KANSAS HOUSING
RESOURCES CORPORATION

Kansas SWS Field Guide
Version 2015.2

Standard Work Specifications

Field Guide for

Single-Family Homes

created by

Kansas Housing Resources Corporation and the Kansas Weatherization Network

2 Health and Safety

2.01 Safe Work Practices

2.0104 Insulation

2.0104.1 Insulation Worker Safety

2.0105 Heating and Cooling Equipment

2.0105.1 Combustion Worker Safety

2.0105.2 Heating and Cooling Worker Safety

2.02 Combustion Safety

2.0201 Combustion Safety Testing-General

2.0201.1 Combustion Appliance Zone (CAZ) Testing

2.0201.2 Combustion Safety

2.0203 Vented Gas Appliances

2.0203.2 Combustion Flue Gas—Orphaned Water Heaters

2.0299 Additional Resources

2.0299.1 Combustion Appliance Depressurization Limits Table

2.0104.1b

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

If unsure whether material contains asbestos, a qualified asbestos professional will be contacted to assess the material and to sample and test as needed

When working around asbestos-containing material (ACM), the following will not be done:

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

Attic insulation that looks like vermiculite (as opposed to fiberglass, cellulose, or urethane foams) will not be removed or disturbed

Objective(s):
Protect workers from toxic exposure

Material identified as vermiculite may contain asbestos

If asbestos is suspected, call an EPA-accredited professional

Observe OSHA 29CFR 1926.1101 abatement protocol when asbestos is suspected.

2.0104.1b - Vermiculite

Do not disturb vermiculite by vacuuming, dusting, or sweeping

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

2.0105.1c

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

Before

Fuel leaks need to be repaired by appropriate professional

After

Notify occupant of any leaks

Tools:

1. Gas sniffer
2. Bubble solution

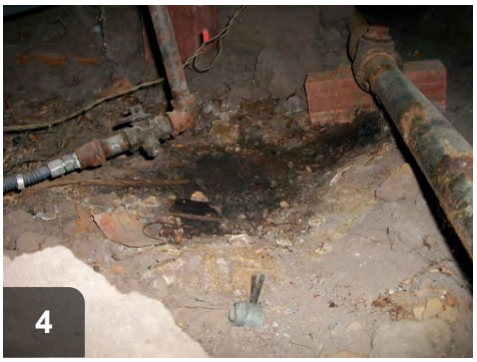
All fuel lines are to be leak-checked inside and outside of home.

2.0105.1c - Raw fuel

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

2.0105.2c

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Identify asbestos hazards in boiler and pipe insulation and remediate in accordance with EPA guidelines

Objective(s):
Protect workers and occupants from asbestos exposure

Suspicious pipe insulation may contain asbestos


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

Refer to Kansas Health and Safety Plan for Guidance.

2.0201.1a

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Emergency problems (e.g., gas leak, ambient CO levels that exceed 35 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested

Determine if combustion and dilution air is adequate for proper combustion and venting of all equipment within the CAZ

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

Objective(s):
Ensure system does not have fatal problems

Ensure combustion appliance has adequate combustion and dilution air

Before

Unsafe combustion appliances indicate need for repair or replacement

After

In cases of replacement, ensure new appliance is safe and sized properly

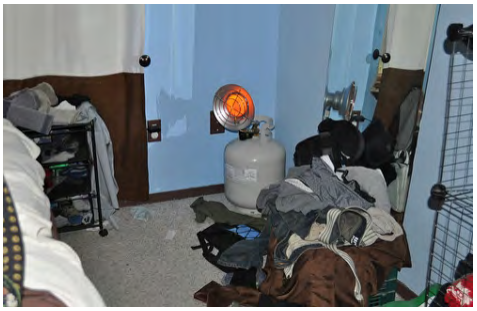
Complete all necessary Mechanical Inspection Forms. See Kansas Procedures Manual. Emergency problems must be corrected before additional weatherization work can proceed.

2.0201.1a - Assessment

Assess existing combustion appliances for damage and replace when necessary

When a simple filter cleaning or replacement will help, make it happen

Ensure there is adequate make-up air -- combustion air inlet in closet



Stop the misuse of combustion appliances -- camp heater in bedroom

Keep occupant apprised of any health or safety concerns

2.0201.1b

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

2.0201.1b - Fuel leak detection

Inspect exterior gas and oil lines for leaks and damage

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

2.0201.1c

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Combustion venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards

Objective(s):
Determine if a draft regulator is present and working and if vent system is in good condition and installed properly

Unsafe

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

Safe

Properly vented appliances make a house healthier and more efficient

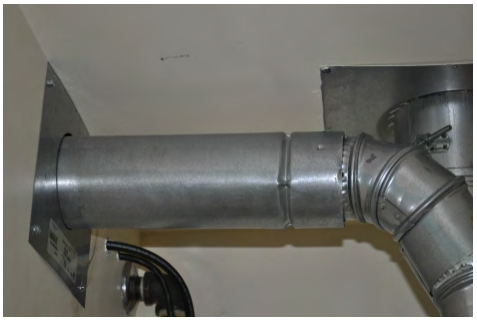
Refer to Local Codes. Adequate slope is generally a 1/4 inch per foot or greater. Inspect for proper flue clearance to combustibles. Refer to Local Codes. B-vent is typically 1 inch, single wall is typically 6 inches.

2.0201.1c - Venting

Determine if a draft regulator is installed and working

Inspect ventilation systems for damage

Inspect ventilation systems for disconnected pipes



Inspect ventilation systems for inadequate slope

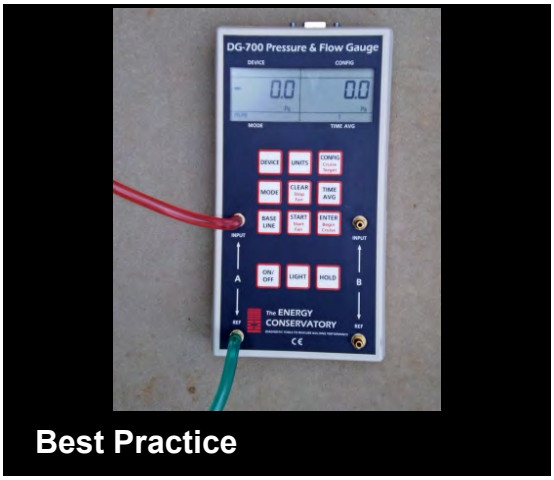
Inspect for missing draft diverter

2.0201.1d

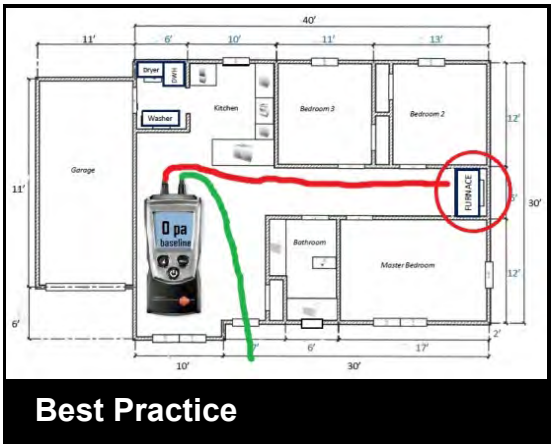
Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Baseline pressure 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



For DG700, Input and Reference hoses should be mounted to the same side



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

Tools:

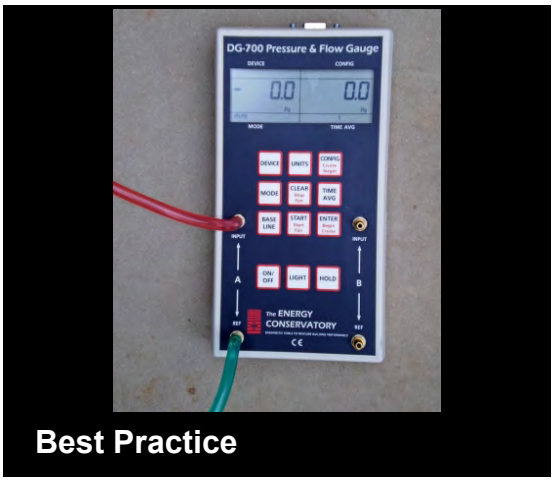
1. Manometer

2.0201.1e

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof, and will not be more negative than the allowable BPI CAZ depressurization limits accounting for base pressure.

Objective(s):
Measure combined effect of mechanical system fans on combustion zone



For DG700, Input and Reference hoses should be mounted to the same side

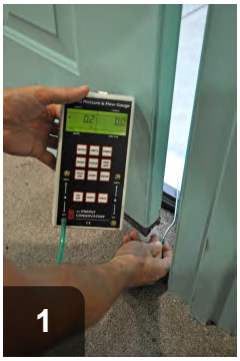
Exhaust fans on, Check interior doors, Air handler on?

Tools:

1. Manometer

CAZ depressurization limit will be in accordance with BPI test standards.

2.0201.1e - Depressurization test



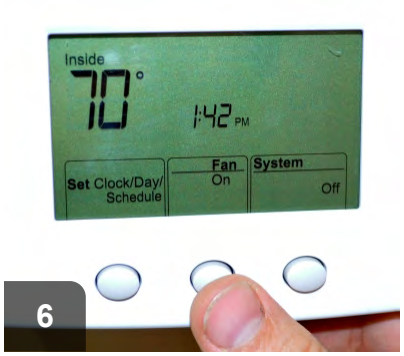
Place manometer reference hose to exterior of house

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

Place test hose by combustion appliance

Take baseline reading

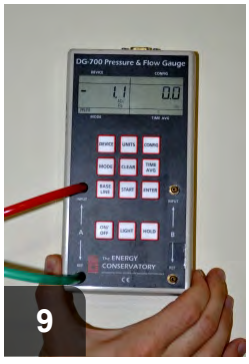
Turn on interior exhaust fans, including any clothes dryers



Is the air handler on?

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

Manometer reading should not be more negative than allowable depressurization limit



If reading is within allowable limit, all is well

2.0201.1f

Desired Outcome:
Accurate information about appliance safe operation is gathered

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

Objective(s):
Detect excessive spillage of combustion gasses

Unsafe

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

Best Practice

Test all sides of natural draft flues since draft may be uneven

Tools:

1. Smoke pencil
2. Timer

Test smallest BTU appliance first.

2.0201.1g

Desired Outcome:
Accurate information about appliance safe operation is gathered

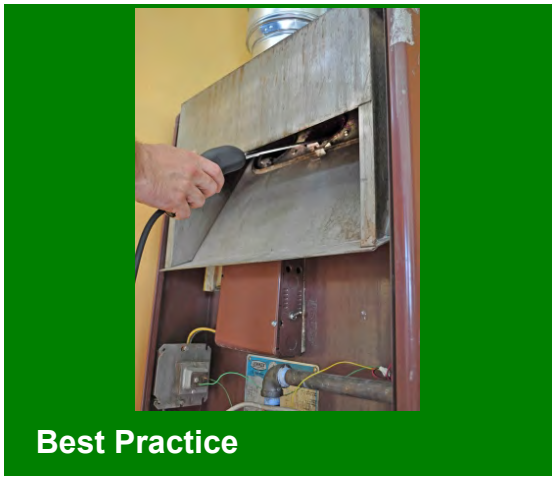
Specification(s):
CO will be tested for in undiluted flue gases of combustion appliances

If CO levels exceed 200 ppm as measured, or 400 ppm air-free measurement, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)

If the outlet of the exhaust is accessible, include a CO test on all sealed-combustion, direct vent, and power-vented appliances (without atmospheric chimneys)

Objective(s):
Measure CO and report excessive levels

CO levels cannot exceed 200ppm as measured, unless to manufacturer specs

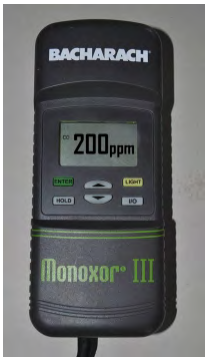


Test CO levels in undiluted flue gases and exhaust outlets, when accessible

Tools:

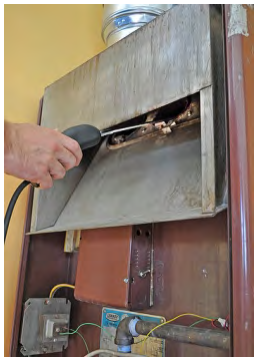
1. Combustion analyzer with probe

2.0201.1g - Carbon monoxide (CO) test in appliance vent



CO levels cannot exceed 200ppm, or 400ppm air-free CO

Test undiluted flue gases in induced-draft furnaces



Test undiluted flue gases in natural draft furnaces

Test undiluted flue gases in natural draft water heaters.

Test accessible exhaust outlets for direct-vent appliances

Test accessible exhaust outlets for power-vented appliances

2.0201.1i

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
At the conclusion of each work day in which envelope or duct sealing measures have been performed, depressurization and spillage testing will be performed

Objective(s):
Ensure work completed in home has not adversely affected the operation of combustion appliances

Conduct spillage and depressurization testing at the end of the work day

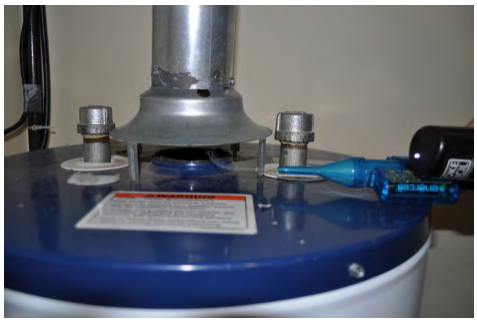
Tools:

1. Manometer
2. Smoke pencil
3. Timer

Testing at the conclusion of each day is best practice. HVAC work must be completed before air sealing measures to minimize risk. Potential depressurization and drafting issues shall be indentified and corrected before air sealing measures.

2.0201.1i - Combustion safety testing at completion of retrofitting home

Run depressurization test at the end of the work day



Complete spillage test using chemical smoke pencil

Test for spillage on all sides of draft diverter

Complete spillage testing on all combustion appliances

Complete carbon monoxide testing using a CO detector

2.0201.2a

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 2012 IRC for the type of appliance installed

Objective(s):
Prevent combustion byproducts from entering the house

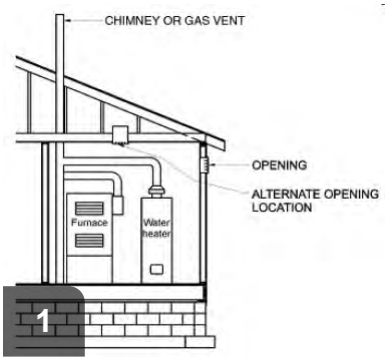
The preference is to draw combustion air from the conditioned area of the dwelling where applicable and allowed by local code.

