessed Light

### Desired Outcome:

Ensure safety from fire and prevent air leakage

## 4.1001.1c - Clearance

### Desired Outcome:

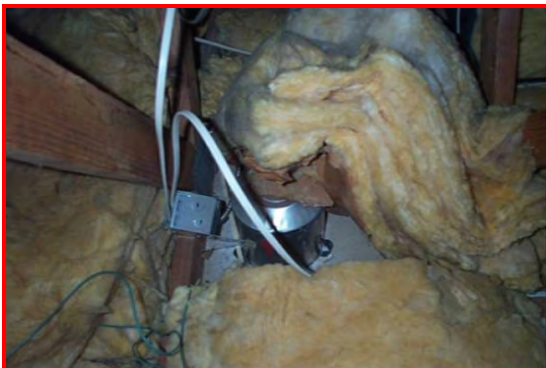
Ensure safety from fire and prevent air leakage

### Specification(s):

The entire closure will maintain a 3" clearance between the closure and the fixture including wiring, box, and ballast

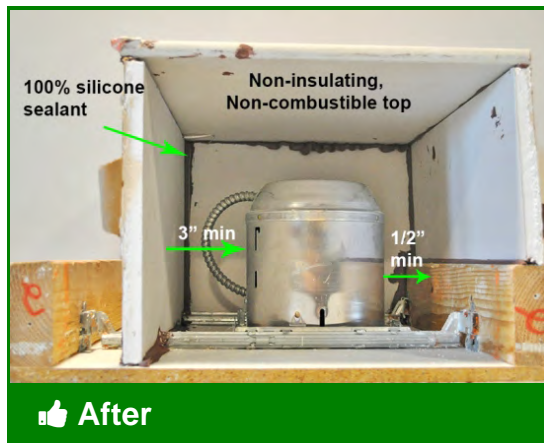
### Objective(s):

Keep an air space around the fixture



Before

Non-IC rated recessed lights produce excess heat and can be a fire risk



After

A 3 inch clearance should be kept from boxing materials

### Tools:

1. Utility knife
2. Tape measure
3. Caulk gun

### Materials:

1. Fire-rated sealant
2. Drywall

For recessed or can lights see specifications 4.1001.1a, 4.1001.1b, 4.1001.1c, and 4.1001.1d. Commercially available fire-rated air barrier systems may also be used. A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top, meets the specifications.



## 4.1001.1 - Non-Insulation Contact (IC) Recessed Light

### Desired Outcome:

Ensure safety from fire and prevent air leakage

## 4.1001.1d - Sealants and weather stripping

### Desired Outcome:

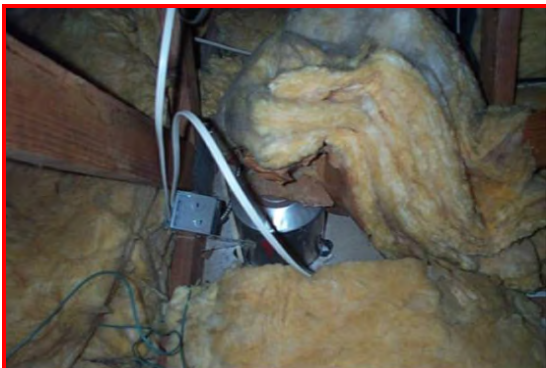
Ensure safety from fire and prevent air leakage

### Specification(s):

Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only

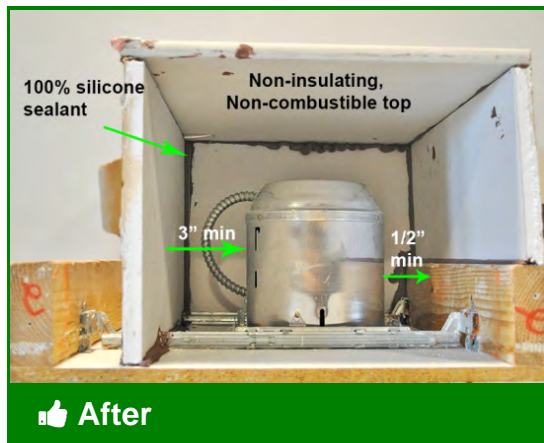
### Objective(s):

To prevent air leakage, completely adhere the sealant to all surfaces to be sealed



**Before**

Non-IC recessed light fixtures produce excess heat and can be a fire risk



**After**

Entire box should be sealed, but none should come in contact with light

### Tools:

1. Caulk gun
2. Spray foam gun
3. Putty knife

### Materials:

1. Fire-rated silicone caulk
2. UL-181 mastic
3. Spray foam

For recessed or can lights see specifications 4.1001.1a, 4.1001.1b, 4.1001.1c, and 4.1001.1d. Commercially available fire-rated air barrier systems may also be used. A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top, meets the specifications.

## 4.1001.3 - Fireplace Chimney and Combustion Flue Vents

### Desired Outcome:

Combustible materials kept away from combustion sources

### 4.1001.3a - Verify attic prep

### Desired Outcome:

Combustible materials kept away from combustion sources

### Specification(s):

Holes, penetrations, and bypasses will be sealed

Dams will be fixed in places that maintain required clearance

### Objective(s):

Prevent air leakage

Ensure insulation dams maintain clearance



 Before

Gaps and penetrations in attic need to be sealed to maintain air barrier



 After

Chimneys, flues, and light fixtures should be dammed to prevent fire

### Tools:

1. Metal snips
2. Caulk gun
3. Fasteners

### Materials:

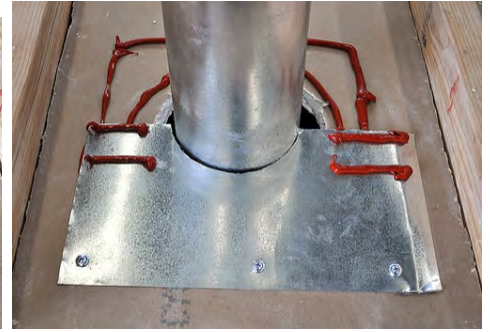
1. 26-gauge steel sheeting
2. High temperature caulk
3. Caulk
4. Backer rod
5. Spray foam



Gaps around flues and penetrations need to be sealed before insulating



High temperature caulk should be used for flues and chimneys



26-gauge steel should be used to construct seals and dams on flues



Only construct dam after sealing has been completed properly



Dammed chimneys, flues and light fixtures prevent fires

## 4.1001.3 - Fireplace Chimney and Combustion Flue Vents

### Desired Outcome:

Combustible materials kept away from combustion sources

## 4.1001.3b - Required clearance

### Desired Outcome:

Combustible materials kept away from combustion sources

### Specification(s):

A rigid dam having a height to ensure a 3" clearance area free of insulation or combustibles between combustion flue vent and dam, unless the flue vent is listed for a lesser clearance

### Objective(s):

Ensure dam material does not bend, move, or sag

Prevent a fire hazard



 Before

To prevent fire hazards, flues, chimneys, and light fixtures require dams



 After

Observe a 3 inch minimum clearance for dams around flues and chimneys

### Tools:

1. Metal snips

### Materials:

1. 26-gauge steel sheeting
2. Fasteners



## 4.1001.4 - Vented Eave or Soffit Baffles

### Desired Outcome:

Attic ventilation meets code requirements and insulation is protected from wind washing

### Note:

## 4.1001.4a - Installation

### Desired Outcome:

Attic ventilation meets code requirements and insulation is protected from wind washing

### Specification(s):

If soffit venting or eave venting is present, baffles will be mechanically fastened to block wind entry into insulation or to prevent insulation from blowing back into the attic

If soffit venting or eave venting is present, baffles will be installed to maintain clearance between the roof deck and baffle in accordance with manufacturer specifications

Installation will allow for the highest possible R-value above the top plate of the exterior wall

### Objective(s):

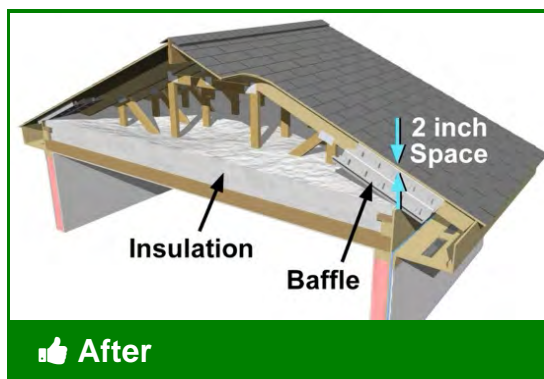
Ensure insulation R-value is not reduced

Maintain attic ventilation



**Before**

Insulation should not block vented eaves



Baffles installed in vented attics to allow air flow past insulation

### Tools:

1. Stapler

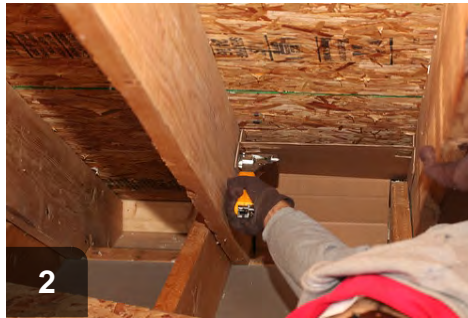
### Materials:

1. Baffles
2. Staples

Soffit baffles are to be installed in conjunction with attic insulation only if soffit venting is existing.



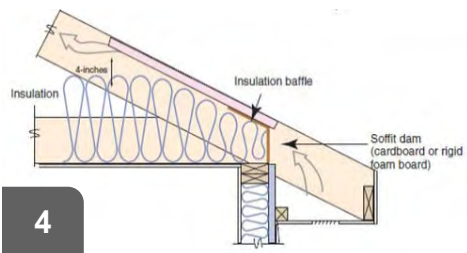
1  
Allow a standard two inch gap for air flow through eave



2  
Baffles should be securely fastened to prevent movement over time



3  
Once baffles are properly installed, insulation can be placed against them



4  
Baffles also hold insulation from falling into eave



## 4.1004.1 - Preparation for Dense Packing

### **Desired Outcome:**

Airtight cavity and insulated knee wall

## 4.1004.1a - Backing

### **Desired Outcome:**

Airtight cavity and insulated knee wall

### **Specification(s):**

All knee walls will have top and bottom plate or blockers installed using rigid materials

When knee wall floor and walls are being insulated, the floor joist running under the knee wall will be air sealed

If fabric is used before dense packing, it will be secured, according to manufacturers specifications or with furring strips every wall stud

If rigid material is used, material will be installed to cover 100% of the surface of the accessible knee wall area

If foam sheathing is used, sheathing will be listed for uncovered use in an attic or covered with a fire barrier

### **Objective(s):**

Eliminate bending, sagging, or movement that may result in air leakage

Prevent air leakage through the top or bottom of the knee wall

Ensure material will not tear under stress from wind loads or insulation



**Before**

Knee walls often need sealing and insulation



**After**

Knee wall is prepped for dense pack insulation

### Tools:

1. Tape measure, Utility Knife
2. Caulk gun/Spray foam gun
3. Drill
4. Stapler

### Materials:

1. Drywall, XPS
2. Caulk/ Spray foam
3. Fasteners
4. Staples



Knee walls missing top plates need one created from rigid material



Top plate holds dense pack insulation in cavity



New top plate should be sealed to surrounding joists and studs



Bottom plates also need to be installed. Measure for size



Cut to size and attempt to install in line with air barrier above



Seal to surrounding joist



If using house-wrap or fabric, tack in place with furring strips or staples



Drywall is also a good barrier for dense packing knee walls

## 4.1004.1 - Preparation for Dense Packing

### Desired Outcome:

Airtight cavity and insulated knee wall

## 4.1004.1b - Installation

### Desired Outcome:

Airtight cavity and insulated knee wall

### Specification(s):

All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates

Insulation that is blown behind fabric or air barrier material will be blown dense to a minimum specification of 3.5 pounds per cubic foot for cellulose

Follow manufacturer's requirements for fiberglass dense pack applications

### Objective(s):

Eliminate misalignment of existing insulation

Prevent insulation from settling or moving



Existing batt insulation should be adjusted to fit properly



If properly dense-packed, insulation should hold in place when finished

Batt insulation adjustment must be audit approved based on insulation grade differences. Bag and blow kneewalls is another option and also requires audit approval.



Attach furring strips to create pockets for dense-pack insulation



Insulation should meet manufacturer specifications for density.



## 4.1004.2 - Preparation for Batt Insulation

### Desired Outcome:

Airtight cavity and properly insulated knee wall

## 4.1004.2a - Knee wall prep for batts

### Desired Outcome:

Airtight cavity and properly insulated knee wall

### Specification(s):

All knee walls will have a top and bottom plate or blockers installed using a Rigid material

All joints, cracks, and penetrations will be sealed in finished material, including interior surface to framing connections

When knee wall floor and walls are being insulated, the floor joist running under the knee wall will be air sealed.

### Objective(s):

Eliminate bending, sagging, or movement that may result in air leakage

Prevent air leakage through the top or bottom of the knee wall

Create an air barrier



Top plate is missing from knee wall



New top plate is sealed to adjacent framing



**Tools:**

1. Spray foam gun
2. Caulk gun
3. Tape measure
4. Utility knife
5. Drill
6. Saw

**Materials:**

1. XPS
2. Lumber
3. Caulk
4. Spray foam
5. Fasteners



Top plate has been cut and fit to size



Top plate has been sealed to adjacent framing



Bottom plate is also missing. Space is measured so XPS can be cut



Bottom plate is cut to size



Bottom plate is placed in line with interior air barrier



Bottom plate is also sealed to surrounding joist and framing

## 4.1004.2 - Preparation for Batt Insulation

### Desired Outcome:

Airtight cavity and properly insulated knee wall

## 4.1004.2b - Installation

### Desired Outcome:

Airtight cavity and properly insulated knee wall

### Specification(s):

Insulation will be installed using one of the following methods:

- New batts will be installed in accordance with manufacture specifications
- All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates

### Objective(s):

Eliminate misalignment of existing insulation



Knee wall with batts improperly installed and missing from stud bays



Properly fit insulation filling full volume of stud bay

### Tools:

1. Utility knife
2. Tape measure

### Materials:

1. Fiberglass batts

Batt insulation adjustment must be audit approved based on insulation grade differences.