Image 1: For homes with one permanent opening, see 2012 IRC: G2407.6.2 (304.6.2): a minimum free area of 1 in2 per 3,000 Btu/h (734 mm2/kW) of total input rating of all appliances

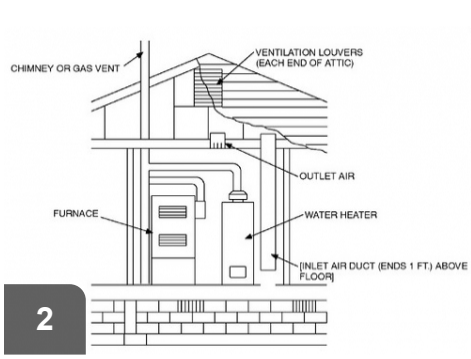
Image 2: For homes with two permanent vertical duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in2 per 4,000 Btu/h (550 mm2/kW) of total input rating of all appliances

Image 3: For homes with two permanent horiztonal duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in2 per 2,000 Btu/h (1,100 mm2/kW) of total input rating of all appliances

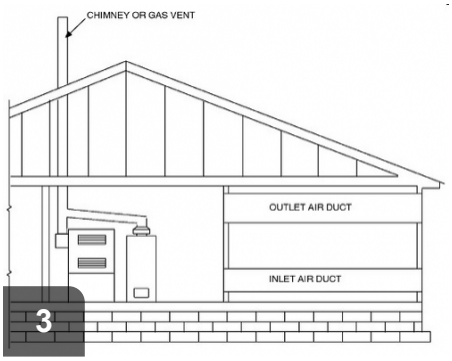
2.0201.2a - Outside combustion make-up air



min free area of 1 sqin per 3,000 Btu/h (734 mm2/kW) of total input rating



min free area of 1 sqin per 4,000 Btu/h (550 mm2/kW) of total input rating



min free area of 1 sqin per 2,000 Btu/h (1100 mm2/kW) of total input rating

2.0201.2b

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

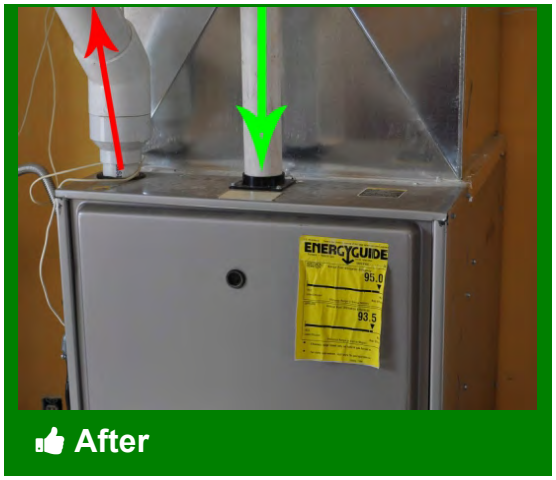
Specification(s):
New appliance will be installed in accordance with manufacturer specifications, 2012 IRC G2427.8, and additional applicable codes

Replacement equipment venting will be assessed to ensure other existing equipment is not adversely affected

Objective(s):
Prevent combustion byproducts from entering the house

Before

Damaged combustion appliances beyond repair should be replaced



After

Sealed-combustion, direct-vent appliances should replace unsafe appliances

Refer to Kansas Procedures Manual for guidance and minimum effiiciencies

2.0201.2b - New appliances

Two-pipe 90% efficiency furnaces are viable replacement appliances

Direct vent combustion appliances are also viable replacements

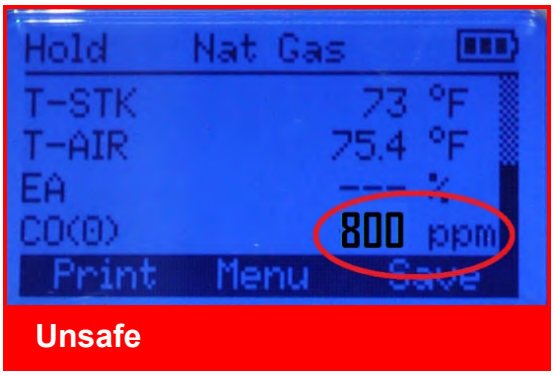
2.0201.2d

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 300 ppm as measured.

Objective(s):
Ensure clean burn of gas ovens



Unsafe

If air-free CO reading exceeds 800ppm, order a clean and tune

Best Practice

Test gas oven for carbon monoxide using a combustion gas analyzer

Tools:

1. Combustion analyzer with probe

Kansas will utilize BPI's action level of 300 ppm as measured. If units exceed 300 ppm as measured at steady state a clean and tune will be conducted. Clients will be notified if units do not improve after cleaning and tuning. Client Education will be provided on how to minimize CO exposure such as running exhaust fans. A CO alarm will be installed.

2.0201.2e

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

Specification(s):
Gas range burners will be tested for CO. A clean a tune will be conducted if measured CO above the burners exceeds 300 ppm as measured.

Objective(s):
Ensure clean burn and operation of gas range burners

Before

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

After

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

Kansas will utilize BPI's action level of 300 ppm. If units exceed 300 ppm as measured at steady state a clean and tune will be conducted. Clients will be notified if units do not improve after cleaning and tuning. Client Education will be provided on how to minimize CO exposure such as running exhaust fans. A CO alarm will be installed.

Measure 12 inches above burner.

2.0201.2e - Gas range burners

Yellow, uncontrolled flames indicate the need for a clean and tune

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

Blue, even flames indicate burners are working properly

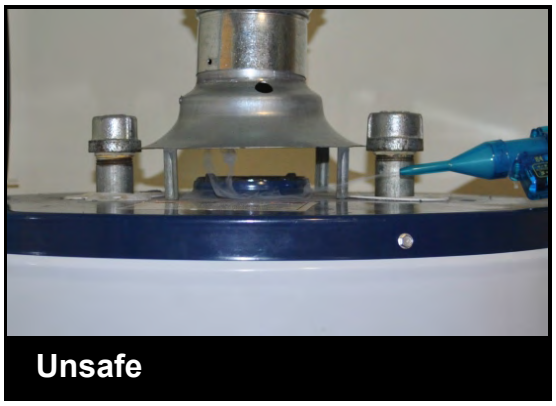
2.0203.2a

Desired Outcome:
Flue gasses successfully removed from the house

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

Objective(s):
Ensure appliance is not spilling longer than two minutes

Orphaned water heaters have oversized flues after a furnace is removed



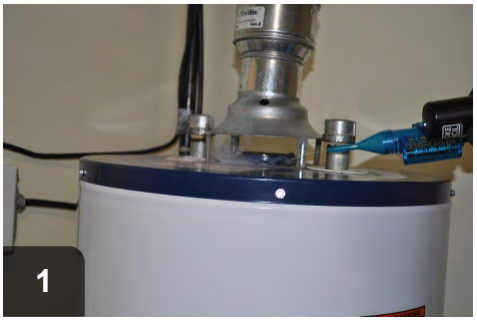
Spillage should not exceed 2 minutes, if present

Tools:

1. Smoke pencil

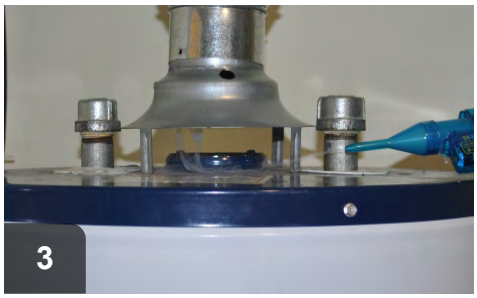
A flue liner may be necessary to achieve proper draft.

2.0203.2a - Spillage testing



If spillage exceeds 2min, steps should be taken to correct draft issue

Resizing the flue to eliminate oversized sections should remediate spillage



Retest spillage after repairs have been completed to verify problem has been corrected

2.0203.2b

Desired Outcome:
Flue gasses successfully removed from the house

Specification(s):
A chimney liner will be installed in accordance with the 2012 IRC or applicable NFPA standard

Objective(s):
Allow water heater to vent properly

Prevent damage to the chimney

2.0299.1a

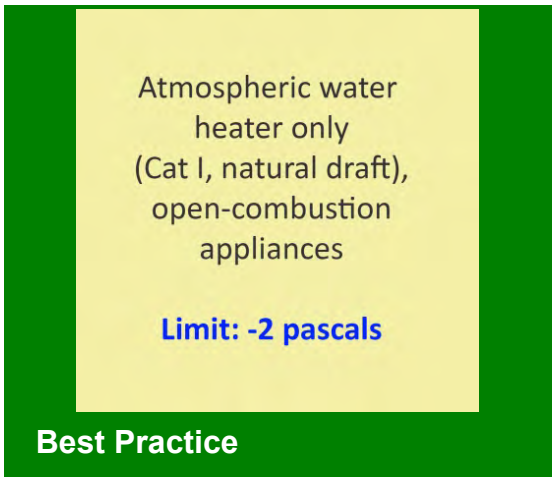
Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -2 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

A natural draft water heater with indicative flue highlighted



Tools:

1. Manometer

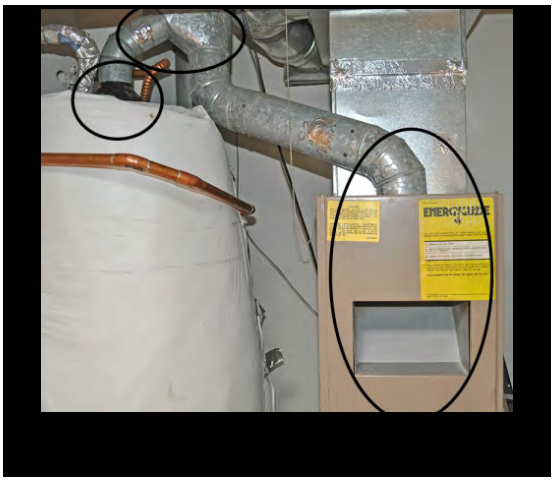
2.0299.1b

Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

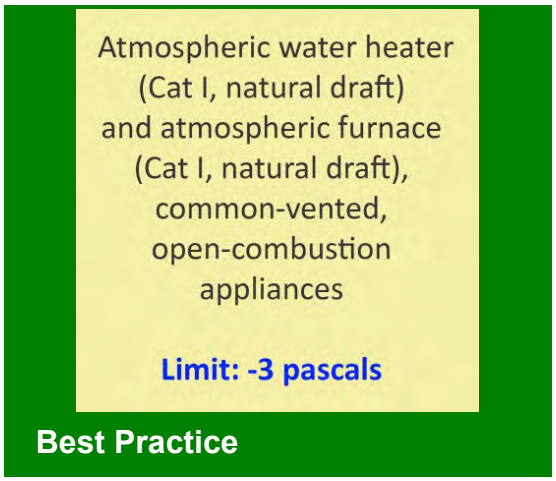
Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -3 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating



Natural draft water heater and natural draft furnace with common vent



Tools:

1. Manometer

Smallest BTU appliance to be tested first.

2.0299.1b - Atmospheric water heater (Category I, natural draft) and atmospheric furnace (Category I, natural draft), common-vented, open-combustion appliances

Common vent of natural draft appliances highlighted

2.0299.1c

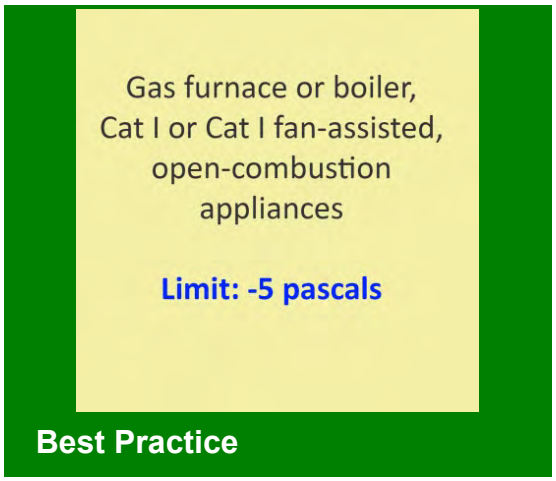
Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -5 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Category I 70% efficiency gas furnace with intake vent highlighted



Tools:

1. Manometer

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

Cat I 80% efficiency furnace

Oil boiler

2.0299.1d

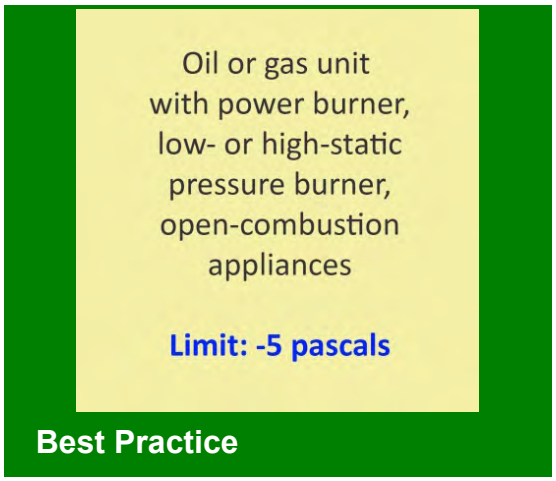
Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -5 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Oil burner



Tools:

1. Manometer

2.0299.1e

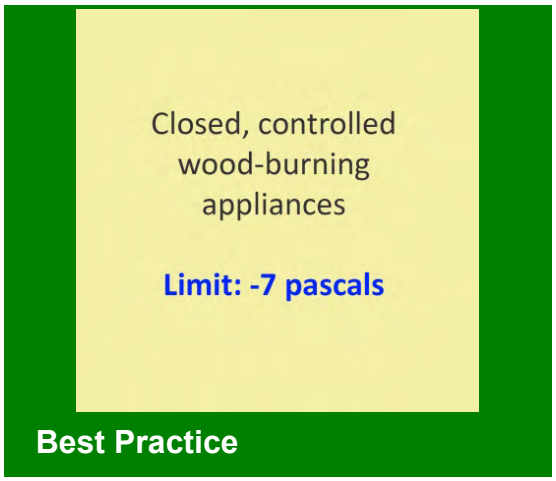
Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -7 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Wood-burning stove



Tools:

1. Manometer

Testing of wood-burning appliances will be limited and clearly documented in client files.

2.0299.1f

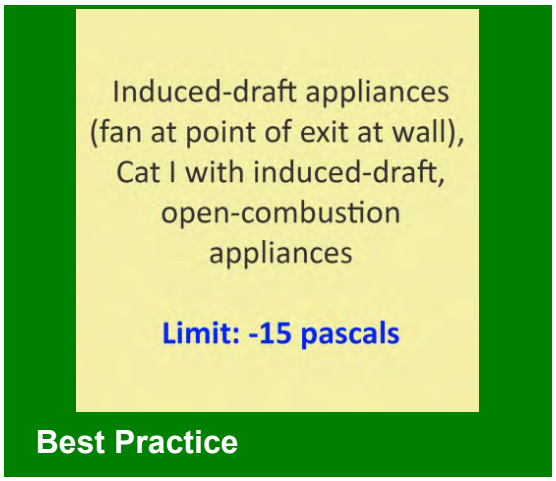
Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -15 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Induced draft furnace



Tools:

1. Manometer

2.0299.1g

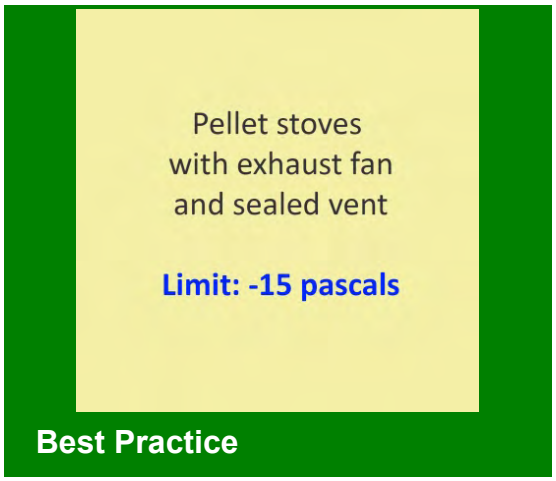
Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -15 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Pellet stove



Tools:

1. Manometer

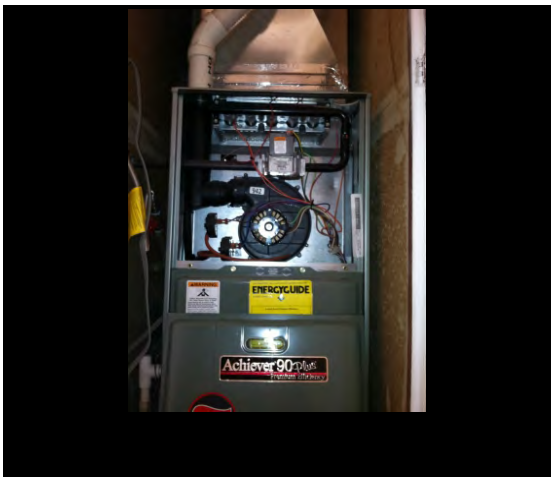
2.0299.1h

Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

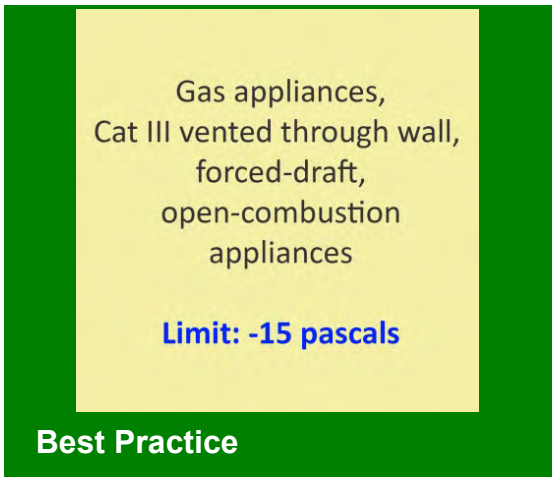
Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -15 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating



Single-pipe 90% efficiency furnace with forced draft



Tools:

1. Manometer

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

Power-vented water heater

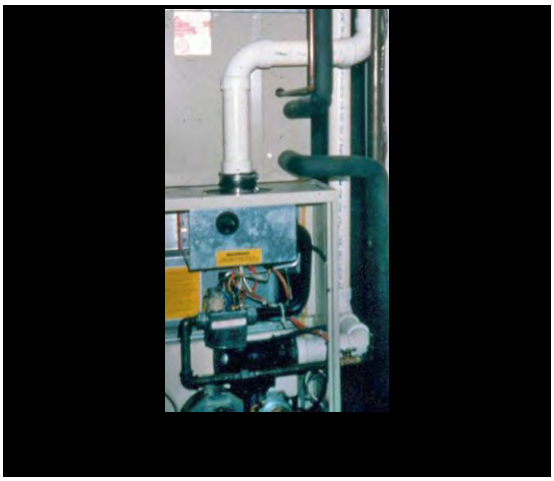
2.0299.1i

Desired Outcome:
Ensure appliances meet manufacturer's certified negative pressure tolerance rating

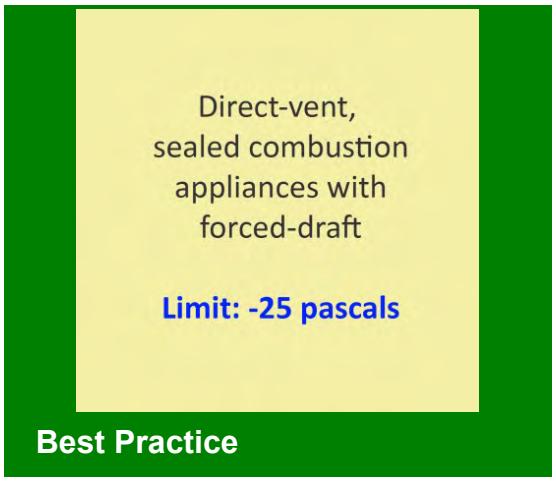
Specification(s):
Manufacturer's certified negative pressure tolerance rating:

- Limit -25 pascals

Objective(s):
Ensure appliances meet manufacturer's certified negative pressure tolerance rating



Forced draft appliance with sealed combustion



Tools:

1. Manometer

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

Two-pipe 90% efficiency furnace


Direct-vent Rinnai


Exterior vent for Rinnai

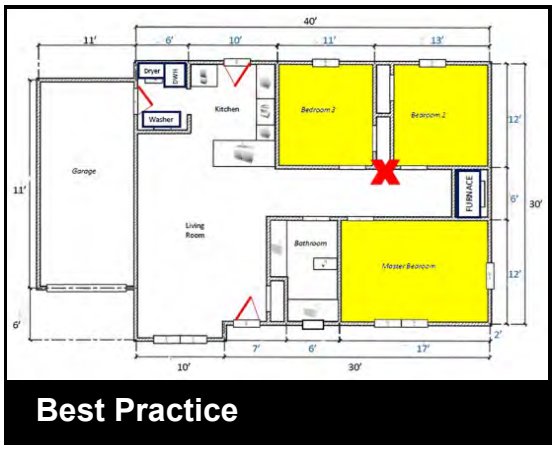
2.0301.1b

Desired Outcome:
Properly installed smoke alarms

Specification(s):
Battery operated UL-217 alarms will be installed outside sleeping areas and on each habitable floor. Alarms shall have non-removable, non-replaceable 10 year lithium batteries.

Objective(s):
Ensure proper installation

All homes should have UL-217 rated smoke alarms



Alarms should be mounted outside sleeping areas such as the one marked in red

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.

2.0301.1b - Smoke alarm (battery operated)

Ceiling mounted smoke alarms can be battery-operated

Wall mounted smoke alarms must be mounted within 12 inches of the ceiling

2.0301.2b

Desired Outcome:
Properly installed CO alarms or monitors

Specification(s):
Battery operated CO detection or warning equipment will be installed in accordance with ASHRAE 62.2 and manufacturer specifications as required by the authority having jurisdiction

Objective(s):
Ensure proper installation

Unsafe

ALL houses should have carbon monoxide monitors installed near sleeping areas

Best Practice

Battery operated CO alarms should be UL-2075 or UL-2034 compliant

Every weatherized home shall have 1 CO alarm. A sealed lithium battery unit is required. Install the alarm outside the primary sleeping area along the wall.

2.0401.2a

Desired Outcome:
Pollutants effectively vented

Specification(s):
Venting will be performed in accordance with the 2012 IRC or the authority having jurisdiction

Objective(s):
Provide ventilation for pollutant sources (e.g., moisture, radon, soil gases)


Before


After

Foundation vents will not be modified where local codes prevent modification. Ground moisture barriers and foundation insulation will not be installed where foundation vents remain operable. Floor airsealing and insulation should be used in these applications if applicable. Where crawlspaces are to be included in the conditioned space, 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.

2.0403.2b

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 100% of 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 (al least 6 mil)
2. Furring strips
3. Fasteners

Ground moisture barrier shall extend a minimum of 6 inch 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, but it can not come in 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.

2.0403.2c

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

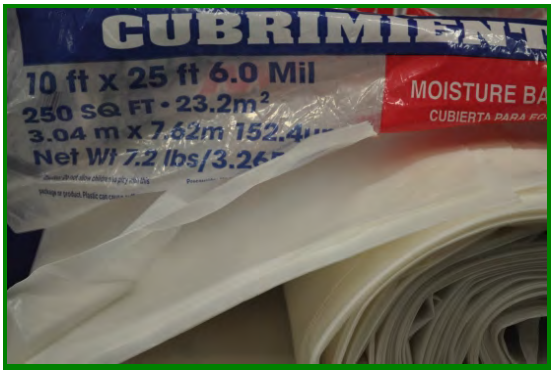
Specification(s):
A ground moisture barrier with a rating of no more than 0.1 perm will be used

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 (5 years), 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 punctures and long lasting

Materials:

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

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

2.0403.2f

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

Crawl spaces lacking moisture barrier risk moisture penetration of floor

Ground moisture barriers in unvented spaces should be sealed

Tools:

1. Utility knife

Materials:

1. Moisture-resistant adhesive tape, mastic, or adhesive

Seams should be overlapped 12 inches utilitizing a reverse or upslope technique and be permanetly sealed.

2.0403.2f - Sealing seams

Tape wall seams and press to ensure airtight bonding of adhesive

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

2.0601.1a

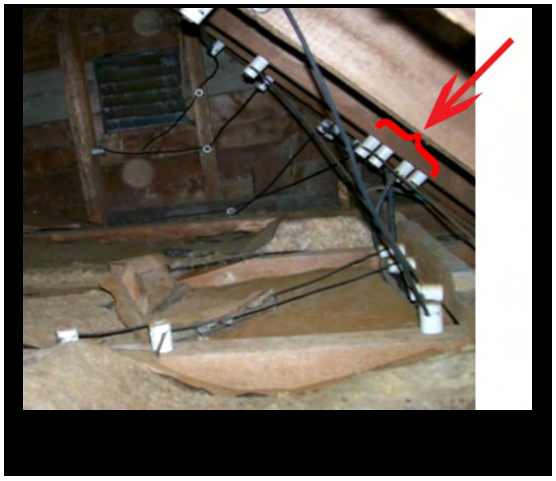
Desired Outcome:
Live unsafe wiring identified and brought to local codes

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

2.0601.1b

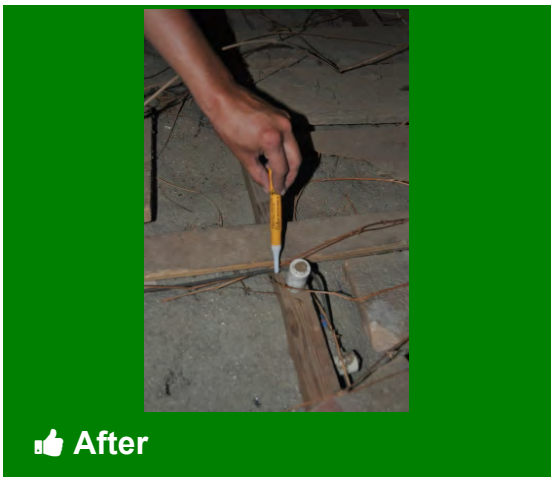
Desired Outcome:
Live unsafe wiring identified and brought to local codes

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

2.0601.1c

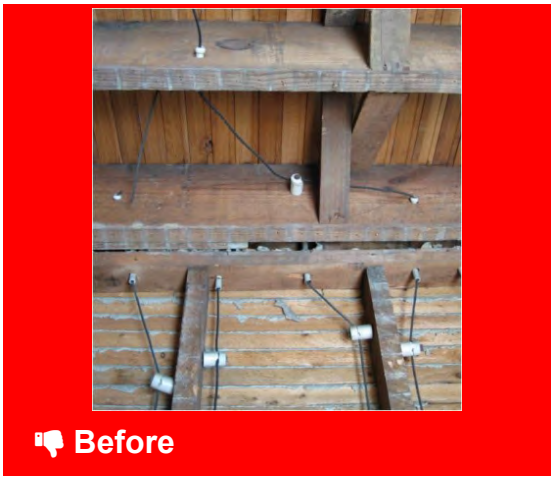
Desired Outcome:
Live unsafe wiring identified and brought to local codes

Specification(s):
Live knob and tube will not be covered or surrounded; required by the National Electrical Code (NEC) or authority having jurisdiction

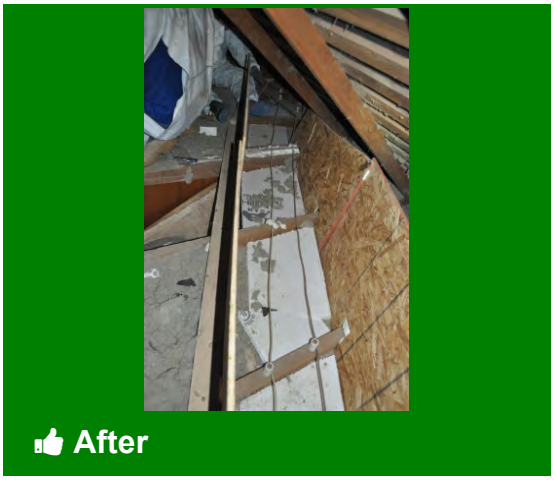
A licensed electric contractor will inspect and certify wiring to be safe if there is sufficient concern about the safety of its condition or if required by local code. if there is sufficient concern about the safety of its condition or if required by local code.
A dam that does not cover the top will be created to separate insulation from the wire path

Objective(s):
Ensure occupant safety

Preserve the integrity and safety of the house



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



Dams should be installed to hold back loose fill insulation

Tools:

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

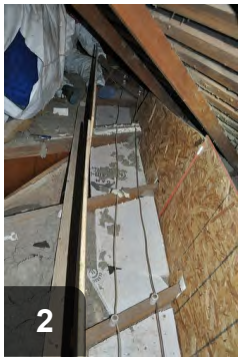
Materials:

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.

2.0601.1c - Isolation and protection

Test K&T to determine if wiring is live



Damming should extend above installed height of insulation

With dams in place, insulation can begin

2.0601.1d

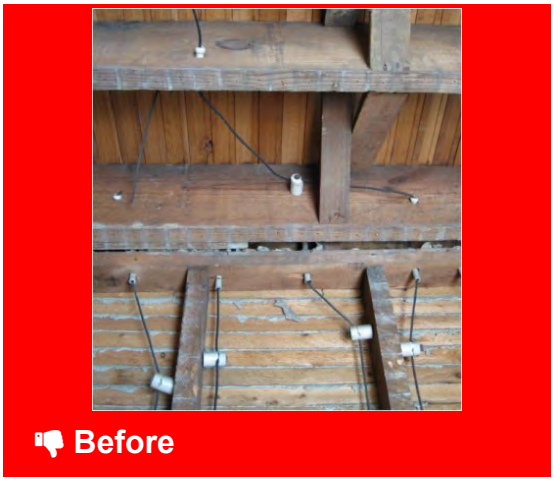
Desired Outcome:
Live unsafe wiring identified and brought to local codes

Specification(s):
Exposed wiring will be replaced with new appropriate wiring in accordance with the NEC and local codes

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

Objective(s):
Ensure occupant safety

Preserve the integrity and safety of the house



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

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

Tools:

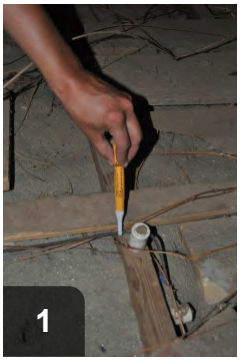
1. Non-contact wire tester

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.

2.0601.1d - Replacement



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

3.1001.1b

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

3.1001.1d

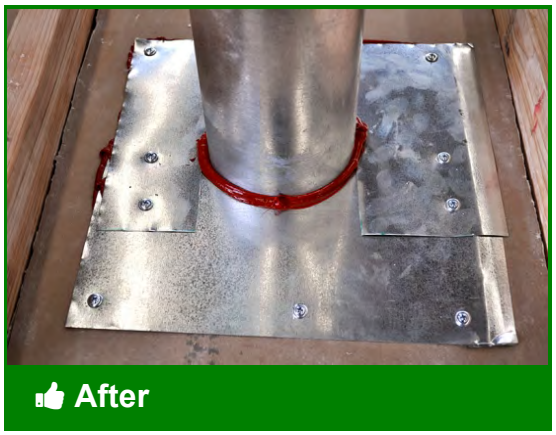
Desired Outcome:
Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

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

Gaps around combustion exhaust flues need to be sealed



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. Metal sheeting

Inspect for proper flue clearance to combustibles. Refer to local codes. B-vent is typically 1 inch, single wall is typically 6 inches. Unlined chimneys should be sealed with a high temp or fire rated material.