Where existing insulation is improperly installed, fix it



Kraft-face should go to "warm in winter" side and batt should fill bay



Batts should fill entire volume of knee wall stud bays

## 4.1005.5 - Enclosed Bonus Room Floor Over Unconditioned Space—Dense Pack Installation

### Desired Outcome:

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

### 4.1005.5a - Air barrier

### Desired Outcome:

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

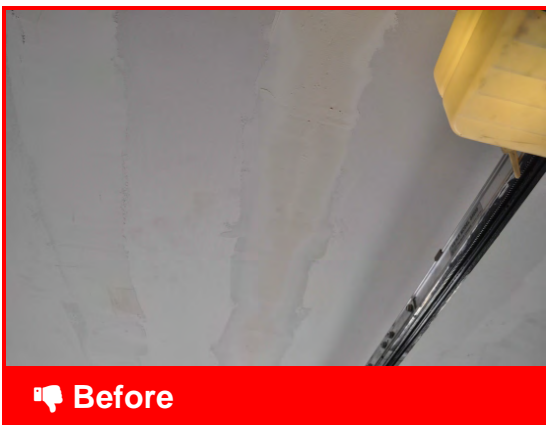
### Specification(s):

Existence of air barrier material in line with the knee walls will be installed or verified when dense packing

Air barrier material will not bend, sag, or move once dense packed

### Objective(s):

Hold dense pack in place



This finished garage below a bonus room is an unconditioned space



Rigid material forms an air barrier located under the bonus room stem wall

### Tools:

1. Drywall saw
2. Utility knife
3. Tape measure
4. Straight edge

### Materials:

1. XPS or other rigid material





Snap chalk lines to keep access cuts clean and easy to repair



Cut through garage ceiling to access joist cavities below bonus room



The rigid block should be placed in line with the stem wall above



Measure joist cavity depth



Measure joist cavity width



Cut XPS, or other rigid material, to measured size of joist cavity



Rigid block should fit snugly into joist cavity to prevent insulation leaks



Rigid block will hold the insulation in place under the bonus room above

## 4.1005.5 - Enclosed Bonus Room Floor Over Unconditioned Space—Dense Pack Installation

### **Desired Outcome:**

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

## 4.1005.5b - Fill floors

### **Desired Outcome:**

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

### **Specification(s):**

Each cavity will be 100% filled to consistent density:

- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot or to a maximum density structurally allowable
- Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density per the manufacturer's recommendations

The number of bags installed will be confirmed and will match the number required on the coverage chart

Insulation will be verified to prevent visible air movement at 50 pascals of pressure difference using chemical smoke or other approved verification method by the authority having jurisdiction

### **Objective(s):**

Eliminate voids and settling

Minimize framing cavity air flows

Insulation will be verified with acceptable applicable methods other than chemical smoke and a blower door.

Dense pack insulation will be verified by bag count, core sampling, or with diagnostic methods such as infrared camera, or chemical smoke with a blower door at 50 pascals.



## 4.1006.1 - Pull-Down Stairs

### Desired Outcome:

Pull-down attic stair properly sealed and insulated

## 4.1006.1a - Installation

### Desired Outcome:

Pull-down attic stair properly sealed and insulated

### Specification(s):

Top-side of the attic enclosure will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

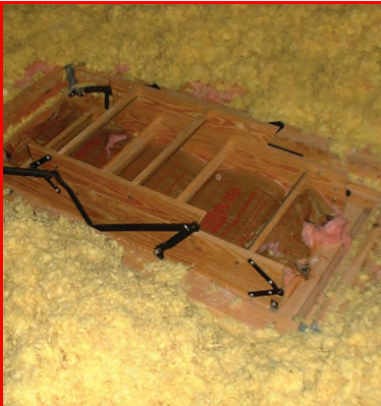
Pull-down stair rough opening will be surrounded with a durable, rigid dam that is higher than the level of the attic floor insulation

Counter-weights should be considered to ease accessibility for excessively heavy hatches

### Objective(s):

Achieve uniform R-value

Prevent loose insulation from entering the living area



 **Before**

Insulation needs to be dammed to keep from falling through during operation



 **After**

Pull down stairs has air tight and insulated box or "coffin" built above it.

**Tools:**

1. Tape measure
2. Drill
3. Saw
4. Caulk gun

**Materials:**

1. Caulk sealant
2. Lumber
3. XPS
4. Pre-fabricated stairwell cover



Stairs and hatch should both be insulated to match r-value of attic

## 4.1006.1 - Pull-Down Stairs

### Desired Outcome:

Pull-down attic stair properly sealed and insulated

## 4.1006.1b - Sealing

### Desired Outcome:

Pull-down attic stair properly sealed and insulated

### Specification(s):

Entire pull-down stair assembly will be covered with an airtight and removable/openable enclosure inside the attic space

Pull-down stair frame will be caulked, gasketed, weatherstripped, or otherwise sealed with an air barrier material, suitable film, frictionally engaging components or solid material that allows attic door operation

### Objective(s):

Prevent air leakage



Unsealed pull-down stairs leads to air leakage to and from the attic



To preserve thermal envelope, an airtight seal needs to be created

### Tools:

1. Caulk gun

### Materials:

1. Weatherstripping
2. Spray foam
3. Caulk



Seal around frame of pull-down stairs with appropriate sealant

## 4.1006.2 - Access Doors and Hatches

### Desired Outcome:

Attic access door properly sealed and insulated

## 4.1006.2a - Installation

### Desired Outcome:

Attic access door properly sealed and insulated

### Specification(s):

Hatches will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

Attic hatches rough opening will be surrounded with a durable,rigid protective baffle that is higher than the level of the surrounding attic floor insulation

### Objective(s):

Achieve uniform R-value on the attic door or hatch

Achieve uniform R-value on the attic floor

Prevent loose attic floor insulation from entering the living area



Uninsulated attic hatches and access panels weaken the thermal envelope

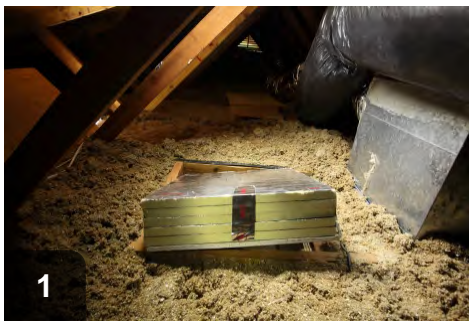


Hatch cover or panel access door should match r-value of attic insulation

**Materials:**

1. XPS
2. Lumber
3. Weatherstripping
4. Fasteners

Attic hatches will be dammed around with a strong and durable material that is higher than the level of the surrounding attic insulation. Weather stripping should be appropriate for the hatch material to ensure durability and appropriate seal. See SWS 4.1006.2a, 4.1006.2b, and 4.1006.2c. Modifications and deviations can be made to ensure accessibility, i.e. low clearances may require a shorter or flexible dam. New hatches must be finished to match surrounding ceiling. i.e painted or stained.



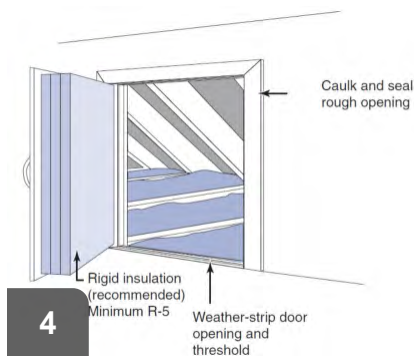
1 Create hatch cover that matches R-value of surrounding insulation



2 Build dam to hold back attic insulation and hold cover in place tightly



3 Weatherstrip underside of hatch cover to create tight seal



4 Alternate installation for vertical access panel to attic



## 4.1006.2 - Access Doors and Hatches

### Desired Outcome:

Attic access door properly sealed and insulated

## 4.1006.2b - Sealing

### Desired Outcome:

Attic access door properly sealed and insulated

### Specification(s):

Access hatch frames will be sealed using caulk, gasket, weather-strip, or otherwise sealed with an air barrier material, suitable film, or solid material

Options will include installing a latch or lock or frictionally engaged components that do not require a latch

The measure must include a protective baffle or insulation barrier

### Objective(s):

Prevent air leakage



 Before

Unsealed attic hatches and panel doors allow air leakage to and from attic



 After

Once sealed, air leakage at attic hatch or door should be minimized

### Materials:

1. Weatherstripping
2. 3/4" Lumber
3. Caulk

See SWS 4.1006.2a, 4.1006.2b, and 4.1006.2c.



1  
Remember to seal around finish details and framing on interior



2  
Build insulation dam from 3/4 inch lumber and seal around base



3  
Weatherstrip around bottom edge of hatch cover to create air tight seal

## 4.1006.2 - Access Doors and Hatches

### Desired Outcome:

Attic access door properly sealed and insulated

### 4.1006.2c - Attachment

### Desired Outcome:

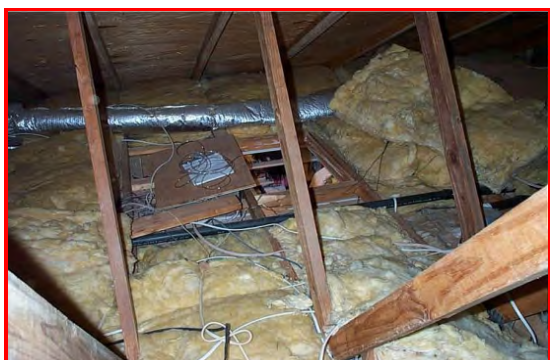
Attic access door properly sealed and insulated

### Specification(s):

Insulation will be permanently attached and in complete contact with the air barrier

### Objective(s):

Insulate to prescribed R-value



 **Before**

Unsealed and uninsulated attic hatches and access doors allow leakage



 **After**

Rigid insulation on back of new hatch cover attached firmly and squarely to allow for air-tight fit

### Tools:

1. Caulk gun
2. Utility knife

### Materials:

1. XPS
2. Adhesive

See SWS 4.1006.2a, 4.1006.2b, and 4.1006.2c.



1  
Apply foam tape to "warm side" face of attic hatch



2  
Ensure an air tight seal by making sure foam tape has no gaps



3  
Apply strong adhesive to "cold-side" of hatch



4  
Adhesive should ring perimeter as well as criss-crossing hatch to ensure complete attachment of insulation



5  
Affix XPS insulation to "cold-side" of hatch with adhesive, ensuring XPS is tight and square to hatch



6  
Repeat adhesive and XPS layers to reach maximum R-value without making hatch excessively heavy or awkward



7  
All XPS layers should be attached firmly to one another and square to hatch

## 4.1006.3 - Whole-House Fan

### **Desired Outcome:**

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value of an adjoining insulated assemb

### **Note:**

## 4.1006.3a - Installation

### **Desired Outcome:**

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value of an adjoining insulated assemb

### **Specification(s):**

Sides of fan insulation box assembly will be insulated to the same R-value as adjoining insulated assembly

### **Objective(s):**

Insulate to prescribed R-value

Operational Fans: If whole house fans are left operational, a dam must be built in the attic to allow attic insulation to be installed up to the fan. Where operational fan louvers do not form an adequate air barrier, a seasonally removable air sealing cover should be applied to the conditioned side of the fan.

Inoperation Fans: If the whole house fan is not operational, airseal and insulate the assembly like a pull down stair by building a 'box/coffin' over it.

## 4.1088.1 - Attic Ventilation

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

### 4.1088.1a - Air barrier and thermal boundary

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

**Specification(s):**

Attic ventilation will be recommended or installed if local code requires attic ventilation during weatherization or retrofits

The presence of an effective air barrier and thermal boundary between the attic and the living space must be verified and appropriate attic sealing and proper insulation is specified as part of the scope of work

**Objective(s):**

Ensure presence of continuous air barrier and thermal boundary



## 4.1088.1 - Attic Ventilation

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

### 4.1088.1b - Vent type

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

**Specification(s):**

Attic vent types will be made of corrosion-resistant material for their specific location (e.g., exterior soffit, gable end, roof ) and material and intended use (e.g., metal vent on metal roof )

Attic-powered ventilators will not be used

**Objective(s):**

Ensure vent meets proper performance characteristics for location and roofing type

## 4.1088.1 - Attic Ventilation

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

### 4.1088.1c - Vent location

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

**Specification(s):**

Placement of attic vents will be considered for proper air flow and prevention of entry of wind driven rain or snow

**Objective(s):**

Encourage proper air flow

Minimize entry of wind driven rain or snow

Vents shall be installed in accordance with manufacturers specifications and sealed with an appropriate sealant. Vents shall be installed under shingles to allow proper drainage to the fullest extent possible.