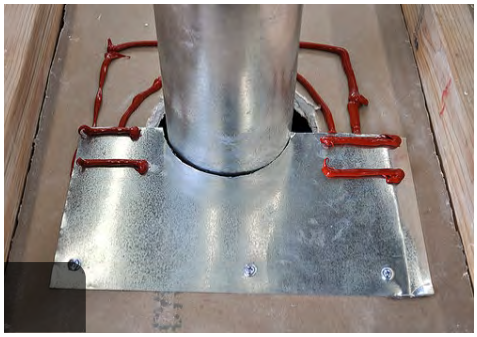
3.1001.1d - High temperature application

Prepare work area by removing any insulation and debris

Use high-temperature caulking (600F min)

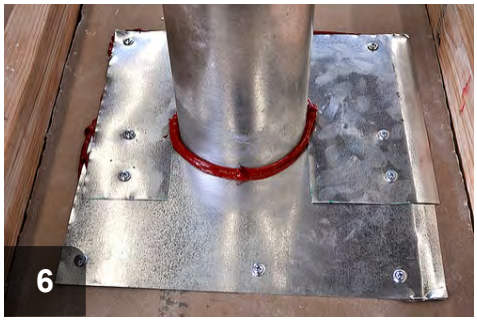
Apply first ring of caulking to match shape of opening

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



Fasten rigid material (metal sheeting)

and apply additional caulking



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

3.1001.2b

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 be maintained by capping chases with rigid material

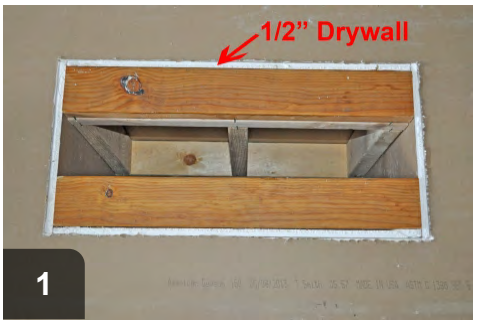
Tools:

1. Drill/screwdriver
2. Caulk gun

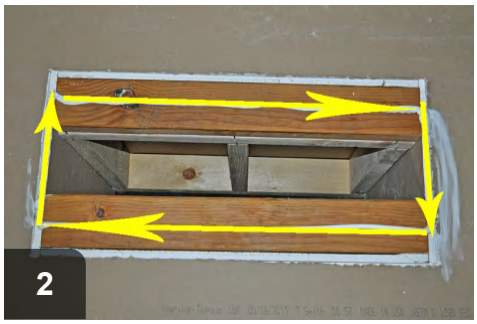
Materials:

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

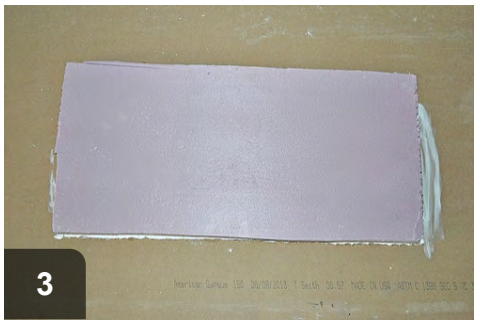
3.1001.2b - Standard chase (interior walls covered with drywall or plaster)



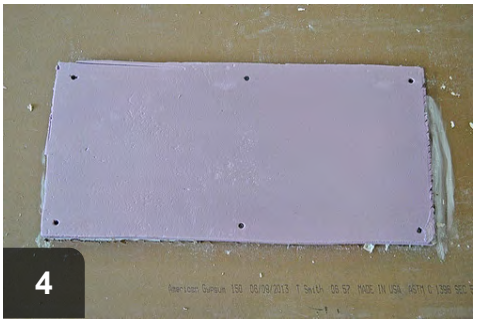
Clear area of debris and insulation in preparation for work



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

3.1001.2c

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 2012 IRC R302.9

Objective(s):
Prevent a fire hazard

Before

Paneled drop soffits typically are more combustible than plain drywall

After

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

Tools:

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

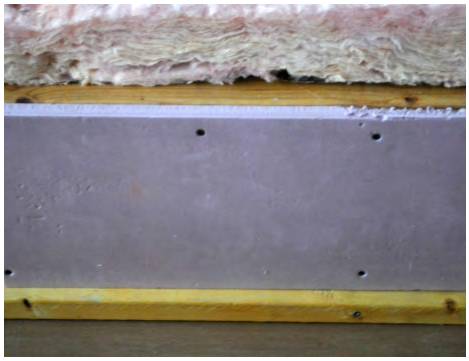
Materials:

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

EPS or bead-board are not acceptable materials.

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

Sealing with drywall reduces overall combustibility of paneled chases



Sealing with XPS also reduces overall combustibility of paneled chases

3.1001.2d

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

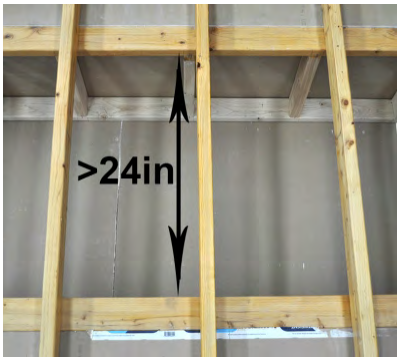
Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

3.1001.2d - Support



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

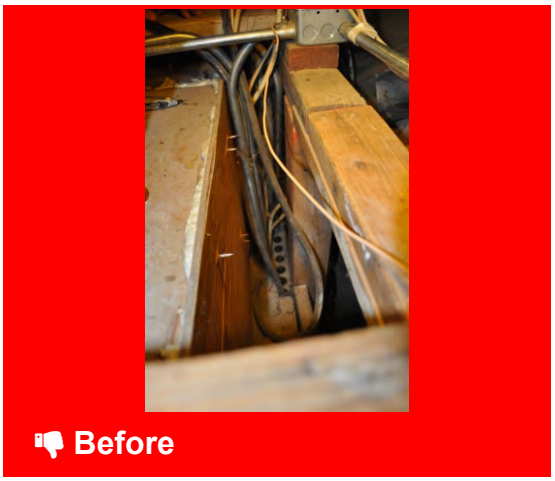
Once chase is capped, it is now ready to be sealed along framing

3.1001.2e

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

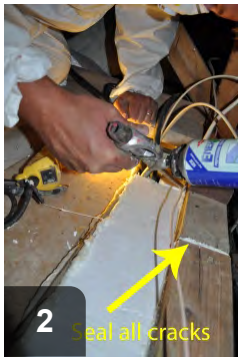
Materials:

1. Spray foam
2. Caulk

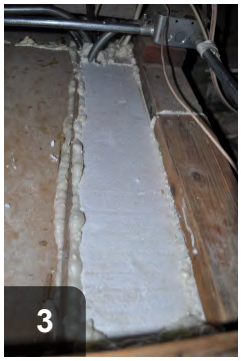
Always wear protective gloves when working with sealants.

3.1001.2e - Joint seal

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

3.1001.3b

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

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with spray polyurethane foam (SPF)

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

Objective(s):
Prevent air leakage from wall cavity to attic

Before

Wall cavities are open to attic

After

Whatever option chosen, test for visible air movement with smoke pencil

Tools:

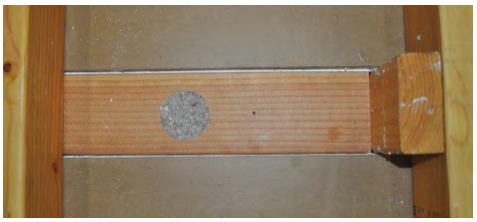
1. Utility knife
2. Saw
3. Insulation machine
4. Caulk gun
5. Spray foam gun

Materials:

1. Drywall
2. XPS
3. Spray foam
4. Caulk
5. Fasteners
6. Dense packable insulation
7. Lumber

These application options can be used for all types of open wall cavities.

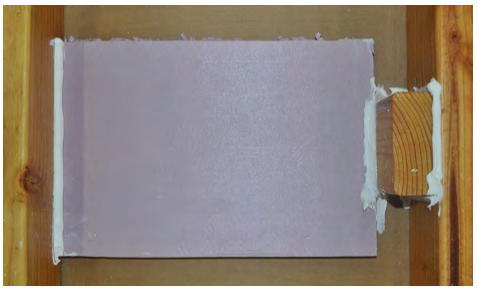
3.1001.3b - Sealing methods



Option 1: Dense pack cavities through wood cap fastened in place

Option 2: Bridge cavities with spray foam

Option 3, Step 1: Apply sealant around opening and on surrounding framing



Option 3, Step 2, Option A: Cap with XPS and seal exposed joints

Option 3, Step 2, Option B: Cap with drywall and seal exposed joints

3.1003.1b

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

Damage to an older ceiling reveals the new ceiling below

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:

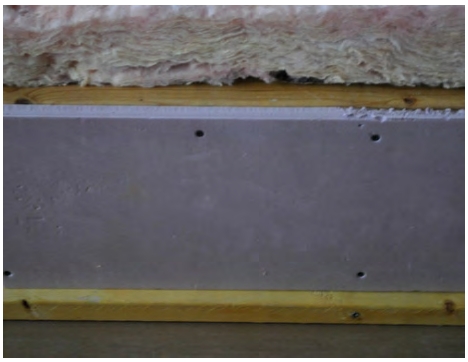
1. Caulk sealant
2. Rigid material -- XPS or Drywall
3. Spray foam
4. Fasteners
5. Dense packable insulation
6. Wrapped fiberglass batts

3.1003.1b - Sealing methods

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

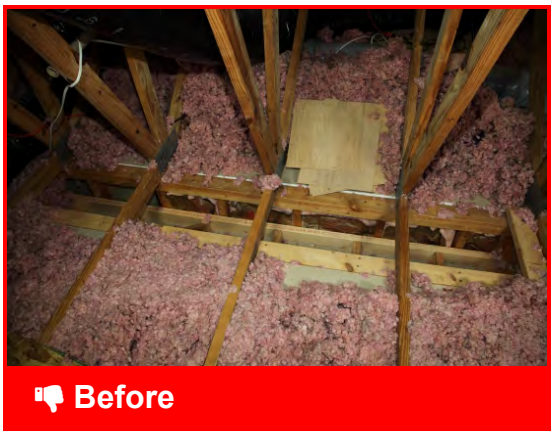
Whatever option chosen, test with chemical smoke to verify no leakage

3.1003.6b

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



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

Completely sealed drop soffits and chases minimize heat transfer

Tools:

1. Measuring tape
2. Utility knife
3. Caulk gun
4. Spray foam gun
5. Saw
6. Drill

Materials:

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

There are a variety of ways to seal soffits. Please examine 3.1003.6c and 3.1003.6d for more information. In inaccessible areas, dense packing soffit to insulate and reduce air flow is an acceptable method.

3.1003.6c

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:

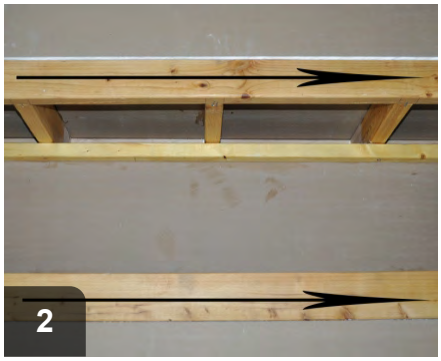
1. Drill/screwdriver
2. Caulk gun

Materials:

1. Drywall
2. Sealant

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

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



Apply sealant along top plates

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

Fasten cap with screws to set sealant and create air barrier

Insulate over now-capped soffit

3.1003.6d

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

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

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 will faced with rigid material, fastened and sealed

3.1201.1a

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 regulations.

3.1201.1c

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

3.1201.1d

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

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

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

3.1201.1d - Replacement sills

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

3.1201.3b

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

Before

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

After

With proper adjustment, doors should hang true and minimize leakage

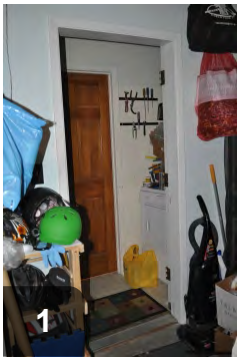
Tools:

1. Screwdriver
2. Planer

Materials:

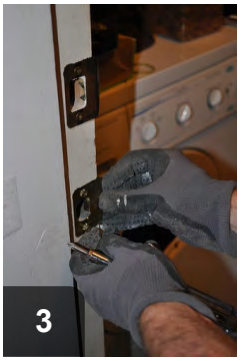
1. Shims

3.1201.3b - Door operation and fit

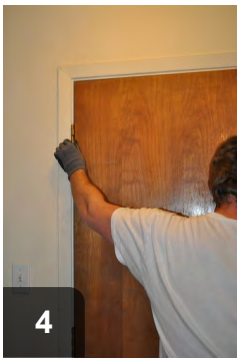


After examining how door hangs, remove door from hinges

Adjust hinge plates to bring door back into true



Adjust strike plate to allow for secure and smooth operation



Rehang door to verify adjustments worked and door operates smoothly

3.1201.3c

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

Daylight visible around an exterior door indicates air infiltration

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

3.1201.3c - Air infiltration

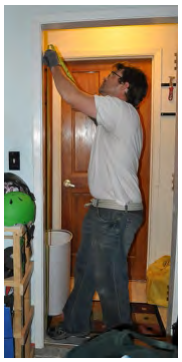
Remove leaky door in order to affix door bottom

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

Trimming to allow for door bottom

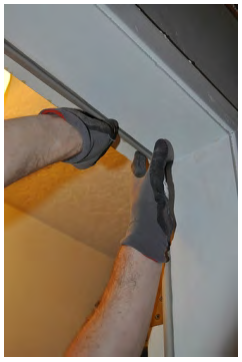
Cut door bottom to width of door

Ensure door bottom fits snugly around door and fasten into place

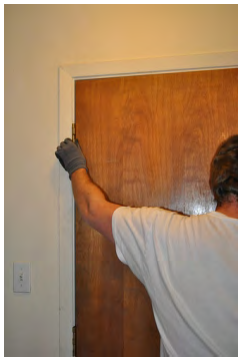


Measure doorway for weatherstripping

Notch upper ends of side weatherstripping to allow for top piece



Weatherstripping should fit snugly into rabbit and against other pieces



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

3.1201.3d

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

3.1201.3d - Water infiltration

Adjust threshold to minimize gap and keep water out

Caulk along threshold from inside and outside to prevent water infiltration

3.1202.1d

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

Follow all applicable KDHE Lead regulations. Final glazing should be smooth, uniform, and free of gaps.

Always wear heavy work gloves when working with glass.

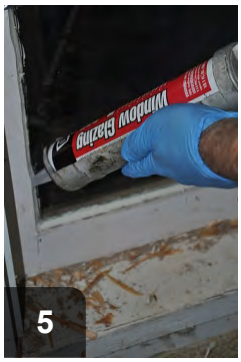
3.1202.1d - New glass installation

Always wear heavy work gloves when working with glass

With broken glass removed, measure opening for replacement glass

Cut replacement glass 1/8" smaller than measured opening

Use shims to center glass while installing push points



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

Secure pane in place with tape to hold until glazing sets

3.1203.1c

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

3.1203.2d

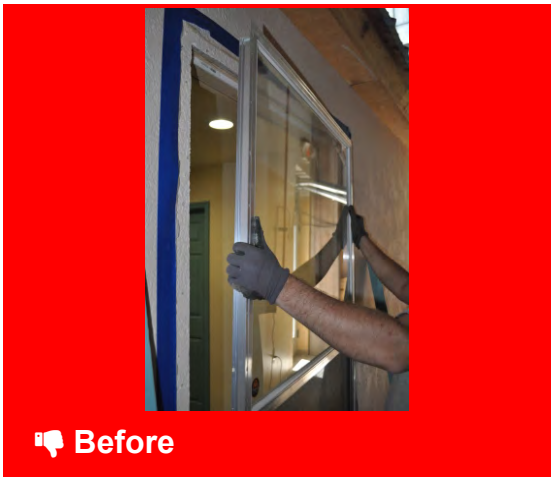
Desired Outcome:
Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

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



Single pane window is being removed to install double pane unit

Double pane unit installed with trim in place

Tools:

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

Materials:

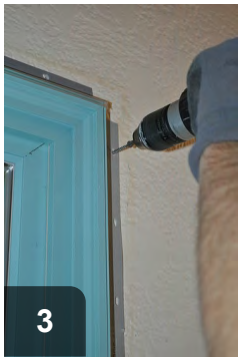
1. Fasteners
2. Flashing
3. Low-expansion spray foam
4. Backer rod
5. Primed trim

Replacement low-E and argon filled windows will be used. Windows should be single hung were applicable to ensure positive closure. Window must be trimmed inside and out with a all six sides of trim primed or finished and all seams caulked.

3.1203.2d - Replacement window installation

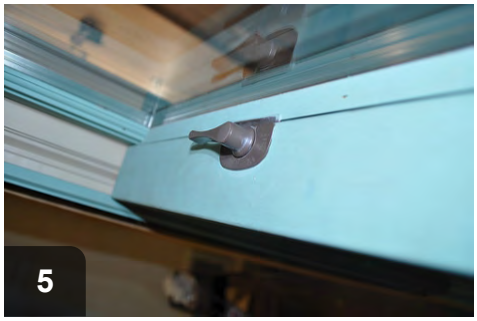
Install flashing to manufacturer specs and industry standards

Flanges have been folded out to allow for easy installation



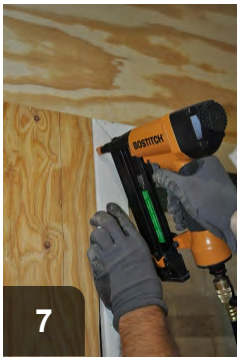
Fasten window flange securely around exterior of entire window

With window secured in place, check for proper function

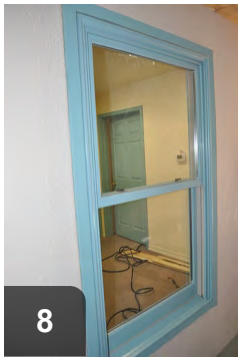


Check that sash locks align properly, indicating window is plumb

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

3.1402.1a

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

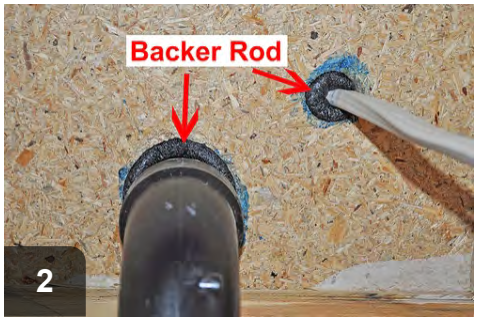
Materials:

1. Backer rod
2. Sealant

Paintable sealants should be used where appropriate.

3.1402.1a - Backing and infill

Prepare work space by removing any insulation



Infill with backer rod

Apply appropriate caulking to ensure backing/infill does not move

Visually inspect to verify no gaps remain

3.1402.1b

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:

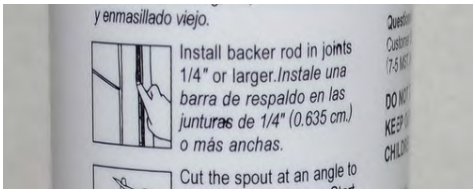
1. Caulk
2. Spray foam

Paintable sealants should be used where appropriate.

3.1402.1b - Sealant selection

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

3.1402.3a

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

Light showing through penetration in exterior block wall

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

Tools:

1. Caulk gun
2. Mason's trowel
3. Metal snips
4. Drill

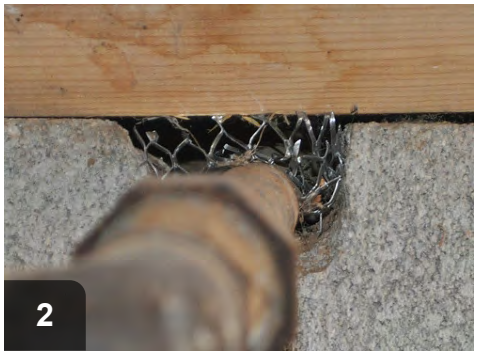
Materials:

1. Caulk
2. Mortar repair material/QuickCrete/ Concrete repair material
3. Metal mesh
4. Fasteners

Expanding foam is not to be used for exterior sealing where visible or exposed to UV light.

3.1402.3a - Seal penetrations

Measure holes to determine the best backing and fill strategy



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

Cement or caulk exterior holes. Foam or caulk interior holes

3.1501.1a

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

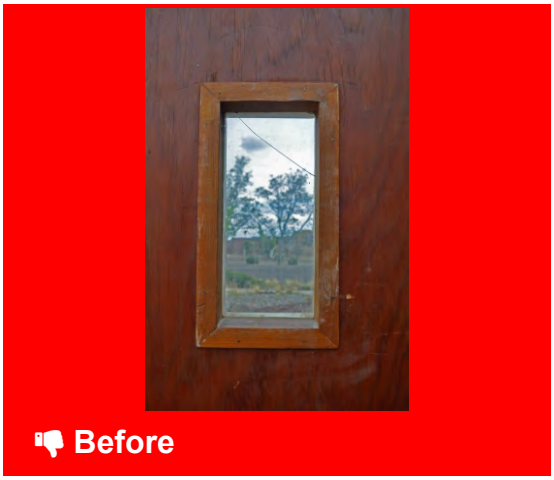
To fully comply with ASHRAE 62.2 all penetrations between the garage and conditioned space must be sealed.

3.1501.1e

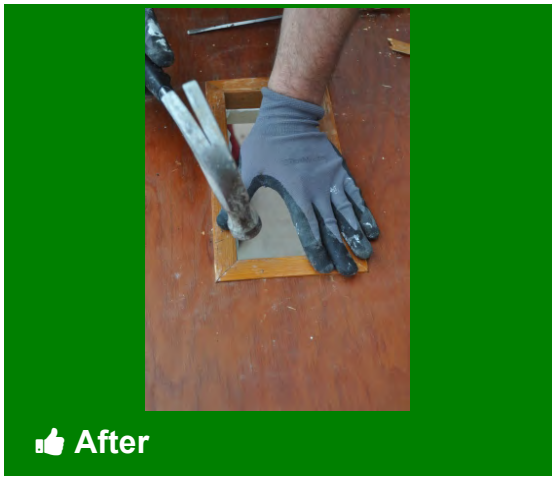
Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
Broken glass panes in doors will be replaced, pointed, and glazed where needed

Objective(s):
Prevent air leakage and pollutant entry



Broken glass in exterior and garage doors allows for leakage. Replace it



With new glass in place, take care to tightly seal and replace stops

Tools:

1. Hammer
2. Pry bar
3. Caulk gun
4. Tape measure

Materials:

1. Brads
2. Caulk
3. Glazing
4. New glass cut to size of rough opening

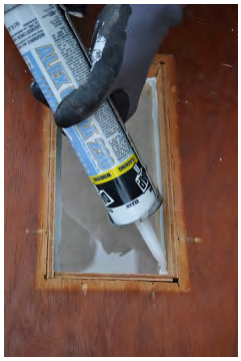
3.1501.1e - Glass

Remove stops, taking care not to damage them

Remove broken glass and clean old sealant and glazing from rough opening

Measure rough opening and cut new glass to size

Apply sealant to rough opening and place new glass



Seal glass into place from inside as well to ensure no air infiltration

Replace stops and rehang door

3.1601.3a

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

Before

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

After

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 galvinized wire
3. Fabric support straps (at least 1 1/2" wide)
4. Staples
5. Fasteners

Ductwork should be a 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.

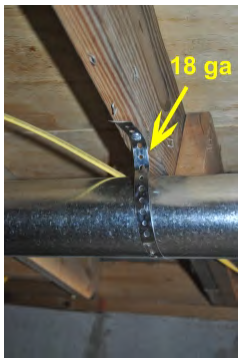
3.1601.3a - Support (applies to all duct types)

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

3.1602.4a

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 2012 IRC R302.9

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.

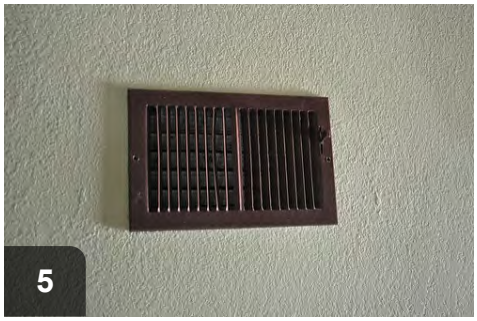
3.1602.4a - Duct boot to interior surface

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

3.1602.4b

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Accessible connections and joints will be made airtight using approved material

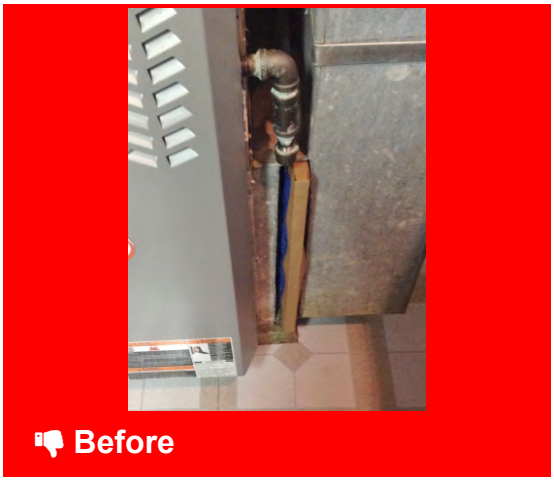
Objective(s):
Ensure ducts and plenums will not leak

3.1602.4d

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 replaced, as applicable. Filter rack covers must be included on new installs. Best Practice is to include this on existing furnaces.

3.1602.5a

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

Before

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

In Progress

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

Tools:

1. Shop vacuum

3.1602.5b

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

👎 Before

Leakage from air return into wall cavities should be eliminated

In Progress

Only materials rated for use in higher temperature areas should be used

Tools:

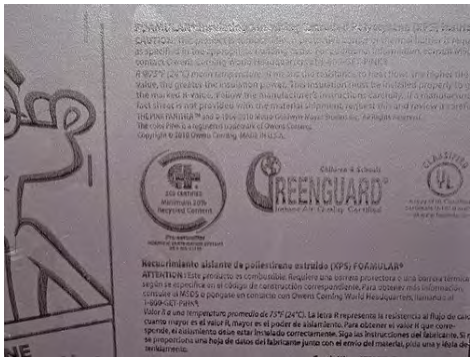
1. Tape measure
2. Utility knife
3. Drill
4. Caulk gun

Materials:

1. XPS
2. Drywall
3. Fire-resistant caulk
4. Fasteners

3.1602.5b - Infill and backing

Do NOT use EPS in air returns due to proximity to combustion appliances



XPS (extruded polystyrene) and drywall are safe for use in air returns

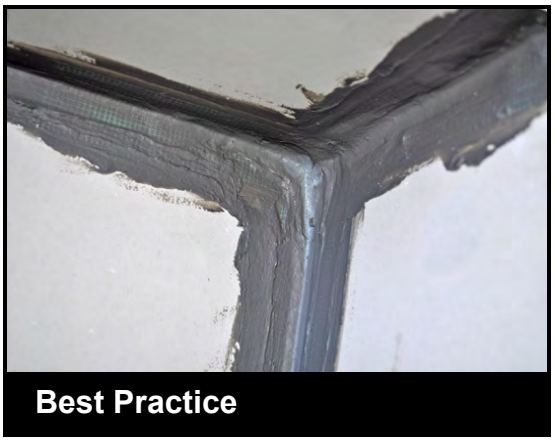
3.1602.5c

Desired Outcome:
The return duct installed to prevent air leakage

Specification(s):
Sealants will be continuous and be in accordance with 2012 IRC R302.9

Objective(s):
Select permanent sealant

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



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

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

4.1001.1a

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 and IC- rated fixture

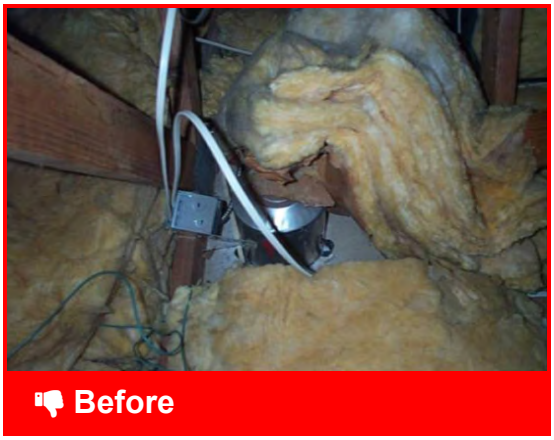
OR

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



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

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

Tools:

1. Utility knife
2. Tape measure

Materials:

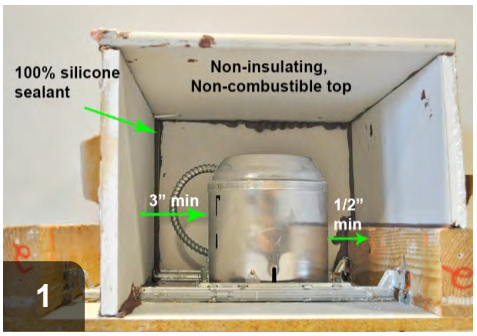
1. 5/8" fire-rated drywall
2. Fire-rated caulk sealant

For recessed or can ligths see specifications 4.1001.1a, 4.1001.1b, 4.1001.1c, and 4.1001.1d.

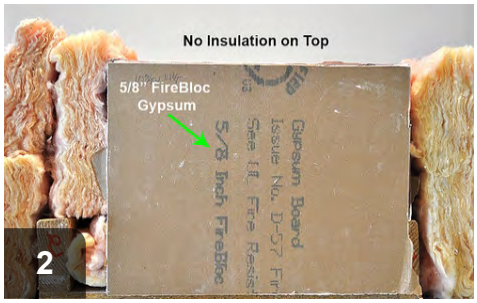
Commercially available fire-rated air barrier systems may also be used.

A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top meets the specifications.

4.1001.1a - Air barrier system



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

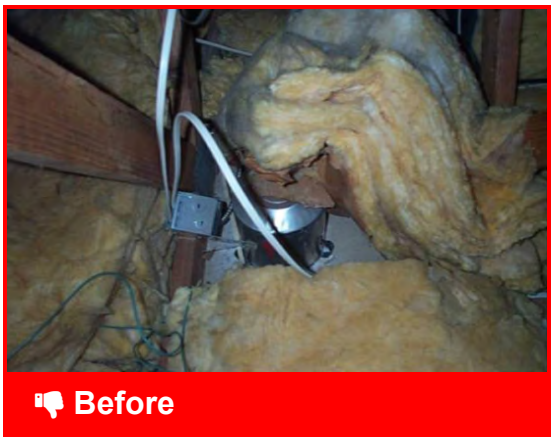
4.1001.1b

Desired Outcome:
Ensure safety from fire and prevent air leakage

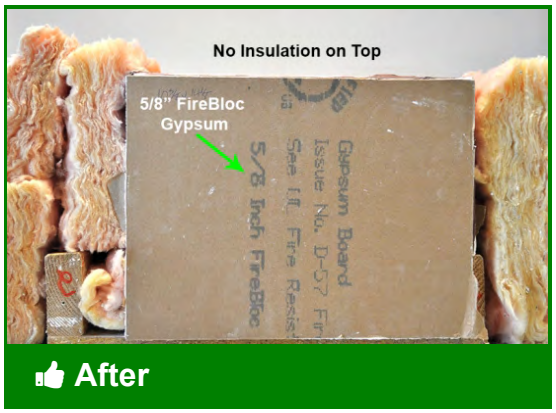
Specification(s):
The top-fire rated enclosure material will have an R-value of 0.5 or less

The top of the enclosure will be left free of insulation

Objective(s):
Prevent heat build up



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 ligths 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.