## 4.1088.1 - Attic Ventilation

### **Desired Outcome:**

Properly restored vents minimize moisture and ice dams

## 4.1088.1d - Ventilation baffling

### **Desired Outcome:**

Properly restored vents minimize moisture and ice dams

### **Specification(s):**

Baffling for attic soffit vents will be installed to:

- Ensure proper air flow
- Prevent wind washing of insulation
- Allow maximum insulation coverage
- Ensure baffle terminates above insulation

### **Objective(s):**

Ensure vent allows proper air flow without compromising insulation performance

## 4.1088.1 - Attic Ventilation

### **Desired Outcome:**

Properly restored vents minimize moisture and ice dams

## 4.1088.1e - Ventilation screens

### **Desired Outcome:**

Properly restored vents minimize moisture and ice dams

### **Specification(s):**

All attic ventilation will have screens with non-corroding wire mesh with openings of 1/16" to 1/4" to prevent pest entry (e.g., birds, bats, bees)

Existing vents that are not screened will be covered with non-corroding wire mesh with openings of 1/16" to 1/4"

Ensure net free area requirements are met

Additional vents or larger vents can be added if screen size is smaller than designated

### **Objective(s):**

Prevent pest entry

## 4.1088.3 - Skylights

**Desired Outcome:**

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

### 4.1088.3a - Sealing

**Desired Outcome:**

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

**Specification(s):**

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

**Objective(s):**

Prevent air leakage

## 4.1088.3 - Skylights

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

## 4.1088.3b - Installation

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

### Specification(s):

Insulation will be installed in accordance with manufacturer specifications and will be in full contact with all sides of existing cavity without gaps, voids, compressions, misalignments, or wind intrusions

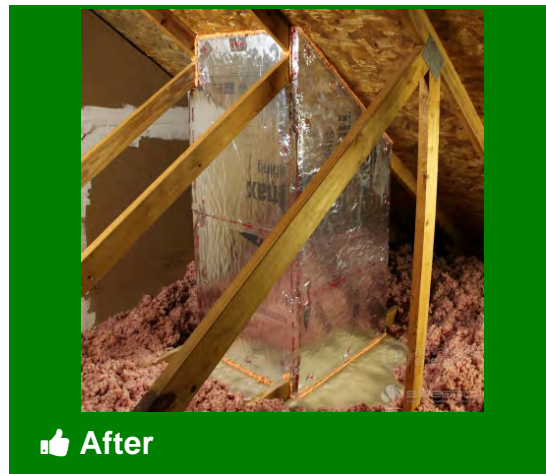
Insulation will be installed to prescribed R-value

### Objective(s):

Insulate to prescribed R-value



Uninsulated, unsealed skylight well



Insulated, air sealed skylight well



**Tools:**

1. stapler
2. tape measure
3. utility knife
4. caulking gun
5. foam gun

**Materials:**

1. caulk
2. one-part foam sealant
3. insulation (fiberglass, cellulose, spray polyurethane foam, polyisocyanurate board, extruded polystyrene board, or other as needed to achieve specified R-value)
4. air barrier material (drywall, foam board, paneling, hardboard, etc.)

Air-permeable insulation such as fiberglass or cellulose should be covered with a sealed attic-side air barrier.



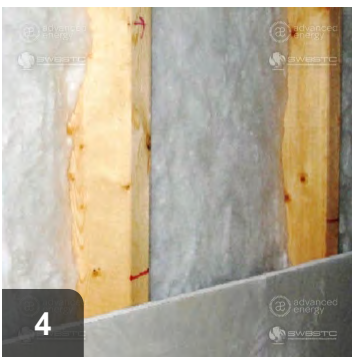
Skylight well



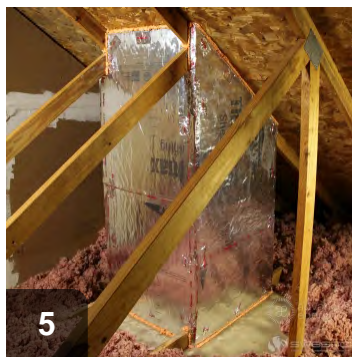
Carefully seal all seams and joints



Install insulation in complete contact with all sides of the cavity.



Install an attic-side air barrier.



The air barrier may be constructed from rigid insulation board. Seal the attic side air barrier

## 4.1101.1 - Exterior Wall Dense Packing

### **Desired Outcome:**

Walls properly prepared to receive dense pack insulation

## 4.1101.1a - Preparation

### **Desired Outcome:**

Walls properly prepared to receive dense pack insulation

### **Specification(s):**

Lead and asbestos 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 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

Interior will be masked and dust controlled during drilling when accessing from interior

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

Blowing machine pressure test will be performed with air on full, feed off, agitator running, 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 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

## 4.1101.1 - Exterior Wall Dense Packing

### **Desired Outcome:**

Walls properly prepared to receive dense pack insulation

## 4.1101.1b - 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:

- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot
- Loose fiber glass material will be installed and will be specifically approved for air flow resistance per manufacturer's specifications

The number of bags installed will be confirmed and will match the number required on the coverage chart

Insulation density will be verified by bag count, core sampling, or infrared camera with the blower door at 50 pascals 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

Also see 4.1103.1a

## 4.1102.1 - Open-Cavity Wall Insulation—General

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

## 4.1102.1a - Sealing

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

### Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

### Objective(s):

Prevent air leakage



Penetrations and bypasses create places where blown in insulation can leak



Sealed penetrations offer leakage protection and keep insulation in place

### Tools:

1. Caulk gun

### Materials:

1. Backer rod
2. Spray foam
3. Caulk



Open walls to be insulated and drywalled need air sealing



Penetrations and bypasses should be sealed to keep insulation in cavities



Use backer rod or other infill for larger penetrations



Seal penetration with caulk or fire-block, as appropriate



## 4.1102.1 - Open-Cavity Wall Insulation—General

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

## 4.1102.1b - Installation

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

### Specification(s):

Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

### Objective(s):

Insulate to prescribed R-value



Open walls should be insulated



Well-insulated rooms are significantly more comfortable in all seasons

### Tools:

1. Insulation machine
2. Staple gun

### Materials:

1. Loose fillable insulation
2. Netting
3. Staples
4. Fiberglass batts



Wall should be netted and insulation blow in to prescribed r-value



OR: Wall can be insulated using batts installed without gaps

## 4.1102.1 - Open-Cavity Wall Insulation—General

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

## 4.1102.1c - Pre-drywall verification

### Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

### Specification(s):

Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided

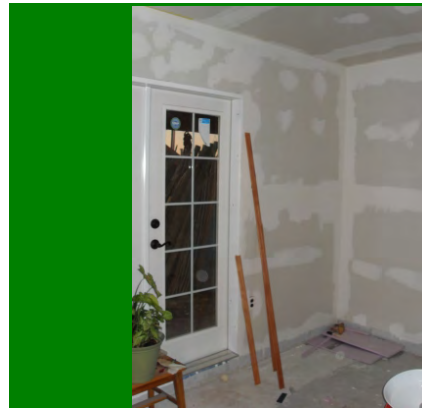
### Objective(s):

Install insulation correctly



 **Before**

Verify insulation is properly installed before drywalling



 **After**

Once proper installation is verified, begin drywalling to finish wall

### Tools:

1. Hands
2. Eyes



Take a visual and physical inspection of insulation installation

## 4.1103.1 - Dense Pack Exterior Walls

### **Desired Outcome:**

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### 4.1103.1a - Exterior dense pack

### **Desired Outcome:**

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### **Specification(s):**

Using fill tube or an alternative method as approved by the authority having jurisdiction, 100% of each cavity will be filled to a consistent density:

- Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density
- Blown fiberglass, mineral fiber, or rock and slag wool 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 cfm /sq. ft. at 50 pascals, as measured using ASTM C 522, E 283, or E 2178; the number of bags installed will be confirmed and will match the number required on the coverage chart
- All holes and penetrations will be plugged and/or sealed

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



Make accurate count of insulation bags to be installed



Install insulation to correct density (at least 3.5 pounds per cubic foot for cellulose, or 1.5 pounds for fiberglass)

### Tools:

1. insulation blowing machine
2. pressure gauge
3. blower door
4. chemical smoke dispenser
5. drill
6. tape measure
7. ladder
8. utility flag bent into a "Z" shape

### Materials:

1. cellulose or fiberglass insulation (any fiberglass material used must be specifically approved for air flow resistance by the manufacturer)
2. wooden, plastic, or foam plugs to fill installation holes
3. piece of fiberglass batt or towel to stop insulation from blowing out around the hose

Also see: 4.1101.1a and 4.1101.1b

Insulation will be verified with acceptable applicable methods other than chemical smoke and a blower door. Dense pack insulation will be verified by bag count, core sampling, or with diagnostic methods such as infrared camera, or chemical smoke with a blower door at 50 pascals.



1 Calculate the number of bags needed



2 Check that the static pressure at the



3 Adjust the pressure with the blower



and verify the number you actually install.

blowing machine and at the hose end controls. is at least 2.9 PSI.



Adjust the feed gate to fill an 8-foot wall cavity in 2 to 4 minutes.



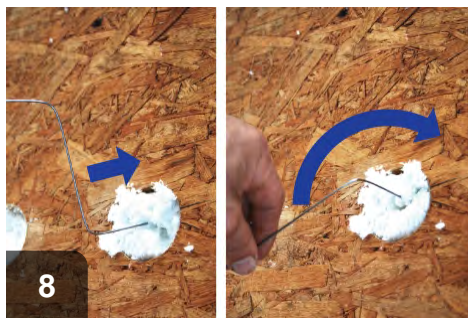
With a rag or fiberglass batt to prevent insulation blowing out, fill all cavities in exterior walls with insulation.



Check to make sure all cavities are properly filled. One of these is empty, and another is not filled to proper density



Check that cavities are filled and are the proper density.



Insert a bent utility flag into insulation. If it is possible to turn, the cavity needs more insulation.

## 4.1103.2 - Additional Exterior Wall Cavities

### Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

## 4.1103.2b - Sealing

### Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

### Specification(s):

Backing will be provided and all newly uncovered openings will be sealed with air barriers, foam, or mastic, maintaining all required clearances

### Objective(s):

Ensure the air barrier is connected across all accessible house elements



 Before

Unsealed penetrations should be sealed to ensure insulation stays in place



 After

Once air barrier has been preserved by sealing, insulation can begin

### Tools:

1. Caulk gun

### Materials:

1. Caulk
2. Backer rod
3. Fire-block, when necessary

Spray foam should not be visible from conditioned space.

## 4.1103.2 - Additional Exterior Wall Cavities

### Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

## 4.1103.2d - Quality assurance

### Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

### Specification(s):

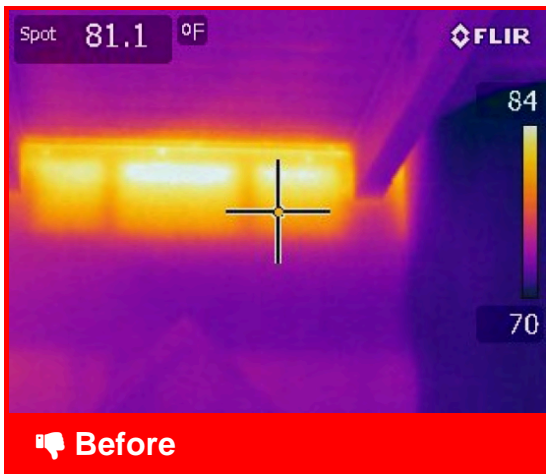
Completed wall sections will be verified to be appropriately filled.

Any voids or low density areas will be drilled and re-packed

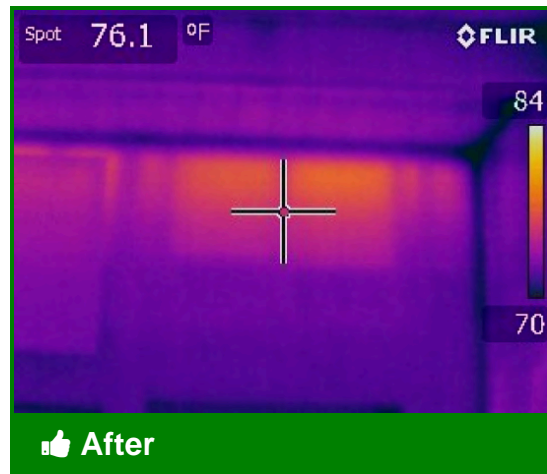
### Objective(s):

Establish air barrier and thermal boundary

Confirm no voids or hidden air flows remain



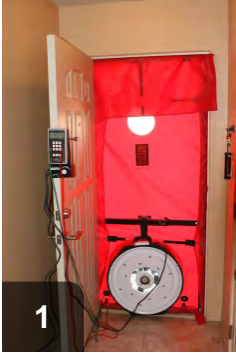
Uninsulated exterior wall cavities to be insulated



Reduced temperature difference indicating insulated wall cavities

### Tools:

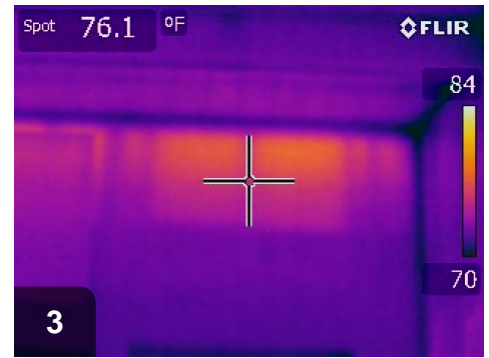
1. Infrared camera



Depressurize house (if safe) to -50pa wrt outside



Inspect for voids and low density areas



Reduced temperature difference indicating insulated wall cavities

## 4.1103.2 - Additional Exterior Wall Cavities

### Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

## 4.1103.2e - Close holes

### Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

### Specification(s):

**SEE BELOW FOR KS STANDARDS**

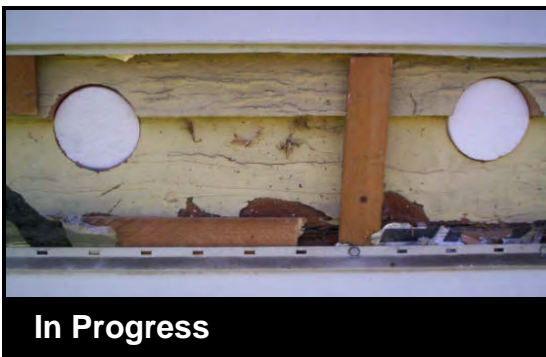
Installation holes will be plugged as follows:

- Exterior holes will be weather barrier patched
- Interior holes will be coated and patched to match original interior surface

All construction debris and dust will be collected and removed

### Objective(s):

Ensure house is returned to watertight and clean condition



With insulation complete, wall needs to be patched to better-than-found



Patches /plugs will be weather tight.