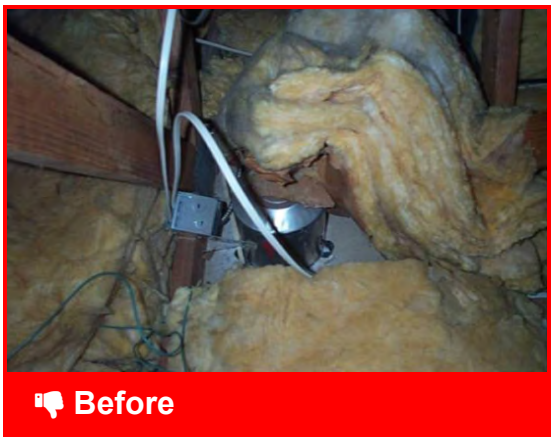
A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top meets the specifications.

4.1001.1c

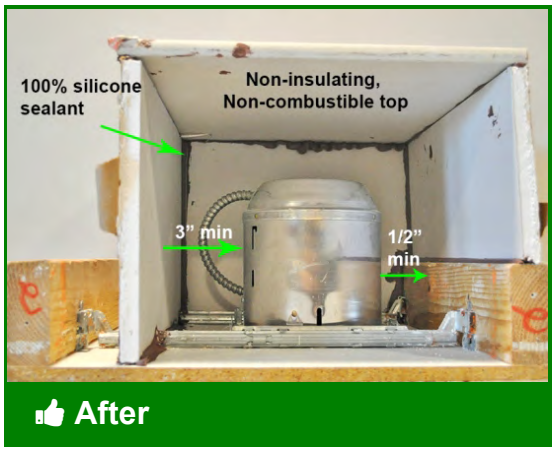
Desired Outcome:
Ensure safety from fire and prevent air leakage

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



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



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 ligths 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.

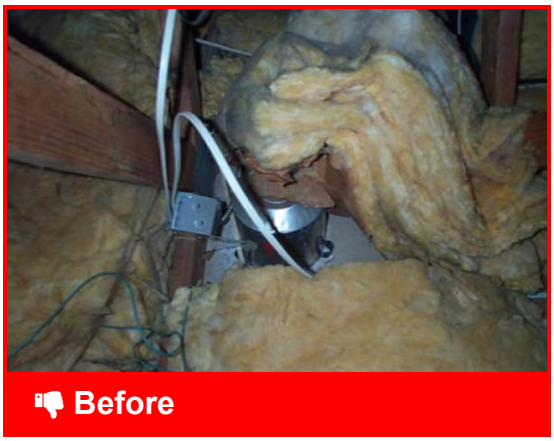
A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top meets the specifications.

4.1001.1d

Desired Outcome:
Ensure safety from fire and prevent air leakage

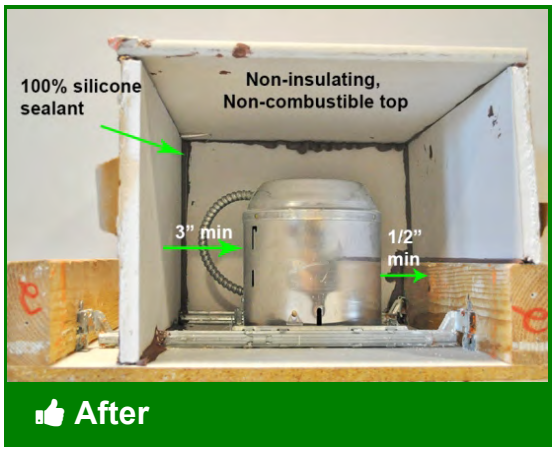
Specification(s):
Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only

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 ligths 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.

4.1001.3a

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

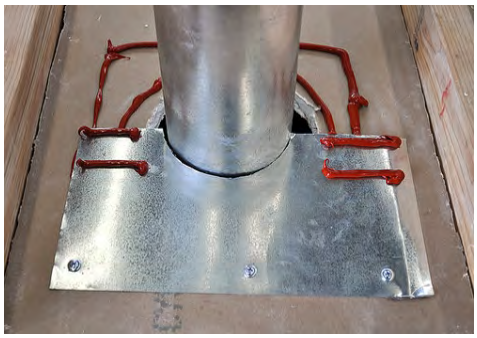
Materials:

1. Metal sheeting
2. High temperature caulk
3. Caulk
4. Backer rod
5. Spray foam

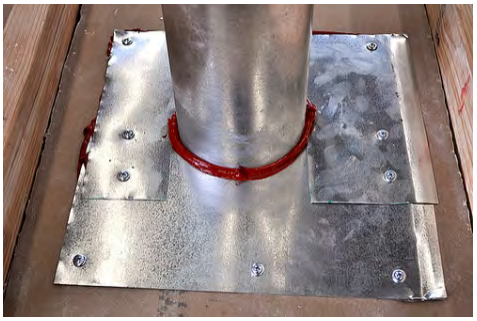
4.1001.3a - Verify attic prep

Gaps around flues and penetrations need to be sealed before insulating

High temperature caulk should be used for flues and chimneys



Metal sheeting 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

4.1001.3b

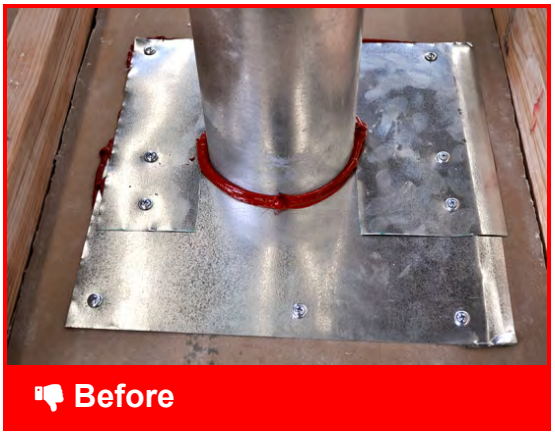
Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
A rigid dam having a height greater than the insulation to be installed will be constructed to ensure a 3" clearance between combustion flue vent and dam

Chimney vents will have an airspace clearance to combustibles in accordance with 2012 IRC M1801.3.4

Objective(s):
Ensure dam material does not bend, move, or sag

Prevent a fire hazard



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

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

Tools:

1. Metal snips

Materials:

1. Metal sheeting
2. Fasteners

4.1001.4a

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

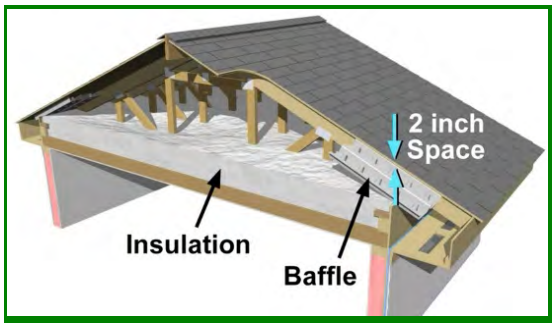
Installation will allow for the highest possible R-value above the top plate of the exterior wall

Objective(s):
Ensure insulation R-value is not reduced

Maintain attic ventilation

Before

Insulation should not block vented eaves



After

Baffles installed in vented attics to allow air flow past insulation

Tools:

1. Stapler

Materials:

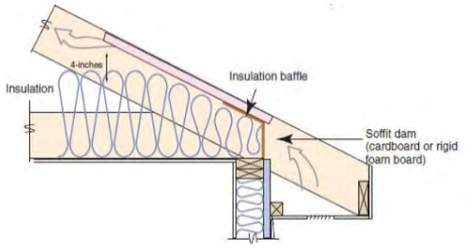
1. Baffles
2. Staples

4.1001.4a - Installation

Allow a standard two inch gap for air flow through eave

Baffles should be securely fastened to prevent movement over time

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



Baffles also hold insulation from falling into eave

4.1003.2a

Desired Outcome:
Insulation reduces heat transfer through ceiling and closed attic sections as well as framing cavities inaccessible to other treatments

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 fiberglass material will be installed and will be specifically approved for air flow resistance per 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 using chemical smoke at 50 pascals of pressure difference

Objective(s):
Ensure complete and consistent coverage throughout ceiling plane

Eliminate voids and settling

Minimize framing cavity air flows

4.1004.1a

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
2. Utility knife
3. Caulk gun
4. Spray foam gun
5. Drill
6. Stapler

Materials:

1. Drywall
2. XPS
3. Caulk
4. Spray foam
5. Fasteners
6. Staples

4.1004.1a - Backing

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

4.1004.1b

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

Before

Existing batt insulation should be adjusted to fit properly

After

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

4.1004.1b - Installation

Attach furring strips to create pockets for dense-pack insulation

Insulation should meet manufacturer specifications for density.

4.1004.2b

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

Avoid compression to achieve full R-value.

4.1004.2b - Installation

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

4.1005.5b

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:

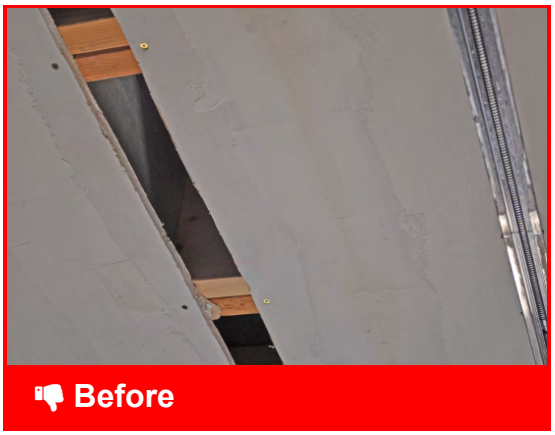
- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot
- Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density per the manufacturer's recommendations

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

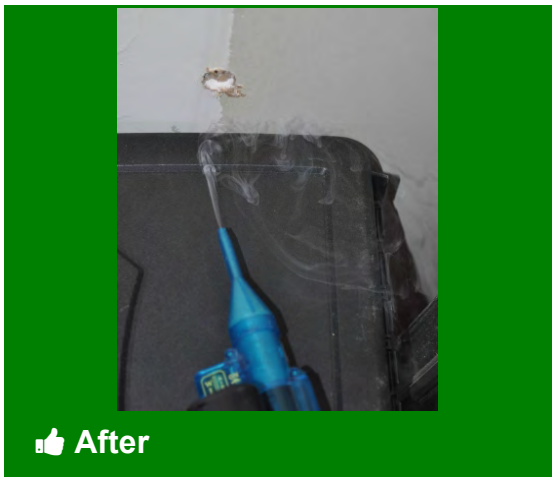
Insulation will be verified to prevent visible air movement using chemical smoke at 50 pascals of pressure difference

Objective(s):
Eliminate voids and settling

Minimize framing cavity air flows



With rigid block in place under bonus room stem wall, insulation can begin



Chemical smoke at 50pa indicates insulation is at appropriate density

Tools:

1. Insulation machine
2. Drill
3. Smoke pencil
4. Blower door
5. Small hole saw bit

Materials:

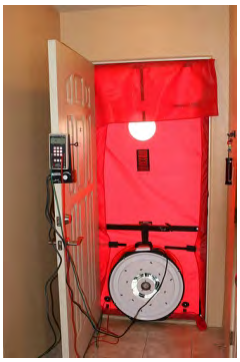
1. Cellulose insulation
2. Dense packable insulation
3. Spackle
4. Seam tape

4.1005.5b - Fill floors

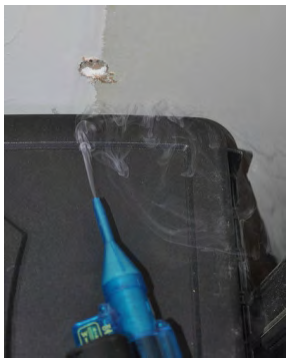
Blow insulation into cavities to density appropriate for chosen material

Close cavities with access panel cut out at the beginning

Cut small test holes in cavities to verify specified density has been met



Set up blower door and depressurize bonus room to -50pa wrt outside



With blower door running, chemical smoke should not draw into test holes

Tape and spackle access panel and test holes to repair garage ceiling

4.1005.6a

Desired Outcome:
Insulation reduces heat flow through floor and framing cavities inaccessible to other treatments

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
- 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 using chemical smoke at 50 pascals of pressure difference

Objective(s):
Eliminate voids and settling

Minimize framing cavity air flows

Remove flooring in attic spaces to access floor cavities and insulate

Flag electrical junctions to make future maintenance and repairs easier

Tools:

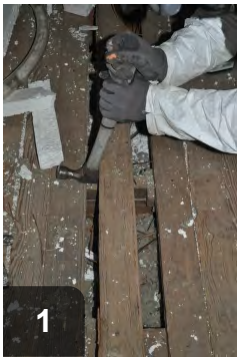
1. Hammer
2. Pry bar

Materials:

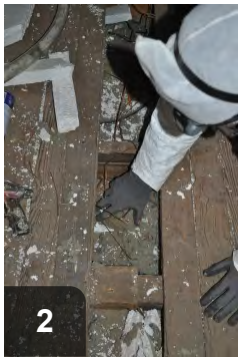
1. Flags

Floored attics should be insulated beneath whenever possible. A drill and dense pack method is best practice. Inspected cavity before insulating to ensure all hazards and air sealing areas are addressed.

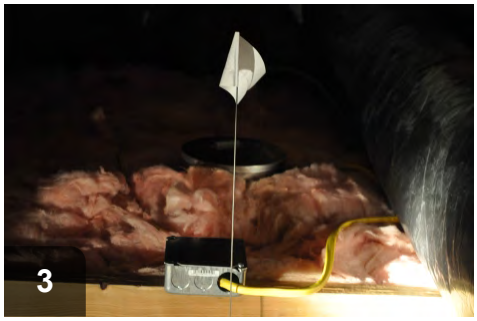
4.1005.6a - Fill floors



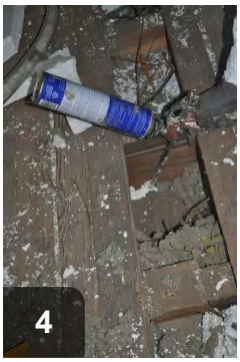
Pry up flooring to access floor cavities



Check cavity for electrical junctions and penetrations



If electrical junctions are found, they should be enclosed and flagged



Air seal any penetrations

4.1006.1a

Desired Outcome:
Pull-down attic stair 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

Pull-down stair rough opening will be surrounded with a durable 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

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

Insulated pull-down stairs cover installed to prevent air leakage

Tools:

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

Materials:

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

'Coffin' style boxes will be insulated to the maximum R-value structurally allowable and that allows full accessibility and functionality. Pre-fabricated covers can be used when accessibility concerns warrant.

4.1006.1a - Installation

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

4.1006.2a

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 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

Before

Uninsulated attic hatches and access panels weaken the thermal envelope

After

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 stipping 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.

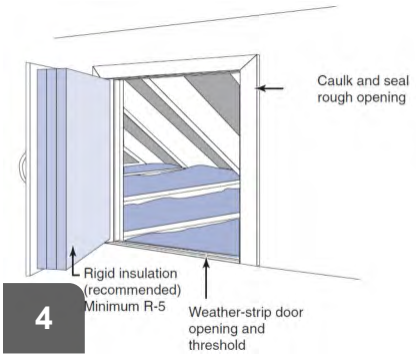
New hatches must be finished to match surrounding ceiling. i.e painted or stained.