**Tools:**

1. Taping knife
2. Caulk gun
3. Drill
4. Paint brush

**Materials:**

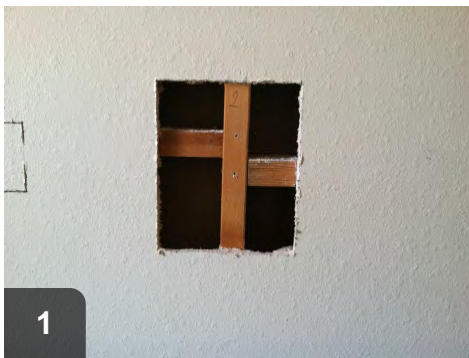
1. Spackle
2. House wrap
3. Lath
4. Stucco
5. Fasteners
6. Adhesive
7. Primer
8. Drywall
9. XPS

Follow all applicable KDHE Lead Regulations and SHPO Guidelines.

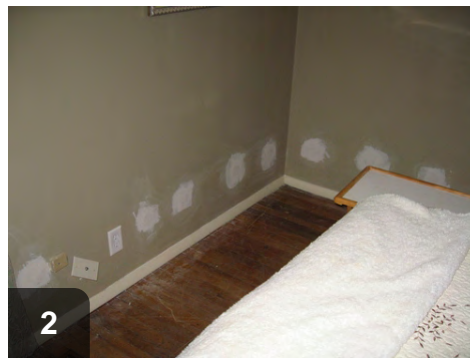
**Exterior:** Exterior sidewall work should not result in any visible work areas or plugs. The first priority is for exterior siding to be removed and insulation installed behind. When removal is not possible, the agency/inspector may approve drilling. Where exterior holes are drilled, holes must be finished to match original surface. Patches will be weather tight and finished.

**Interior:** Interior sidewall work should strive for the highest quality of finished product. Clients shall be informed and agree to the type of sidewall patching performed. Sheetrock and lath and plaster holes should be finished to provide a smooth, nearly paint ready surface. Minimal to zero sanding is the desire. The use of painted or stained chair rail to cover holes is acceptable. Chair rail will be installed around the full perimeter of the room where appropriate.

The use of plastic plugs will be allowed in garage walls and ceiling, CAZ closets, and other unfinished areas. The use of plugs will also be allowed in manufactured home ceiling and in wood paneling where permission is documented by the client.



For interior access, locate access holes at studs for easier patching



Drywall patches are to be paint ready.

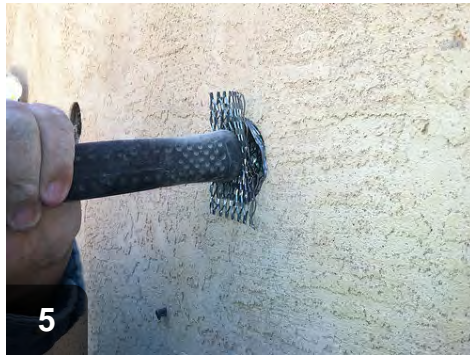


For exterior access, use a drop cloth or gutter to help with clean up





4  
Plug holes with rigid material that will not move or sag over time



5  
For stucco and plaster patches, lath will need to be used to hold weight



6  
If possible, maintain house wrap, or replace it after holes are plugged



7  
Put siding back in place, or return exterior finish to match remaining wall

## 4.1301.1 - Standard Floor System—Batt Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### 4.1301.1b - Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions

If kraft-faced batts are used, they will be installed with kraft facing to subfloor

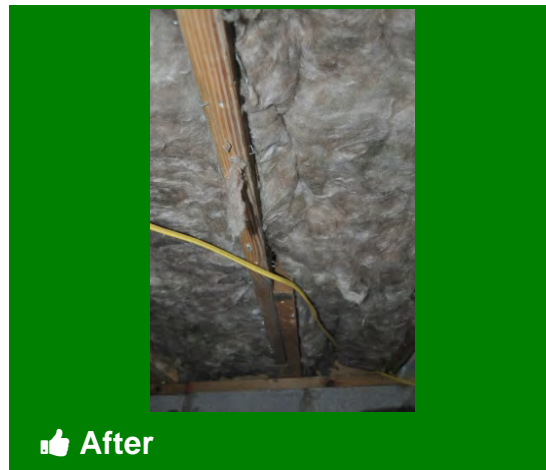
Insulation will be installed to prescribed R-value

### Objective(s):

Insulate to prescribed R-value



Uninsulated floors above unconditioned spaces are an energy drain



Batts should fill most of joist bay and be in full contact with subfloor

### Tools:

1. Utility knife
2. Tape measure

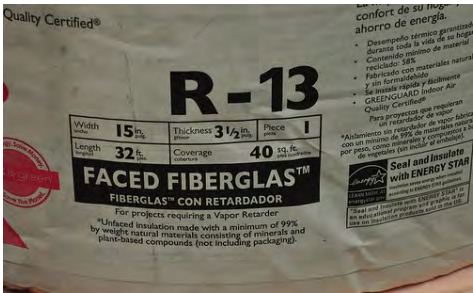
### Materials:

1. Kraft-faced fiberglass batts to work order specifications

Floor insulation shall be R-19 unless specified otherwise.

Measures							
Measure 8 Floor Ins. R-11			Components F1				
Comment							
				Estimated			
#	Material / Labor	Description /Comment	Units	Qty	Unit Cost	Total	Q
1	Insulation	Floor Insulation - Kraft-faced Batts - R-11	SqFt	1180	\$0.22	\$259.60	
2	Labor	Floor Insulation - Kraft-faced Batts - R-11	SqFt	1180	\$0.35	\$413.00	
3	Miscellaneous Su	Floor Insulation - Kraft-faced Batts - R-11	Each	1	\$100.00	\$100.00	

Order and install insulation as called for in Work Order



If precise r-value cannot be purchased, choose option with greater r-value



Install kraft-faced batts with paper against subfloor



Ensure batts are in full contact with subfloor and remain uncompressed

## 4.1301.1 - Standard Floor System—Batt Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### 4.1301.1c - Securing batts

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

Batts will be secured with physical fasteners

### Objective(s):

Ensure insulation remains in contact with subfloor



 Before

Fiberglass batts should not be hanging away from subfloor



 After

"Lightning rods" or twine can be used to hold batts in contact

### Tools:

1. Utility knife
2. Drill
3. Staple gun

### Materials:

1. Lightning rods
2. Twine
3. Fasteners

Best practice is to install supports every 2-3 feet with fasteners within 6 inches of batt ends.



Batt should be in contact with subfloor without being compressed



Twine fastened across bays in a zig-zag pattern can also be used



## 4.1301.2 - Standard Floor System—Loose Fill with Netting

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

## 4.1301.2b - Netting, fabric

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

When using netting or fabric, staples will be placed according to manufacturer specifications

Netting or fabric will meet local fire codes

### Objective(s):

Secure insulation



Uninsulated floors above unconditioned spaces are an energy drain



Netting is secured to joists and sills to create cavities for insulation

### Tools:

1. Utility knife
2. Scissors
3. Stapler

### Materials:

1. Fabric netting
2. Staples

All penetrations and air sealing locations must be addressed before installing netting.

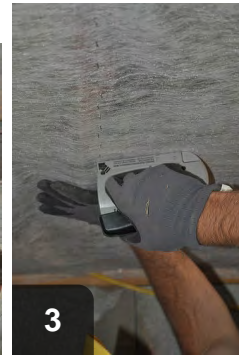




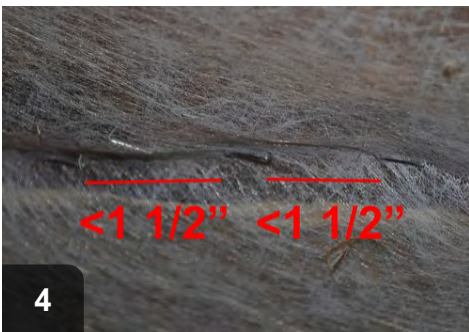
1  
Secure netting across each joist to create separate cavities



2  
Secure netting across sills to prevent leakage of insulation



3  
Keep netting taut while stapling to prevent wrinkles and leakage



4  
Staples should be kept tightly together, placed no more than 1 1/2" apart

## 4.1301.2 - Standard Floor System—Loose Fill with Netting

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

## 4.1301.2c - Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

Insulation in netted or fabric cavities will be dense packed with loose fill insulation in accordance with manufacturer specifications

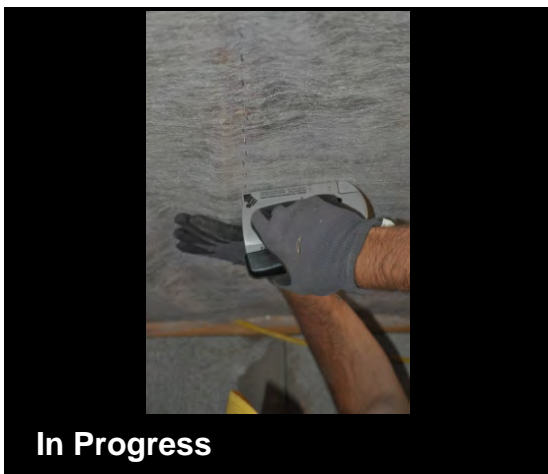
Insulation will be installed to prescribed R-value

Insulation will be in continuous contact with air barrier

### Objective(s):

Insulate to prescribed R-value

Ensure a continuous thermal boundary between conditioned and unconditioned space



With netting in place, insulation can begin



Cavities filled to manufacturer specs to achieve prescribed r-value

**Tools:**

1. Utility knife
2. Insulation machine

**Materials:**

1. Loose fill fiberglass or cellulose

The insulated cavity will be completely filled. Holes must be patched or repaired to prevent fill insulation from falling out.

**Measures**

Measure 7 Floor Ins. R-30			Components F1				
Comment							
#	Material / Labor	Description / Comment	Units	Estimated			Q
				Qty	Unit Cost	Total	
1	Insulation	Floor Insulation - Net & Fill - R-30	SqFt	1180	\$0.59	\$696.20	<input type="checkbox"/>
2	Labor	Floor Insulation - Net & Fill - R-30	SqFt	1180	\$0.35	\$413.00	<input type="checkbox"/>
3	Miscellaneous Su	Floor Insulation - Net & Fill - R-30	Each	1	\$100.00	\$100.00	<input type="checkbox"/>

Order and install insulation based on specifications in work order



Always wear proper PPE when blowing in insulation



Cut holes in each individual cavity to insert insulation machine nozzle



Ensure that hole is large enough for nozzle without allowing for outflow

Nature Blend® Loose Fill Formula									
Coverage Chart for Thermal Acoustical Application									
R-Value Chart for Thermal Acoustical Application									
Thickness (inches)	R-Value	Weight (lb/cu ft)	Weight (lb/cu yd)	Weight (lb/cu ft)	Weight (lb/cu yd)	Weight (lb/cu ft)	Weight (lb/cu yd)	Weight (lb/cu ft)	Weight (lb/cu yd)
13	4.4	4.0	17.4	57.6	0.30	15.9	63.5	0.35	63.5
19	6.1	5.5	27.9	35.8	0.61	25.3	39.6	0.56	39.6
22	6.9	6.2	32.2	35.1	0.73	30.5	32.8	0.67	32.8
26	7.8	7.0	38.6	25.9	0.85	34.9	25.9	0.85	25.9
30	8.8	8.0	44.9	19.0	0.97	39.3	19.0	0.97	19.0
36	10.5	10.5	52.6	16.1	1.10	44.8	16.1	1.10	16.1
42	12.2	12.2	60.3	13.2	1.22	50.3	13.2	1.22	13.2
48	13.9	13.9	67.9	10.3	1.34	55.8	10.3	1.34	10.3
54	15.6	15.6	75.5	7.4	1.46	61.3	7.4	1.46	7.4
60	17.3	17.3	83.1	4.5	1.58	66.8	4.5	1.58	4.5

Consult manufacturer specs on insulation packaging for proper installation



Blow in insulation to prescribed r-value

## 4.1301.5 - Cantilevered Floor—Batt Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### 4.1301.5a - Air barrier

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

Air barrier will be installed between joists and sealed

Air barrier will be placed to the most interior edge of the top plate of the wall below

### Objective(s):

Separate cantilevered floor from conditioned floor space

Allow for insulation



Cavities are open allowing unconditioned air to communicate within the space between floors.



Cavity has been blocked, sealed, and insulated. Rigid air barrier is hidden behind insulation in this photo

**Tools:**

1. tape measure
2. utility knife
3. flashlight
4. caulking gun
5. foam gun

**Materials:**

1. rigid air barrier (plywood, OSB, drywall, rigid foam board)
2. caulk or foam sealant
3. dense-pack cellulose or fiberglass insulation
4. batt insulation
5. two-part spray polyurethane foam (optional)

Install insulation at the required R-value in permanent contact with the subfloor under the cantilevered section.

Use finished plywood for exposed cantilevered floor areas such as under an elevated back porch.

## 4.1301.5 - Cantilevered Floor—Batt Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

## 4.1301.5b - Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

Air barrier will be insulated between joist from top plate of the wall below to subfloor above

Cantilevered subfloor will be insulated in complete contact with the floor without gaps, voids, compressions, misalignments, or wind intrusions

If kraft-faced batts are used, they will be installed with kraft facing to the air barrier

Insulation will be installed to prescribed R-value

### Objective(s):

Insulate to prescribed R-value



Cavities are open and subfloor of conditioned space above is uninsulated.



Batt insulation is installed to either fill the cavity or be properly supported to maintain contact with the subfloor.



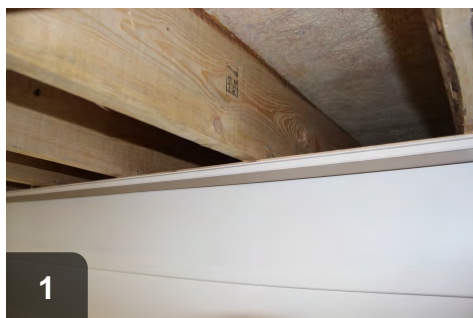
**Tools:**

1. drill
2. mechanical fasteners
3. claw hammer or pry bar

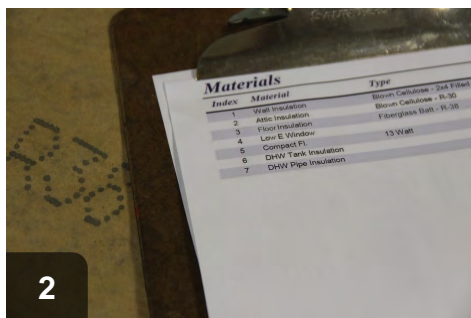
**Materials:**

1. batt insulation - kraft-faced or unfaced
2. insulation supports

Dense pack insulation is also an acceptable alternative. Also see 4.1301.5a.



Cavities are open and subfloor of conditioned space above is uninsulated.



Insulation R-value to be installed matches the work order.



Here the worker is removing the kraft facing, which may be needed in some areas.



Ensure the batt is positioned correctly.



Batt insulation is installed to either fill the cavity or be properly supported to maintain contact with the subfloor.

## 4.1301.5 - Cantilevered Floor—Batt Installation

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### 4.1301.5c - Attachment

### Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

### Specification(s):

Batts will be secured with physical fasteners

### Objective(s):

Ensure insulation remains in contact with subfloor and air barrier



 Before

Insulation should be secured to prevent drooping or movement



 After

"Lightning rods" or twine should keep full contact with the subfloor

### Tools:

1. Utility knife
2. Drill
3. Staple gun

### Materials:

1. Lightning rods
2. Twine
3. Fasteners

Cantilevered Floors should be inspected for insulation and treated just like a framed floor. Batt or dense pack insulation are acceptable.



Batts should have full contact with subfloor without being compressed



Twine fastened across bays in a zig-zag pattern can also be used

## **4.1401.1 - Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation**

### **Desired Outcome:**

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

### **4.1401.1a - Preparation**

#### **Desired Outcome:**

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

#### **Specification(s):**

All band/rim joist areas will be open and accessible for SPF application

All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation

Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt

Grease and oil will be removed using appropriate cleaners or solvents

Moisture content of all wood substrate materials will be checked to ensure it is below 20%

#### **Objective(s):**

Prepare all substrate surfaces for the application of SPF

## **4.1401.1 - Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation**

### **Desired Outcome:**

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

## **4.1401.1b - Installation**

### **Desired Outcome:**

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

### **Specification(s):**

SPF will be applied to desired thickness, using pass thickness maximum in accordance with manufacturer specifications, onto subfloor between floor joists and all rim/band joists

When applied to first floor, SPF will be continuous from subfloor surface, over band/rim joist and sill plate, and in contact with foundation below, except as stipulated by classification 4.1402.1c

When applied to second story floor or above, SPF will be continuous from subfloor surface, over band/rim joist, and in contact with top plate below

### **Objective(s):**

Insulate and seal floors

## **4.1401.1 - Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation**

### **Desired Outcome:**

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

### **4.1401.1c - Fire protection**

### **Desired Outcome:**

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

### **Specification(s):**

If SPF exceeds a thickness of 3", all SPF will be separated from the occupied interior space of the building with an approved thermal barrier material (typically ½" or thicker gypsum wallboard or an approved thermal barrier coating)

Application to rim/band joist up to 3" can be left exposed if the foam is Class I, unless the space is a habitable space and then cover it with drywall or another thermal barrier

Local codes will be confirmed and followed for fire protection requirements

### **Objective(s):**

Provide necessary fire protection for combustible SPF insulation



## 4.1401.1 - Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation

### Desired Outcome:

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

### 4.1401.1d - Onsite documentation

### Desired Outcome:

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

### 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

## **4.1401.2 - Band/Rim Joists – Insulation other than Spray Polyurethane Foam**

### **Desired Outcome:**

Closed crawl spaces insulated to achieve best thermal performance possible

### **4.1401.2a - Preparation**

### **Desired Outcome:**

Closed crawl spaces insulated to achieve best thermal performance possible

### **Specification(s):**

The rim joist, sill plate and adjacent surfaces will be sufficiently clean and free of debris to allow for the proper adhesion of any caulks, adhesives or spray foam used during installation.

### **Objective(s):**

Prepare all surfaces for the installation of insulation

## **4.1401.2 - Band/Rim Joists – Insulation other than Spray Polyurethane Foam**

### **Desired Outcome:**

Closed crawl spaces insulated to achieve best thermal performance possible

## **4.1401.2b - Insulation installation**

### **Desired Outcome:**

Closed crawl spaces insulated to achieve best thermal performance possible

### **Specification(s):**

A foam-based insulation will be installed so as to create a continuous thermal and pressure boundary or vinyl faced fiberglass batt insulation, installed tightly to the wood and sealed at all edges. If rigid insulation is used, all edges will be sealed and the insulation will be installed tightly to the wood to prevent the movement of moisture throughout the assembly. Insulation will be installed in accordance with local/national code requirements and/or manufacturer's instructions regarding flame spread

### **Objective(s):**

Improve thermal performance Prevent moisture condensation on the inside of the band joist

## 4.1402.1 - Closed Crawl Spaces—Wall Insulation

### Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

### 4.1402.1a - Insulation selection

### Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

### Specification(s):

A fire-rated insulation (25 or less flame spread or Class I or Class A) will be used with a minimum life expectancy of 10 years

### Objective(s):

Provide fire-safe, durable insulation that will not exacerbate moisture issues in the crawl space



Crawlspace Wall, clean, dry, ground moisture barrier installed and sealed



Batt insulation installed smooth, without gaps or voids, stapled in place

### Tools:

1. tape measure
2. knife
3. straight edge
4. stapler/mechanical fasteners

### Materials:

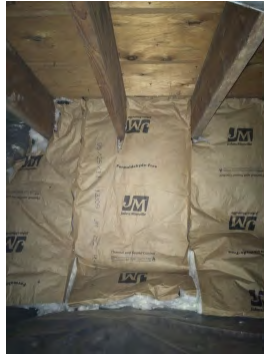
1. Batt Insulation
2. Mechanical Fasteners/staples

R-19 fiberglass batt insulation may also be used. R-19 vinyl-faced, metal building insulation or wall batt insulation may be used. Insulation should be attached to the entire wall surface with appropriate fasteners. Install insulation with no significant voids or edge gaps. Foundation insulation will only be used in conjunction with a ground moisture barrier. Draped insulation shall extend down the wall and

extend 1 foot from the wall along the ground.



Ensure Crawlspace is dry. Install and seal ground moisture barrier.



Cutt Batts to fit around joists. Extend insulation 1 foot from wall.



Corners are lapped to provide full coverage

## 4.1601.2 - Insulating Metal Ducts

### Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

## 4.1601.2a - Selection of duct insulation material

### Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

### Specification(s):

Duct insulation on all ducts located in unconditioned spaces will be a minimum of R-8, in accordance with local code, or buried under attic insulation, whichever is greater, and have an attached vapor retarder

Hot humid and warm coastal regions will not bury ducts

### Objective(s):

Decrease heat loss and condensation problems



 **Before**

Uninsulated ducts in unconditioned spaces are an energy drain



 **After**

Properly insulated ducts operate at much higher rates of efficiency

Ductwork will be sealed (see SWS 4.1601.2b) before being insulated. Sealing and insulating ductwork is considered a general heat waste measure and should be performed whenever the ductwork is outside of the conditioned volume of the home. Ductwork is generally, not insulated inside the conditioned volume.





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

## 4.1601.2 - Insulating Metal Ducts

### Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

## 4.1601.2b - Duct sealing

### Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

### Specification(s):

All joints, seams, and connections in ductwork shall be securely fastened and sealed with UL 181 B-M mastics (adhesives) or mastic- plus-embedded-fabric systems installed in accordance with the manufacturer's instructions before insulation is applied

### Objective(s):

Minimize duct leakage



 **Before**

Unsealed joints and connections need to be sealed to prevent health risks



 **After**

Sealed ductwork connections help prevent leakage

### Tools:

1. Putty knife

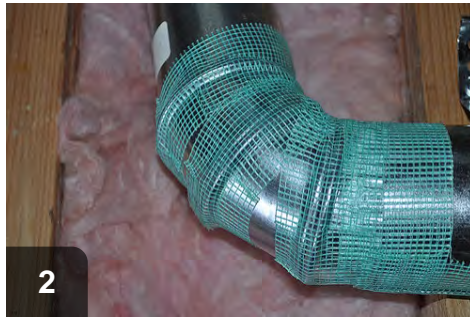
### Materials:

1. Mesh tape
2. Mastic

Ductwork will be sealed before being insulated. Ductwork will also be sealed inside the conditioned volume of the home where excessive leakage or pressure differences are a concern.



Prepare work area by assessing any safety concerns



Wrap joint with fiberglass mesh tape



Apply UL 181 mastic to seal joint

## 4.1601.2 - Insulating Metal Ducts

### Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

### 4.1601.2c - 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 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

### Objective(s):

Ensure a secure connection between the duct system and the duct insulation



 **Before**

Materials holding insulation in place should not compress or kink duct



 **After**

Durable materials can be attached without compressing insulation

### Tools:

1. Scissors
2. Metal snips

### Materials:

1. Nylon twine
2. Wire
3. Tie bands

Plastic cable ties are allowed. Ensure insulation is not compressed.

## 4.1601.2 - Insulating Metal Ducts

### Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

## 4.1601.2d - Taping of the duct insulation

### 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 duct insulation will be taped

No gaps will exist between pieces of duct insulation

### Objective(s):

Prevent gaps in the vapor barrier of the insulation



 **Before**

Unsecured and sealed insulation around ducts is useless



 **After**

All seams should be sealed with UL-181 duct tape to preserve vapor barrier

### Tools:

1. Utility knife

### Materials:

1. UL-181 tape
2. R-8 duct insulation with vapor barrier



## 5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment

### Desired Outcome:

Equipment and condensate drain operate as designed

### Note:

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

## 5.3003.10a - Connection

### Desired Outcome:

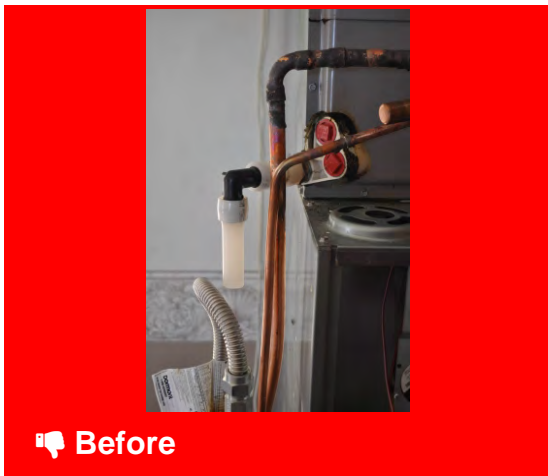
Equipment and condensate drain operate as designed

### Specification(s):

Connections in condensate drain system will be watertight

### Objective(s):

Ensure condensate drain connections do not leak



HVAC equipment needs condensate drainage to prevent water damage



Drainage pipes should be sealed to be watertight

### Tools:

1. Hacksaw
2. Crimper

### Materials:

1. Pex piping and angles
2. PVC piping and angles
3. Purple primer and PVC Cement



## 5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment

### Desired Outcome:

Equipment and condensate drain operate as designed

### Note:

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

## 5.3003.10b - Insulation

### Desired Outcome:

Equipment and condensate drain operate as designed

### Specification(s):

Condensate drainlines will be insulated with a minimum 1" of insulation with a vapor retarder when there is potential for condensation or freezing on the drainline

### Objective(s):

Ensure condensate drain connections do not leak



 **Before**

Once drainage pipes cross into unconditioned space, they can freeze



 **After**

Pipes in unconditioned spaces should be insulated with 1" pipe insulation

### Tools:

1. Tape measure
2. Utility knife

### Materials:

1. 1" thick pipe insulation
2. Zip ties

Heat tape is recommended as best practice and required by some manufacturers for warranty compliance when installed outside the conditioned space.

## 5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment

### Desired Outcome:

Equipment and condensate drain operate as designed

### Note:

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

### 5.3003.10c - Overflow protection: upflow

### Desired Outcome:

Equipment and condensate drain operate as designed

### Specification(s):

Secondary drain pan and float switch will be installed when overflow could damage finished surfaces

OR

Float switch in the primary condensate drain for upflow systems will be installed when overflow could damage finished surfaces

### Objective(s):

Ensure condensate drain connections do not leak



A float switch should be installed to prevent overflow and damage

This specification will only apply when installing new units. Typically a requirement of units installed in attics over living spaces. Install per manufacturer installation specifications.

## 5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment

### Desired Outcome:

Equipment and condensate drain operate as designed

### Note:

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

## 5.3003.10d - Pumps

### Desired Outcome:

Equipment and condensate drain operate as designed

### Specification(s):

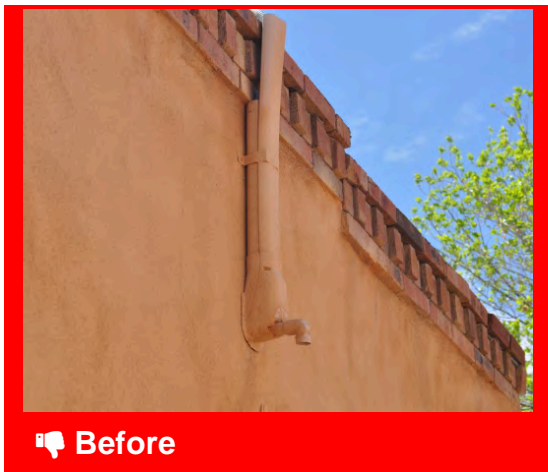
Condensate drain pumps will be installed when condensate cannot be drained by gravity

Power source for pump will be installed

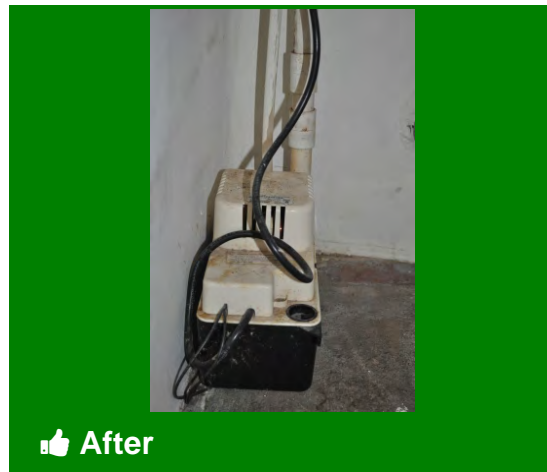
Operation and drainage of pump will be verified

### Objective(s):

Ensure condensate drain connections do not leak



Before  
HVAC equipment that drains upward through a roof cannot drain naturally

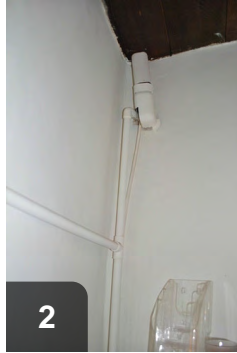


After  
For non-gravity draining systems, a pump is necessary

Install per manufacturer installation specifications and local codes where applicable.