4.1006.2a - Installation

Create hatch cover that matches r-value of surrounding insulation

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

Weatherstrip underside of hatch cover to create tight seal



Alternate installation for vertical access panel to attic

4.1006.2b

Desired Outcome:
Attic access door properly sealed and insulated

Specification(s):
Access hatch frames will be sealed using caulk, gasket, weatherstrip, 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 of a pre-fabricated unit above the opening 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

4.1006.2b - Sealing

Remember to seal around finish details and framing on interior

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

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

4.1006.2c

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:

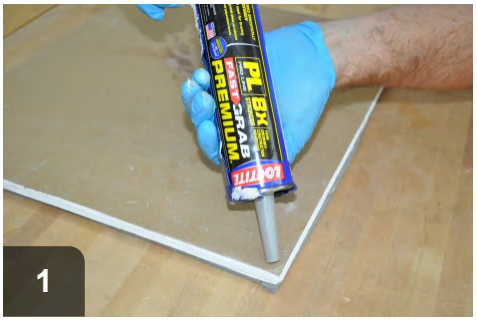
1. Caulk gun
2. Utility knife

Materials:

1. XPS
2. Adhesive

See SWS 4.1006.2a, 4.1006.2b, and 4.1006.2c

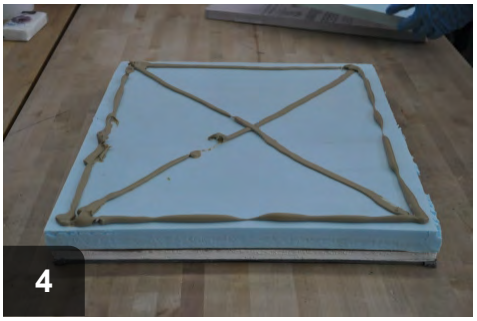
4.1006.2c - Attachment



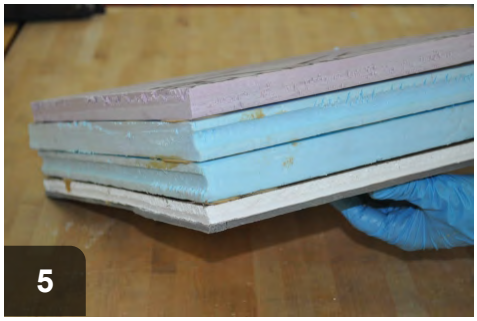
Apply strong adhesive to "cold-side" of hatch

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

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



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



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

4.1006.3b

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

Specification(s):
Fan insulation box frame will be continuously weatherstripped to ensure a tight fit

Fan insulation box will be constructed at a depth to protect the fan housing and motor from insulation

Objective(s):
Prevent air leakage

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 operation, air seal and insulate the assemble like a pull down stair by building a 'box/coffin' over it.

4.1088.1a

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

4.1088.1b

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

4.1088.1c

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.

4.1088.3b

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

4.1101.1a

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

4.1101.1b

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

4.1102.1a

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

4.1102.1a - Sealing

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

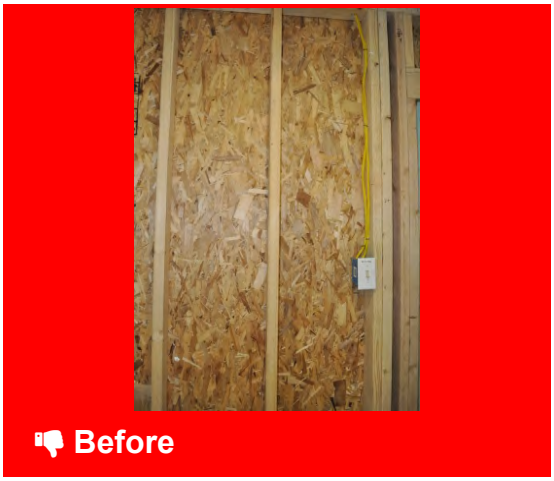
4.1102.1b

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

4.1102.1b - Installation

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

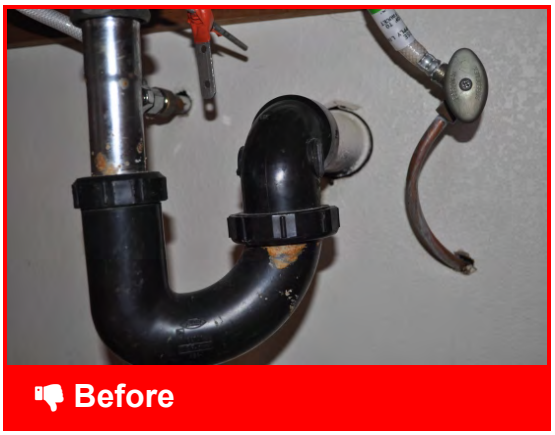
OR: Wall can be insulated using batts installed without gaps

4.1103.2b

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



Unsealed penetrations should be sealed to ensure insulation stays in place

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

Inspect home before and during blowing sidewall insulation. Check for open top and bottom plates, open wall cavities under sinks, and holes and voids to the interior. Be aware of where return and supply ducts are located to prevent dense packing ductwork.

4.1103.2e

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

Specification(s):
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

In Progress

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

After

When repair is finished, it shouldn't be obvious any work was done

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 hightest 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 finsished 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.

4.1103.2e - Close holes

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

Drywall patches are to be smooth and nearly paint ready.

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

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

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

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

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

4.1301.1b

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

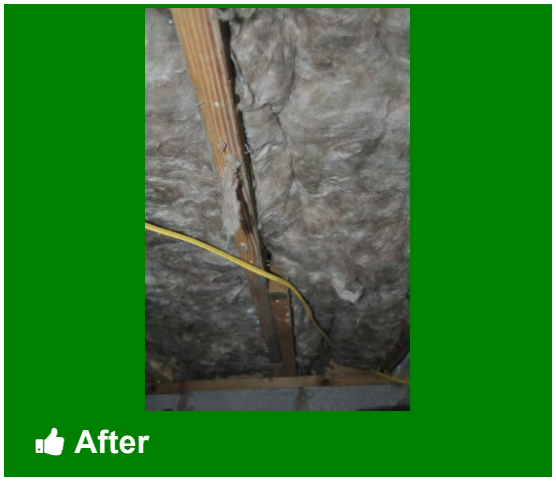
Specification(s):
Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions

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.

4.1301.1b - Installation

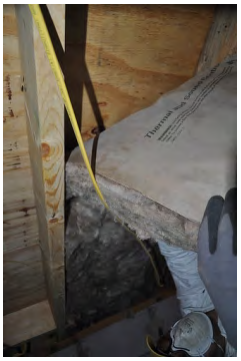
Measures

Measure 8 **Floor Ins. R-11** *Components* F1

Comment

#	*Material / Labor*	*Description /Comment*	*Units*	*Estimated* *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



Install kraft-faced batts with paper against subfloor

Ensure batts are in full contact with subfloor and remain uncompressed

4.1301.1c

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

Fiberglass batts should not be hanging away from subfloor

"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 every 2-3 feet with fasteners with 6 inches of batt ends.

4.1301.1c - Securing batts

Batt should be in contact with subfloor without being compressed

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

4.1301.2b

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

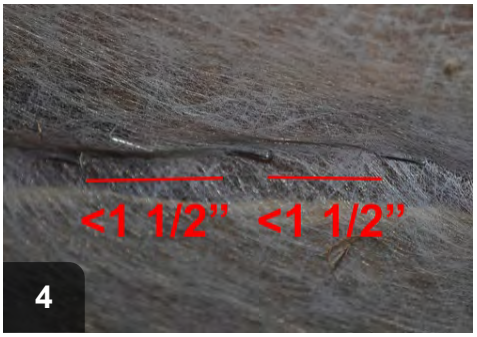
All penetrations and air sealing locations must be addressed before installing netting.

4.1301.2b - Netting, fabric

Secure netting across each joist to create separate cavities

Secure netting across sills to prevent leakage of insulation

Keep netting taut while stapling to prevent wrinkles and leakage



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

4.1301.2c

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

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

4.1301.2c - Installation

Measures

Measure 7 Floor Ins. R-30 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Estimated Qty	Unit Cost	Total	Q
1	Insulation	Floor Insulation - Net & Fill - R-30	SqFt	1180	$0.59	$696.20	
2	Labor	Floor Insulation - Net & Fill - R-30	SqFt	1180	$0.35	$413.00	
3	Miscellaneous Su	Floor Insulation - Net & Fill - R-30	Each	1	$100.00	$100.00	

1

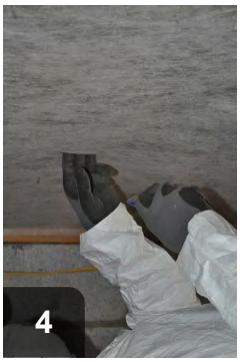
Order and install insulation based on specifications in work order

2

Always wear proper PPE when blowing in insulation

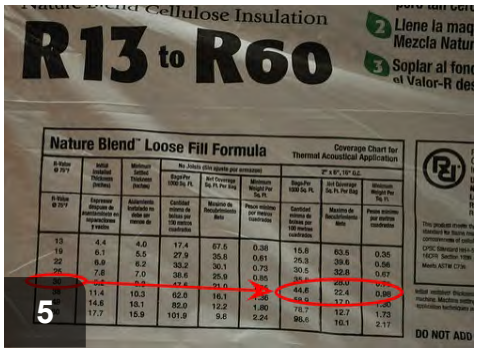
3

Cut holes in each individual cavity to insert insulation machine nozzle



4

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



5

Consult manufacturer specs on insulation packaging for proper installation

6

Blow in insulation to prescribed r-value

4.1301.4b

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

Specification(s):
A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly

Seams and penetrations will be sealed

Objective(s):
Relocate air barrier

Uninsulated floors over unconditioned spaces are an energy drain

Rigid barriers allow for air sealing and create cavities for insulation

Tools:

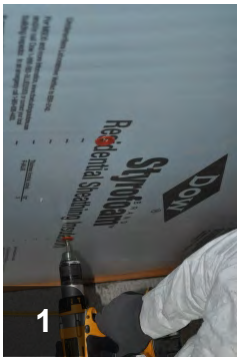
1. Utility knife
2. Saw
3. Drill
4. Tape measure
5. Caulk gun

Materials:

1. Rigid material -- drywall, XPS, plywood
2. Fasteners
3. Caulk

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

4.1301.4b - Rigid air barrier



Securely fasten rigid barrier, aligning seams with joist when possible

Seal all seams with caulk to prevent leakage

Pay particular attention at complex joints

Remember to caulk along sills

4.1301.4c

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

Specification(s):
Dense pack insulation will be installed between air barrier and subfloor according to manufacturer specifications

Insulation will be installed to prescribed R-value

Objective(s):
Insulate to prescribed R-value

Once rigid barrier is sealed, insulation can be blown in

Rigid barrier should be resealed to maintain air barrier after filling

Tools:

1. Insulation machine
2. Caulk gun

Materials:

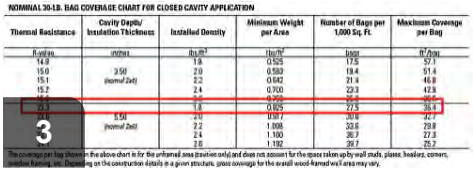
1. Dense packable insulation
2. Caulk

Holes need to be patched.

4.1301.4c - Installation

Ensure that proper PPE is worn while working with insulation

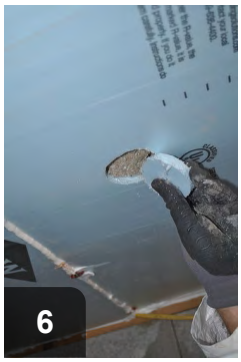
Fill cavities to specified r-value from Work Order



Check manufacturer specifications for r-value before filling

Drill hole slightly larger than nozzle into rigid barrier with hole saw

Dense pack insulation into floor cavities



When filled to specified density and r-value, fill access hole

Plug access hole and seal to maintain air barrier

4.1301.5a

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

4.1301.5b

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

Dense pack cellulose is also an allowable practice in catilever floor cavities.

4.1301.5c

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

Insulation should be secured to prevent drooping or movement

"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. Ensure area is airsealed before insulating. See SWS 4.1301.4b and 4.1301.4c.

4.1301.5c - Attachment

Batts should have full contact with subfloor without being compressed

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

4.1301.5d

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

Specification(s):
Exterior soffit material will be installed and sealed

Objective(s):
Cover and protect insulation

4.1401.2b

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. 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 and prevent moisture condensation on the inside of the band joist

Bad Practice

Compressed batt insulation in Rim Joist

Best Practice

Batt installed smooth and fills entire cavity

Tools:

1. Tape Measure
2. Knife
3. Straight Edge

Materials:

1. Batt

R-19 fiberglass batt insulation may also be used as long as the rim and band area has been airsealed to prevent air and minimize moisture movement. Batts should be installed to cover the entire cavity without compression. The cavity will be airsealed as needed before insulation is installed.

4.1402.1a

Desired Outcome:
Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):
A non fibrous, fire-rated Class I insulation will be used with a minimum life expectancy of 10 years

Objective(s):
Provide fire-safe durable insulation

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 wall and extend 1 foot from wall along the ground.

4.1402.1a - Insulation selection

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

Cutt Batts to fit around joists.

Corners are lapped to provide full coverage

4.1601.2a

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

Uninsulated ducts in unconditioned spaces are an energy drain

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.

4.1601.2a - Selection of duct insulation material

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

4.1601.2b

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

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

Sealed ductwork connections help prevent leakage

Tools:

1. Putty knife

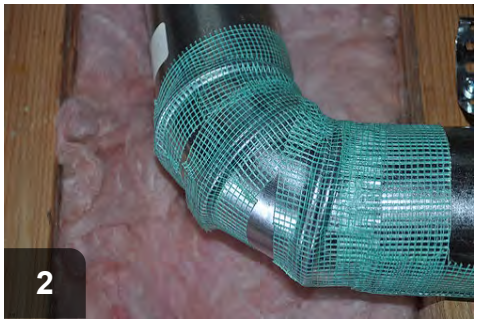
Materials:

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.

4.1601.2b - Duct sealing

Prepare work area by assessing any safety concerns



Wrap joint with fiberglass mesh tape

Apply UL 181 mastic to seal joint

4.1601.2c

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

Materials holding insulation in place should not compress or kink duct

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.

4.1601.2d

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

Unsecured and sealed insulation around ducts is useless

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

5.3003.10b

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.

5.3003.10c

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

5.3003.10d

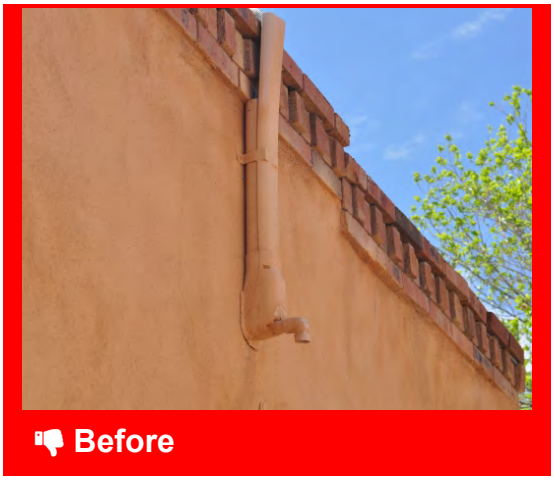
Desired Outcome:
Equipment and condensate drain operate as designed

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



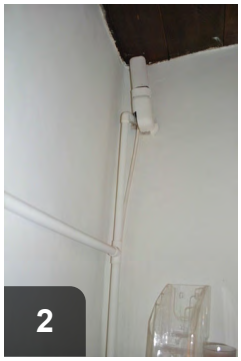
HVAC equipment that drains upward through a roof cannot drain naturally

For non-gravity draining systems, a pump is necessary

Install per manfucturer installation specifications and local codes where applicable.

5.3003.10d - Pumps

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

5.3003.10g

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 speficiation will only apply when installing new units. Install per manufacturer installation specifications.

5.3003.10h

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

6.6002.1a

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 62.2-2013 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.

6.6002.2b

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

Termination fittings with no collar are to be avoided

Properly sized ducts with snug connections to collared fittings last longer

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 greater than the fitting will be cut to accommodate termination fittings. All new and existing exhaust fans will be vented to the exterior.