HVAC unit is mounted to "historic" adobe wall which cannot be penetrated



Instead, unit is drained by utilizing a pipe and pump in the next room



The pump is connected directly into the sewage system

## **5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment**

### **Desired Outcome:**

Equipment and condensate drain operate as designed

### **Note:**

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

## **5.3003.10e - Vents and traps**

### **Desired Outcome:**

Equipment and condensate drain operate as designed

### **Specification(s):**

Vents and traps will be installed on condensate drainlines

Trap supplied with the equipment will be used and manufacturer specifications will be followed

### **Objective(s):**

Ensure condensate drain operates as designed

Ensure condensate drain does not leak air

This will apply to new installations only, not retrofitting existing units.



## **5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment**

### **Desired Outcome:**

Equipment and condensate drain operate as designed

### **Note:**

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

## **5.3003.10f - Drain pan**

### **Desired Outcome:**

Equipment and condensate drain operate as designed

### **Specification(s):**

Condensate from all cooling coils or evaporators shall be conveyed from the drain pan outlet to an approved place of disposal

Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than 1/8 unit vertical in 12 units horizontal (1% slope)

Condensate shall not discharge into a street, alley, or other areas where it would cause a nuisance

### **Objective(s):**

Prevent water damage from drain system malfunction

## 5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment

### Desired Outcome:

Equipment and condensate drain operate as designed

### Note:

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

## 5.3003.10g - Float switch

### Desired Outcome:

Equipment and condensate drain operate as designed

### Specification(s):

All secondary drain pans will have a float switch and be drained away through a drainline

### Objective(s):

Prevent water overflowing the pan and draining onto the ceiling below



Float switches should be installed in drainage pans to prevent overflow

This specification will only apply when installing new units. Install per manufacturer installation specifications. See 5.3003.10c.

## **5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment**

### **Desired Outcome:**

Equipment and condensate drain operate as designed

### **Note:**

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

## **5.3003.10h - Termination**

### **Desired Outcome:**

Equipment and condensate drain operate as designed

### **Specification(s):**

Condensate drain will be terminated in accordance with local codes

### **Objective(s):**

Ensure condensate does not leak to the house

Ensure condensate drain does not freeze

## 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



### Best Practice

Only place appliances in operation that are installed to manufacturer specification and have passed combustion testing

## 6.6002.1 - Ducts

### Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

### 6.6002.1a - Duct design and configuration

### Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

### Specification(s):

Ventilation ducts will be as short, straight, and smooth as possible

Ventilation ducts will not be smaller than the connections to which they are attached

### Objective(s):

Effectively move the required volume of air



Duct work for exhaust fans should be short, smooth, and not pinch down



Duct is the same size as the outlet and makes shortest run possible

### Tools:

1. Metal snips
2. Drill

### Materials:

1. Metal duct piping
2. Fasteners

See ASHRAE 62.2-2016 regulations. All ductwork requirements about air sealing, being as straight as possible, being supported, and being insulated will apply to exhaust fans. When applicable, pitch duct to remove condensation to outdoors. Duct diameter will be equal to or greater than the exhaust fan outlet.

## 6.6002.1 - Ducts

### Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

## 6.6002.1e - 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

The metal gauge of rigid kitchen fan ducting shall meet code requirements or the approval of the authority having jurisdiction.

### Objective(s):

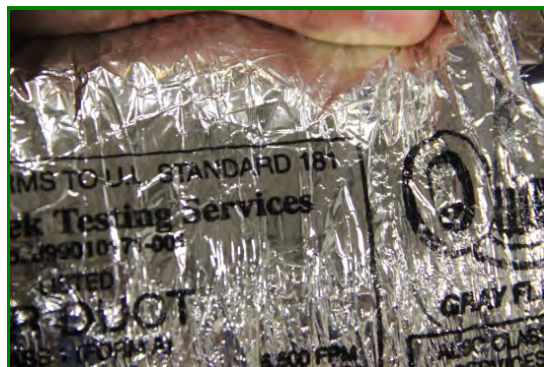
Effectively move the required volume of air

Preserve the integrity of the duct system



**Bad Practice**

Existing duct is installed incorrectly and is not UL listed



**Best Practice**

This flexible duct conforms to UL 181

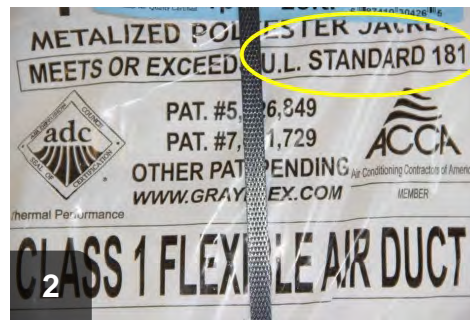
### Materials:

1. All materials should be UL 181 Listed
2. 30-gauge minimum Rigid Duct

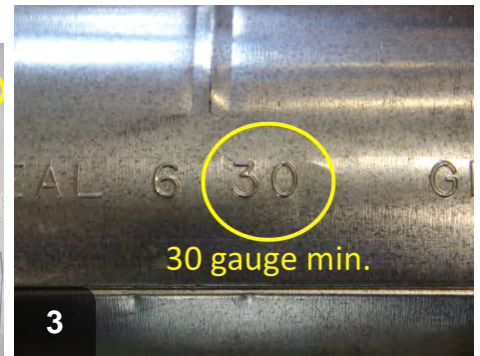




1 Look for the Air Diffusion Council seal.



2 Flex installed should meet or exceed UL181.



3 When rigid duct is being used, its wall thickness should be 30 gauge minimum.

## 6.6002.2 - Terminations

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

### 6.6002.2b - Termination fitting

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

### Specification(s):

A termination fitting with an integrated collar will be used

Collar will be at least the same diameter as the exhaust fan outlet; if collar is larger than exhaust fan outlet, a rigid metal transition will be used

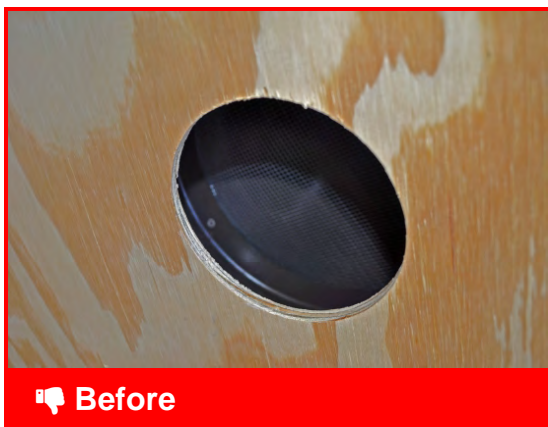
Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable

### Objective(s):

Effectively move the required volume of air to the outside

Preserve integrity of the building envelope

Ensure durable installation



**Before**  
Termination fittings with no collars are not allowed



**After**  
Use a termination fitting with integrated collar

### Tools:

1. Drill

### Materials:

1. Fasteners

Gable venting locations are ideal where a standard dryer type termination can be applied. Where venting through the roof is required, a collared fitting specifically for exhaust fans shall be used. A hole no greater than a 1/4 inch larger than the fitting will be cut to accommodate termination fittings. All new and existing exhaust fans will be vented to the exterior.

Use a termination fitting with integrated collar such as Broan's roof cap 636 and additional duct collar (or kit RVK1A) or similar style.



BAD: Termination fittings without collars should be avoided



Termination fittings with collars should be used for exhaust ventilation



Collared fittings extend through the roof to fasten securely with duct



BAD/REWORK: Do not attach ducting to roof decking without a collar. A integrated collar must be used.

## 6.6002.2 - Terminations

### **Desired Outcome:**

Securely installed termination fittings with unrestricted air flow

## 6.6002.2c - Duct to termination connection

### **Desired Outcome:**

Securely installed termination fittings with unrestricted air flow

### **Specification(s):**

Duct will be connected and sealed to termination fitting as follows:

- Round metal-to-metal or metal-to-PVC 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 will be fastened with tie bands using a tie band tensioning tool
- PVC-to-PVC materials 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

Fasteners will not inhibit damper operation

### **Objective(s):**

Effectively move the required volume of air to the outside

Preserve integrity of the building envelope

Ensure durable installation





**Before**

Termination is not mechanically fastened, or sealed appropriately.



**After**

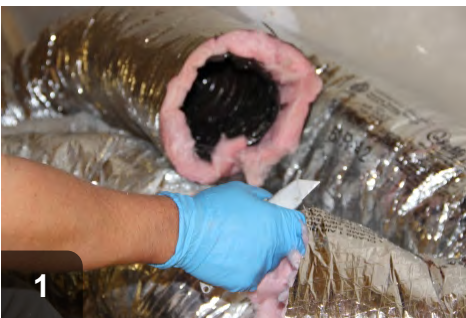
Termination fitting is secure, and duct is sealed to termination.

### Tools:

1. wire cutter
2. chip brush
3. zip tie tension tool
4. utility knife

### Materials:

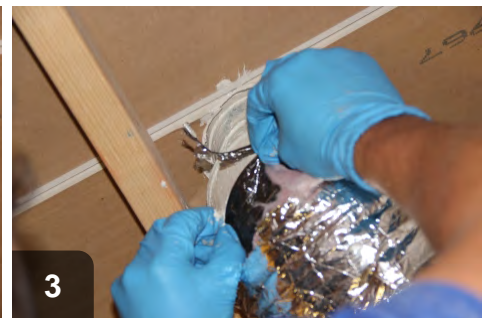
1. insulated flex duct with liner
2. UL 181 sealant
3. zip tie straps
4. PVC primer
5. PVC cement



With other end of the duct connected to the fan, cut duct to desired length.



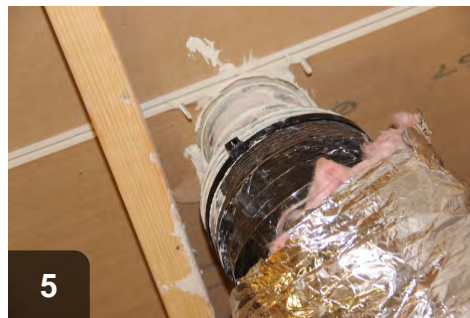
Apply mastic to termination fitting.



Fit duct liner on to termination fitting.



With duct liner in place, use the zip tie



With liner secured and zip tie



Ensure termination damper functions

tension tool to secure the liner to the fitting.

trimmed, you are ready to pull the insulation to cover the fitting.

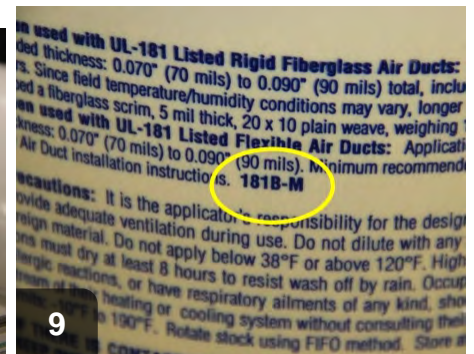
as intended.



Round metal-to-metal connections require fiberglass mesh tape and 3 mechanical fasteners minimum.



PVC-to-PVC connections should use PVC primer and cement.



Sealants should be UL181-M or UL181B-M listed.



## 6.6002.2 - Terminations

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

## 6.6002.2d - Weatherproof installation

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

### Specification(s):

Exterior termination fitting will be flashed or weather sealed

Water will be directed away from penetration

Installation will not inhibit damper operation

Manufacturer specifications will be followed

### Objective(s):

Preserve integrity of the building envelope

Ensure a weather tight and durable termination installation

Ensure unrestricted air flow



Holes for termination fitting need to be sealed to weatherproof



Termination installation should follow shingling to deter water penetration

**Tools:**

1. Hole saw
2. Caulk gun
3. Drill

**Materials:**

1. Fasteners
2. Caulk



Termination fitting is installed to repel water and sealed

## 6.6002.2 - Terminations

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

## 6.6002.2e - Pest exclusion

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

### Specification(s):

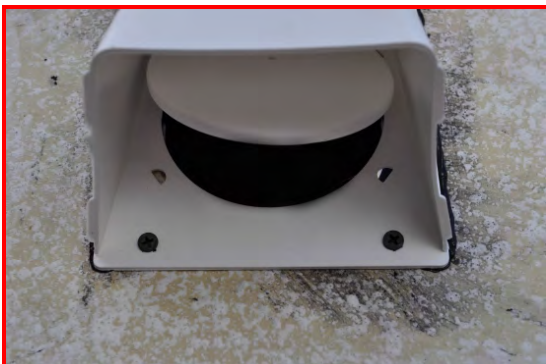
Screen material with no less than 1/4" and no greater than 1/2" hole size in any direction will be used

Installation will not inhibit damper operation or restrict air flow

### Objective(s):

Prevent pest entry

Ensure proper air flow



 **Before**

Exhaust terminations without screens are an invitation to pest intrusion



 **After**

Screen mesh should be between 1/4" and 1/2" in either direction

Screen material required on new installations. Recommended installation on existing terminations but not required.

## 6.6002.2 - Terminations

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

## 6.6002.2f - Termination location

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

### Specification(s):

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

Terminations will be installed:

- A minimum of 3' away from any property line
- A minimum of 3' away from operable opening to houses
- A minimum of 10' away from mechanical intake
- As required by authority having jurisdiction

### Objective(s):

Prevent exhaust from reentering house



Exhaust vent has been improperly mounted too close to mechanical vent



Exhaust vent was properly mounted over 3ft from door, window, and deed line

**Tools:**

1. Measuring tape
2. Hole saw
3. Drill

Gable venting locations are ideal where a standard dryer type termination can be applied.

Where venting through the roof is required, a collared fitting specifically for exhaust fans shall be used. If proper clearance can't be achieved, document reasons why in the client file.

## 6.6002.2 - Terminations

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

## 6.6002.2g - Kitchen exhaust

### Desired Outcome:

Securely installed termination fittings with unrestricted air flow

### Specification(s):

Galvanized steel, stainless steel, or copper will be used for termination fitting for kitchen exhaust

### Objective(s):

Prevent a fire hazard



Kitchen exhaust vents should not be made from highly combustible materials



This roof-mounted kitchen exhaust fan is galvanized steel--heat resistant



## 6.6003.3 - Through the Wall

### Desired Outcome:

Through the wall fans installed to specification

### Note:

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

## 6.6003.3a - Hole in building shell

### Desired Outcome:

Through the wall fans installed to specification

### Specification(s):

A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly

### Objective(s):

Allow for ease of weatherproofing



 Before

Determine size to cut hole by measuring fan assembly and ducting



 After

A snug fit should be ensured to minimize weatherproofing required

### Tools:

1. Tape measure
2. Saw



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

## 6.6003.3 - Through the Wall

### Desired Outcome:

Through the wall fans installed to specification

### Note:

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

## 6.6003.3b - Wiring

### Desired Outcome:

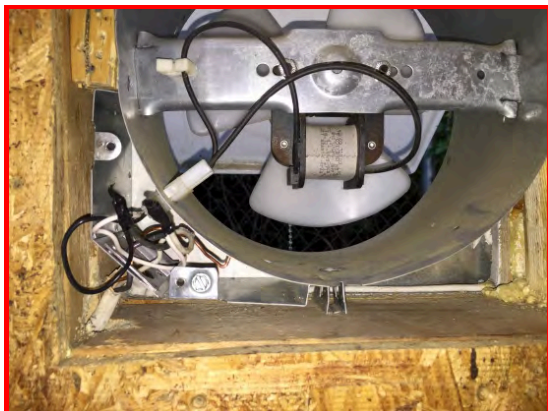
Through the wall fans installed to specification

### Specification(s):

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



 Before

Incorrect: disconnected ground, no wire nuts on splices, no clamp on wires passing through junction box



 After

Fan junction box with cover installed



**Tools:**

1. Wire strippers
2. Utility knife or cable ripper
3. Screwdriver
4. Non-contact voltage tester
5. Lineman's pliers

**Materials:**

1. Ground wire crimp sleeves
2. Non-metallic sheathed wire (Type NM-B) e.g., Romex ®
3. Plastic junction box and cover plate
4. Wire nuts
5. Cable staples
6. Clamp-type cable connectors

Follow manufacturer's specifications and applicable codes when wiring newly installed equipment.



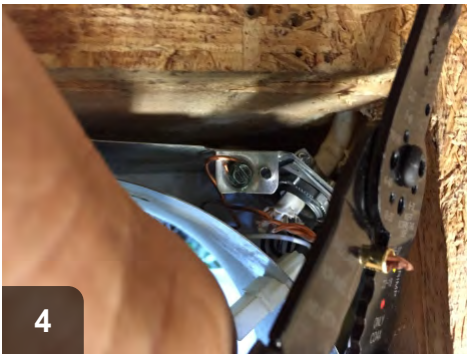
1  
Inspect for: proper ground, wire nuts on splices, clamps on wiring where it enters junction box, cover installed on box



2  
Install clamp on wiring into junction box



3  
Install wire nuts on splices



4  
Use crimp sleeves to connect ground wires



5  
Tuck wiring into place



6  
Reinstall cover on junction box

## 6.6003.3 - Through the Wall

### Desired Outcome:

Through the wall fans installed to specification

### Note:

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

## 6.6003.3e - Backdraft damper

### Desired Outcome:

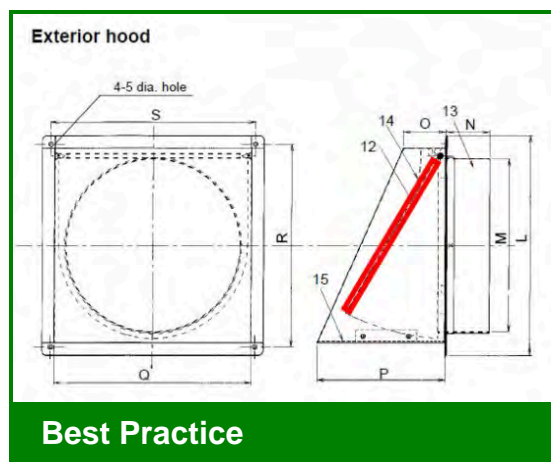
Through the wall fans installed to specification

### 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



Damper should be installed to maintain exterior air barrier

## 6.6003.3 - Through the Wall

### Desired Outcome:

Through the wall fans installed to specification

### Note:

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

## 6.6003.3g - Fan to interior surface seal

### Desired Outcome:

Through the wall fans installed to specification

### Specification(s):

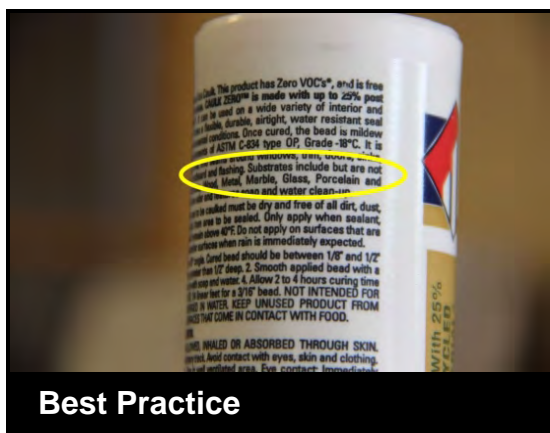
Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

### Objective(s):

Prevent air leakage around intake housing

Prevent a fire hazard



**Best Practice**

Sealant should be waterproof and adhere to desired surfaces.



**Best Practice**

Sealant should be applied to the fan housing where it comes in contact with the exterior wall.

Seal the inlet and the outlet to make weathertight and to reduce unintended infiltration.



## 6.6003.3 - Through the Wall

**Desired Outcome:**

Through the wall fans installed to specification

**Note:**

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

## 6.6003.3h - Insulation

**Desired Outcome:**

Through the wall fans installed to specification

**Specification(s):**

All components outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local code

Exception: If system operates continuously, fan housing need not be insulated

**Objective(s):**

Preserve integrity of the duct system

Best practice is bury the fan and components under insulation.

## 6.6003.3 - Through the Wall

### Desired Outcome:

Through the wall fans installed to specification

### Note:

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

## 6.6003.3i - Air flow

### Desired Outcome:

Through the wall fans installed to specification

### Specification(s):

Air flows in CFM will be measured and adjusted to meet the design requirements

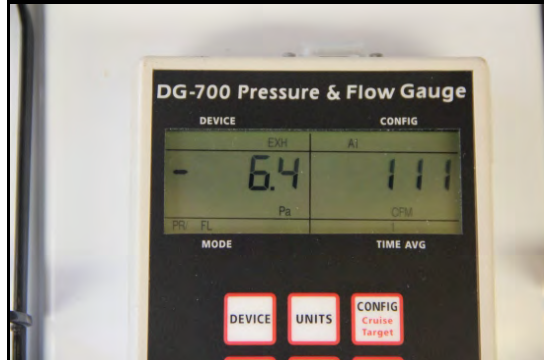
### Objective(s):

Exhaust sufficient air from desired locations to outside



### Best Practice

Using a digital manometer, exhaust flow meter and fabricated cover, measure the fan flow.



### Best Practice

Air flow should be within acceptable limits for the location of the fan.

### Tools:

1. exhaust fan flow meter
2. manometer

### Materials:

1. a fabricated cover for fans larger than the flow meter



1  
The exhaust fan flow meter won't fit most range hoods. A fabricated cover is needed.



2  
A fabricated cover can be used so long as the opening is smaller than the meter itself and larger than the E1 opening.



3  
Attach a pressure hose to the exhaust fan flow meter.



4  
Attach a the hose to a T connection on channels A & B with the manometer set to measure exhaust fan flow.



5  
With manometer properly set up, prepare to test air flow



Fans must pull the required CFM according to ASHRAE.

## 6.6003.3 - Through the Wall

### Desired Outcome:

Through the wall fans installed to specification

### Note:

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

## 6.6003.3k - Combustion safety

### Desired Outcome:

Through the wall fans installed to specification

### Specification(s):

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

Make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

### Objective(s):

Ensure safe operation of combustion appliances



 Before

Installing new ventilation can cause imbalances within the house

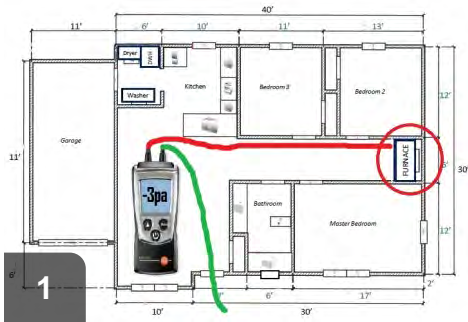


 After

Test that depressurization limit is not being exceeded by new ventilation

### Tools:

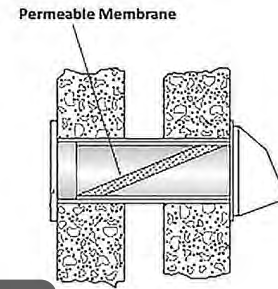
1. Manometer



Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions



If depressurization limit is exceeded, mitigate to eliminate safety risk



Mitigate safety risk with make-up air or other pressure relief



After mitigation, verify that depressurization limits are not being exceeded

## 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~~ Variance approved

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



**Before**

Dryer is vented outside, but with the incorrect material.



**After**

Dryer is vented outdoors, with correct material. Run is as short and straight as possible ensuring maximum flow.

### Tools:

1. metal trimmers
2. drill

### Materials:

1. metal flex duct
2. dryer vent kit
3. hose clamps



**1**

Disconnect existing vent pipe from termination. If hose clamp is installed, save for reuse.



**2**

Disconnect existing vent pipe from dryer.



**3**

Attach approved vent material to termination vent. Termination vent may need to be trimmed.



Trim metal vent to ensure the run is as short and straight as possible.



Connect vent pipe to dryer.



Dryer vents to outdoors, and exhaust damper is functional.



For vent runs >35 feet, a booster fan is required.

## **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

## 6.6201.2 - Primary Ventilation Air Flow between Rooms

### Desired Outcome:

Air circulates freely between rooms

## 6.6201.2a - Balancing pressure

### Desired Outcome:

Air circulates freely between rooms

### Specification(s):

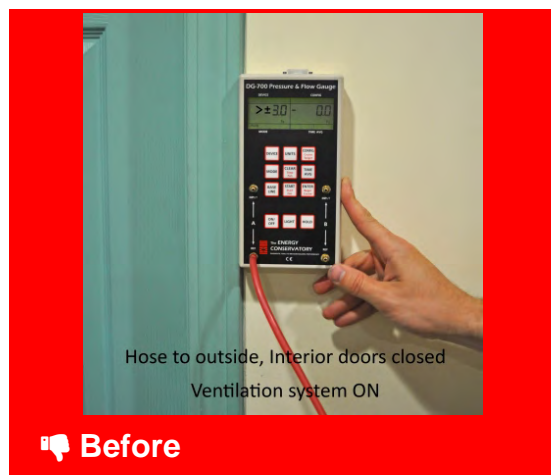
An appropriate means of pressure balancing will be installed (e.g., transfer grilles, jumper ducts, individual room returns)

No room will exceed  $\pm 3$  pascals with reference to the common area with all interior doors closed and ventilation systems running

### Objective(s):

Ensure free flow of air between rooms

Preserve integrity of the building envelope



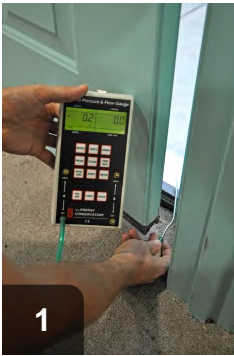
If reading is  $>\pm 3$ pa, interior ventilation needs to be installed



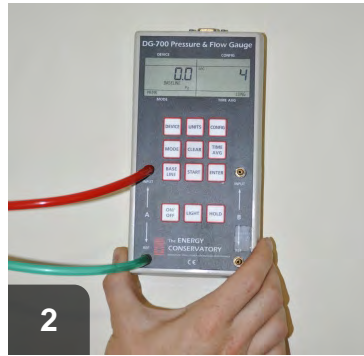
Passive door vents and individual room returns are two possibilities

This specification only applies when installing new whole-house ventilation systems.

Best practices dictates testing rooms with ventilation systems first, then proceed as necessary.



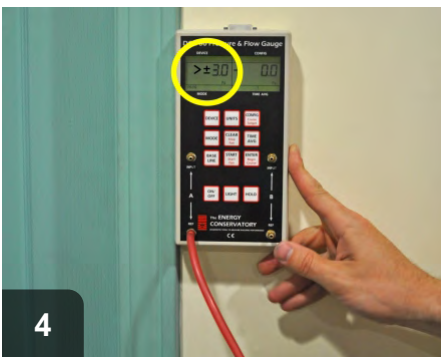
1 With interior doors open, put reference hose to exterior



2 Take baseline reading



3 Turn on exhaust fans and close interior doors



4 With hose under door, check pressure again. Readings  $> \pm 3\text{pa}$  are no good and require interior ventilation

## 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



## 7.8003.1 - 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

CFL or LED bulbs may replace incandescent bulbs. Replacement bulbs should closely match the lumen output and color spectrum. Generally, a 800 lumen, omni-directional bulb with 3,000 Kelvin color temperature is the appropriate replacement for a 60 watt incandescent.

## 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

Low flow showerheads shall be 2.0 gpm and shall not be a mister style. Kitchen aerators will be 1.5 gpm and shall not be a needle style. Bath aerators may be 1.0 to 1.5 gpm and shall not be a needle style.

## 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.

### 7.8102.2b - Equipment removal

**Desired Outcome:**

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

**Specification(s):**

Accepted industry procedures and practices will be followed to:

- Remove old water heater and associated components in accordance with IRC or authority having jurisdiction
- Seal any unused chimney openings and penetrations in accordance with IRC or authority having jurisdiction
- Remove unused oil tank, lines, valves, and associated equipment in accordance with IRC or authority having jurisdiction

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

**Objective(s):**

Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

## 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.

### 7.8102.2c - New equipment installation

**Desired Outcome:**

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

**Specification(s):**

New water heater and associated components will be installed to accepted industry standards, in accordance with the IRC and manufacturer specifications

The system will be installed to be freeze resistant

Any existing water leaks will be repaired before installation begins

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

**Objective(s):**

Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

## 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.

### 7.8102.2d - Emergency drain pan

**Desired Outcome:**

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

**Specification(s):**

An emergency drain pan and drain line shall be installed in accordance with the IRC

**Objective(s):**

Collect and safely dispose of water escaping from the storage tank

Emergency drain pans will be installed with newly installed water heaters only.



## 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:

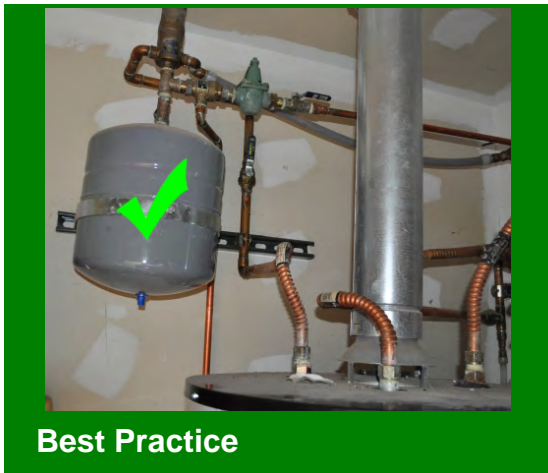
Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

### Specification(s):

Expansion tanks will be installed on weatherization installed water heaters where required and in accordance with the AHJ

### Objective(s):

Protect the storage tank from expansion



Expansion tank installed on the cold inlet side.

Expansion tanks will be installed with newly installed water heaters only.

## 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

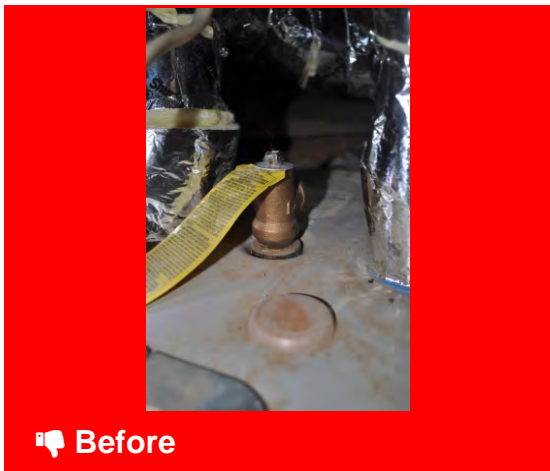
### Specification(s):

Correct temperature and pressure relief valve will be installed in compliance with IRC and according to manufacturer specifications

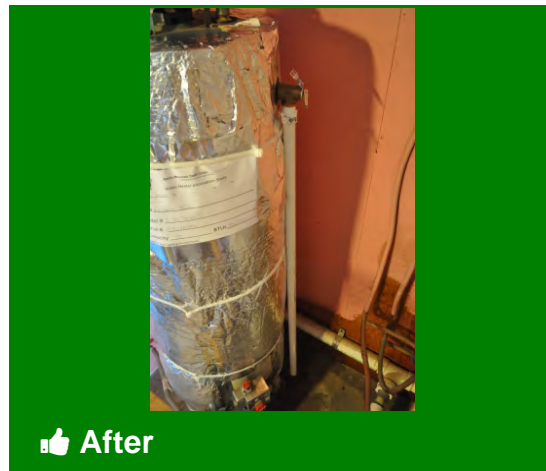
Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

### Objective(s):

Discharge excessive energy (pressure or temperature) from storage tank to safe location



Water heaters should be not capped off 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.

Temperature and pressure relief valves will be installed with newly installed water heaters only.



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.

## 7.8102.2i - Thermal efficiency

### **Desired Outcome:**

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

### **Specification(s):**

If additional tank insulation is installed, it will be rated a minimum of R-11 and will be installed to manufacturer specifications

If additional insulation is installed, it will be installed based on fuel type, making sure not to obstruct draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates

The first 6' of inlet and outlet piping will be insulated in accordance with manufacturer specifications

Combustible pipe insulation must maintain a minimum clearance of 6" from gas water heater draft hood and/or single wall metal pipe. Clearance from vent such as "B" vent should be maintained per vent manufacturer's specifications

Heat traps will be installed on the inlet and outlet piping where not provided by manufacturer

### **Objective(s):**

Reduce standby loss from near tank piping and storage tank

Ensure insulation does not make contact with flue gas venting

Heat traps will be installed on newly installed water heaters only. Water heater blankets should be installed where allowed by the manufacturer and by policy. Blankets should be smooth and permanently secured to ensure insulation does not come loose. A piece of string or cable tie near the top and the bottom is best practice to support any tape.

## 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.

## 7.8102.2k - 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



**Unsafe**

Water heaters producing water over 120 degrees raise heating costs



**Safe**

Water heaters should produce water under 120 degrees to prevent scalding

### Tools:

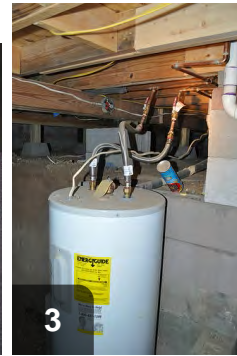
1. Thermometer



1  
Test temperature of hot water at faucets in house



2  
Hot water temperatures should not exceed 120 degrees Fahrenheit



3  
Adjust water heater settings and insulate as needed



4  
After adjustment and insulation, retest to verify temp is under 120 degrees



## 3.1101.1c

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

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

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

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

### **Objective(s):**

Minimize air leakage

Maintain durability

Ensure resulting closure is permanent and supports expected load

Ensure sealant is effective and durable

NOTE: Bypasses are holes and gaps in the air barrier. The approach to sealing these holes depends on the size, location, and surrounding material. Cracks and gaps can be sealed with appropriate sealants and materials. Large holes may need to be covered with strong patching materials. Patching material should be selected based on the surrounding material. These materials should be attached with mechanical and/or adhesive bonds and sealed. Paintable sealants and materials should be used where appropriate.

## 4.1005.8a

### **Desired Outcome:**

Insulation controls heat transfer through ceiling

### **Specification(s):**

New insulation will not be added until all air sealing has been completed

Existing insulation will be inspected to confirm that it is not concealing air barrier weaknesses and is in full contact and alignment with the air barrier

Where the insulation is disturbed or found not to be in contact with the air barrier, it will be reinstalled to be in contact with the air barrier; if it cannot be reinstalled or if its condition compromises its effectiveness, the insulation will be removed

Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area with measurement beginning at the air barrier

All electrical junctions will be flagged to be seen above the level of the insulation

Open electrical junction boxes will have covers installed

Insulation dams and enclosures will be installed as required

Blocking will be installed to maintain existing vented attic functionality

### **Objective(s):**

Ensure proper performance of insulation

Verify uniformity of insulation material

Provide location of electrical junctions for future servicing

Prevent an electrical hazard

**Before**

Accessible attic floors should be air sealed and insulated

**After**

Depth markers and insulation dams aid in proper insulation of attic spaces

**Tools:**

1. Pry Bar
2. Hammer
3. Caulk gun
4. Utility knife
5. Staple gun
6. Spray foam gun
7. Tape measure

**Materials:**

1. Flags
2. Depth markers
3. Staples
4. XPS
5. Caulk
6. Spray foam
7. Junction box covers

NOTE: Blown depth most result in settled depth and density to achieve appropriate R-Value.

## 4.1005.8a - Preparation



Check cavity for electrical junction and penetrations



flagged electrical



Seal and penetrations



Non-IC can lights should be covered with a dam and have no insulation on top



Install depth markers and insulation dams above height of insulation

## 4.1005.8b

### Desired Outcome:

Insulation controls heat transfer through ceiling

### Specification(s):

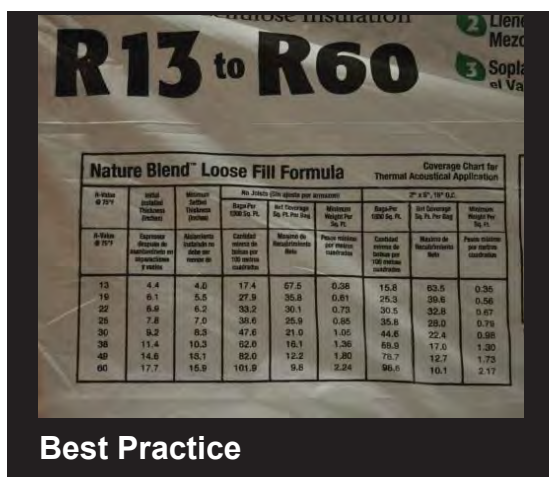
The correct depth and number of bags will be blown in accordance with manufacturer specifications

Insulation will be installed to prescribed R-value

Final R-value will account for the compression of existing insulation

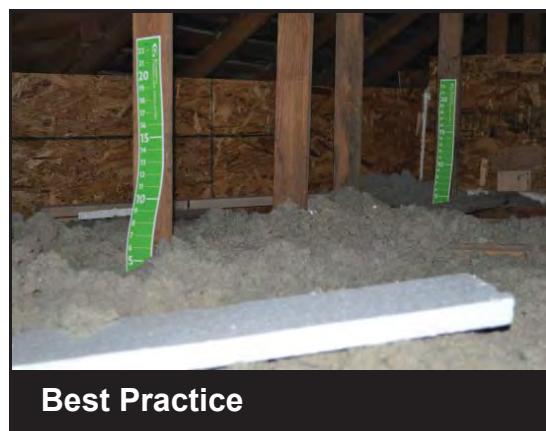
### Objective(s):

Insulate to prescribed R-value



### Best Practice

Check chart on product to ensure proper insulation depth to achieve R-value



### Best Practice

Use depth markers to ensure insulation has reached prescribed R-value

### Tools:

1. Insulation machine

### Materials:

1. Loose fill insulation
2. Insulation Depth Sticks

Final product must achieve uniform R-value throughout area. Insulation R-sticks are to be used to ensure a level product and allow for visual inspection. Allow for plenty of extra material to ensure settled depth is adequate.

## 4.1005.8d

### Desired Outcome:

Insulation controls heat transfer through ceiling

### 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

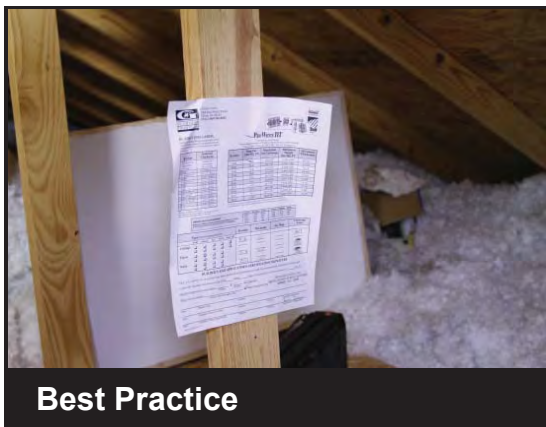
### Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

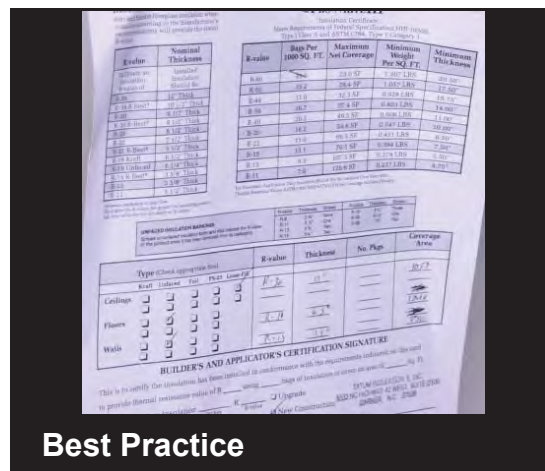
Ensure ability to match bags required for total area completed

Comply with 16 CFR 460.17



**Best Practice**

Information on insulation installed should be posted nearby



**Best Practice**

Posted info includes insulation type, r-value, settled depth, coverage area, etc

**NOTE:** An Insulation Certificate must be placed in the attic in a visible location. This documentation is required for all applications of additional insulation



Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For loose-fill, the receipt must show the coverage area, initial installed thickness, minimum settled thickness, R-value, and the number of bags used. To figure out the R-value of the insulation, use the data that the manufacturer gives you. The receipt must be dated and signed by the installer.