6.6002.2b - Termination fitting

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

6.6002.2d

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:

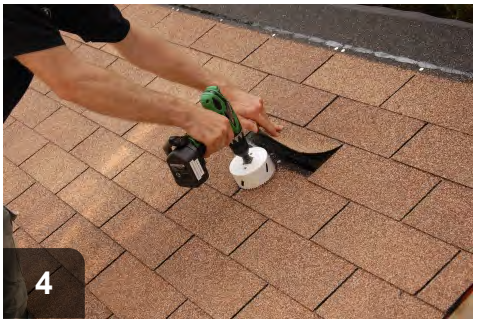
1. Fasteners
2. Caulk

6.6002.2d - Weatherproof installation

Locate the center of your vent hole by drilling from inside through roof

Measure the termination fitting to determine proper hole saw diameter

Based on termination fitting size (in this case, 4"), mark to cut hole



Hole should be no more than 1/4" larger than termination fitting diameter

Verify hole size is correct before installation

Termination fitting is installed to repel water and sealed

6.6002.2e

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
Screen material with no less than ¼" and no greater than ½" 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

Exhaust terminations without screens are an invitation to pest intrusion

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.

6.6002.2f

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 achieved, document reasons why in the client file.

6.6002.2g

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

6.6003.3a

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

Determine size to cut hole by measuring fan assembly and ducting

A snug fit should be ensured to minimize weatherproofing required

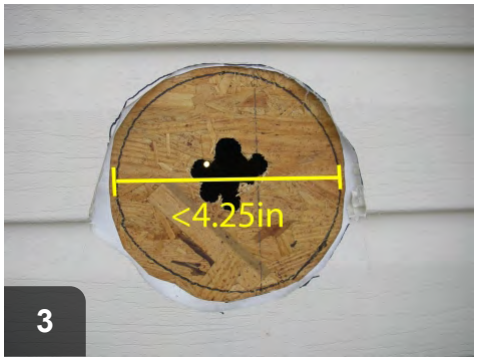
Tools:

1. Tape measure
2. Saw

6.6003.3a - Hole in building shell

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

6.6003.3b

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

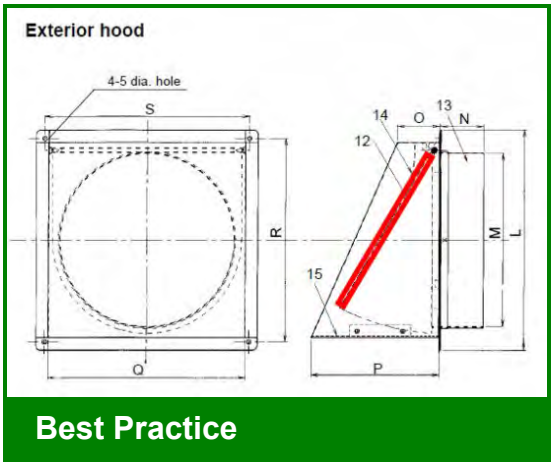
Objective(s):
Prevent an electrical hazard

6.6003.3e

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



Best Practice

Damper should be installed to maintain exterior air barrier

6.6003.3f

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 through fan housing

Ensure a permanent seal to the building air barrier

6.6003.3h

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

6.6003.3k

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

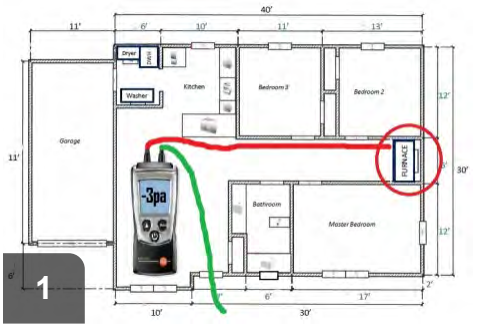
Test that depressurization limit is not being exceeded by new ventilation

Tools:

1. Manometer

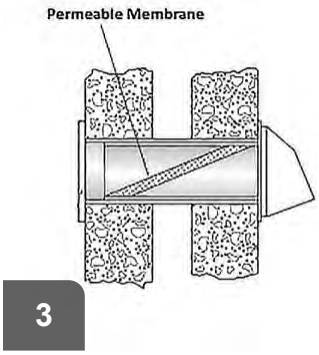
See SWS 2.0299.1a-i for CAZ depressurization limits

6.6003.3k - Combustion safety



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

6.6005.1a

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

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

Do not insulate clothes dryer runs.

6.6005.1b

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

Termination fittings for dryers should have backdraft dampers

6.6005.1b - Termination fitting

Most modern dryer vents have a built-in backdraft damper

To minimize pest intrusion, mesh >1/4" square can be used (see 6.6002.2e)

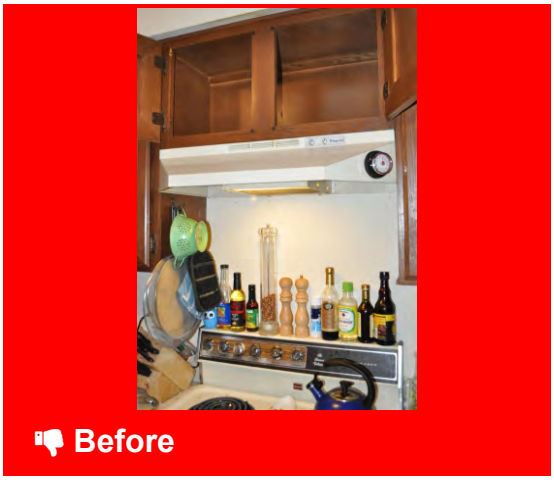
6.6005.2d

Desired Outcome:
Kitchen range fan installed to specification

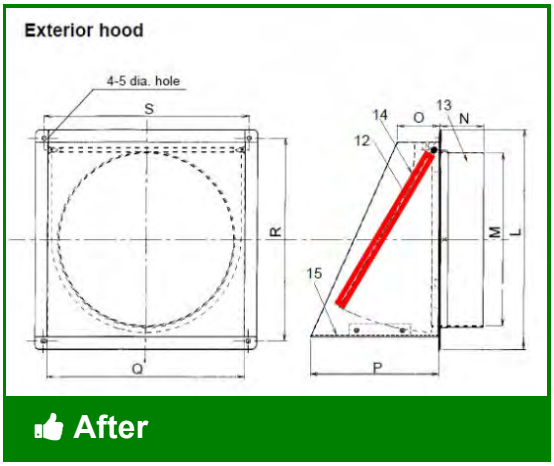
Specification(s):
Termination fitting will be installed including a backdraft damper, as described in termination fitting detail

Objective(s):
Ensure safe operation of combustion appliances

Ensure occupant health and safety



Kitchen fans should exhaust to the exterior, not just recirculate air



Exhaust fans should have backdraft dampers

6.6005.2d - Termination fitting

Backdraft damper on roof mounted exhaust fan

An interior backdraft damper can also be installed for good measure

6.6201.2a

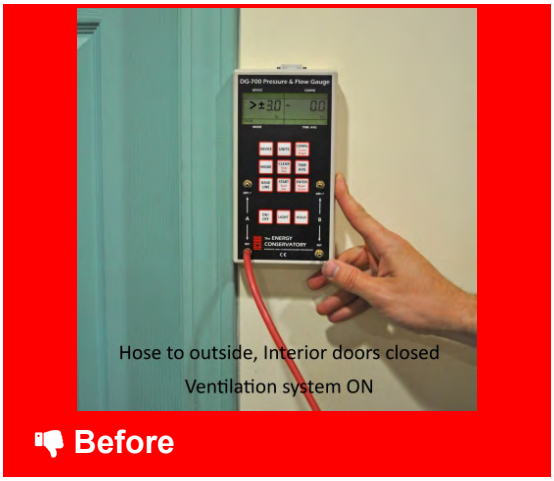
Desired Outcome:
Air circulates freely between rooms

Specification(s):
An appropriate means of pressure balancing will be installed (e.g., transfer grilles, jumper ducts, individual room returns)

No room will exceed +/- 3 pascals with reference to the outdoors with all interior doors closed and ventilation systems running

Objective(s):
Ensure free flow of air between rooms

Preserve integrity of the building envelope

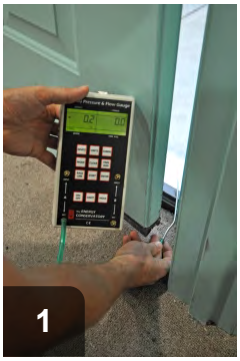


If reading is >+/-3pa, interior ventilation needs to be installed

Passive door vents and individual room returns are two possibilities

This corrective measure will only be installed as necessary to correct existing or created dangerous depressurization conditions.

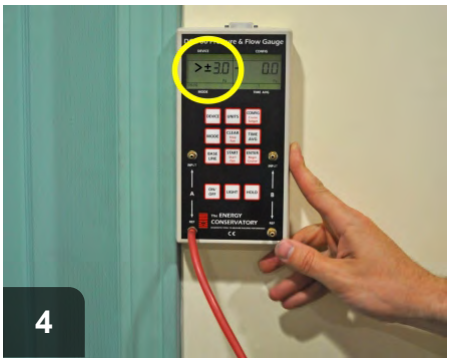
6.6201.2a - Balancing pressure



With interior doors open, put reference hose to exterior

Take baseline reading

Turn on exhaust fans and close interior doors



With hose under door, check pressure again. Readings >+/-3pa are no good and require interior ventilation

7.8001.1a

Desired Outcome:
A more energy efficient appliance installed

Specification(s):
Appliance shall be ENERGY STAR® rated

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):
Energy efficient appliance installed

Measure opening for fit. Replace with Energy star model of equal size.

7.8003.1b

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

Materials:

1. CFL or LED bulbs

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.

7.8101.1b

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

Features will be selected that meet any special needs of the occupant (e.g., shut off, swivel, handheld showers)

Objective(s):
Reduce water and energy consumption

Ensure occupant satisfaction

Materials:

1. Non-hardening thread sealant

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.

7.8102.2c

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 2012 IRC and manufacturer specifications

The system will be installed to be freeze resistant

Any existing water leaks will be repaired before installation begins

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

Objective(s):
Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

7.8102.2k

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

Water heaters producing water over 120 degrees raise heating costs

Water heaters should produce water under 120 degrees to prevent scalding

Tools:

1. Thermometer

7.8102.2k - Discharge temperature

Test temperature of hot water at faucets in house

Hot water temperatures should not exceed 120 degrees Fahrenheit

Adjust water heater settings and insulate as needed

After adjustment and insulation, retest to verify temp is under 120 degrees

7.8103.1c

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
Water heater storage tanks shall have a minimum R-value of R-24, unless the SIR to add insulation is less than 1.0

Added insulation will not obstruct the unit's draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates

The first 6' of inlet and outlet piping will be insulated in accordance with 2012 IRC N1103.4.2 or local requirements, whichever is greater

Objective(s):
Reduce standby losses from near tank piping and storage tank

Ensure insulation does not make contact with flue gas venting

Standard water heaters have built-in insulation ranging from R-7 to R-20.

Storage-type water heaters should be wrapped to bring total value to R-24

Tools:

1. Utility knife

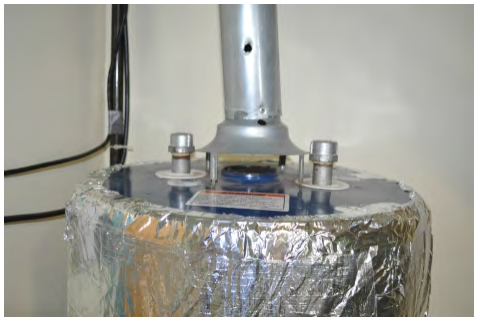
Materials:

1. Pipe wrap
2. Water heater blanket
3. Foil tape
4. Long zip ties

Water heater blankets should be installed where allowed by the manufacture 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.

7.8103.1c - Thermal efficiency

Check occupant's water heater model to see what r-value is built-in



Blanket does not obstruct draft diverter or plumbing pipes and elements

Wrap does not obstruct ventiation, thermostat access plate, hi-limit switch, or fuel line

Data plate should still be accessible after wrapping

Both hot and cold water pipes should be insulated to R-3 for first 6ft

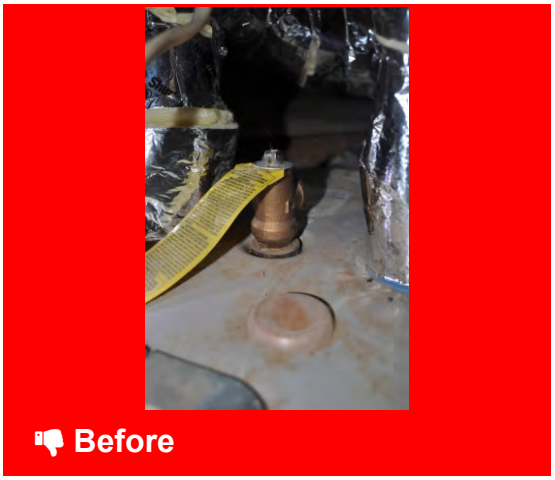
7.8103.1e

Desired Outcome:
Safe, reliable, and efficient operation of the appliance maintained

Specification(s):
Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC

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:

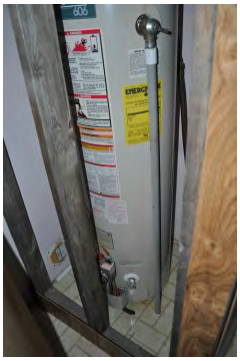
1. Pipe wrench
2. Hacksaw

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.

7.8103.1e - Temperature and pressure relief valve



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

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 bongs 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:

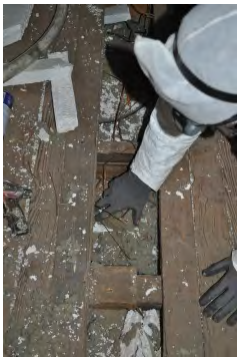
1. Pry Bar
2. Hammer
3. Caulk gun
4. Utility knife
5. Staple gun
6. Spray foam gun
7. Tape measure

Materials:

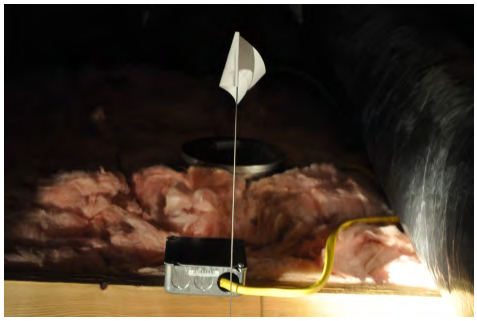
1. Flags
2. Depth markers
3. Staples
4. XPS
5. Caulk
6. Spray foam
7. Junction box covers

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 damn and have no insulation on top

Install depth markers and insulation dams above height of insulation

4.1005.8b

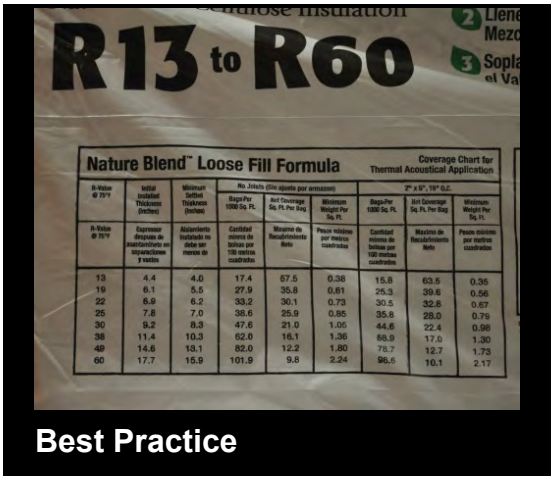
Desired Outcome:
Insulation controls heat transfer through ceiling

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



Check chart on product to ensure proper insulation depth to achieve R-value

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

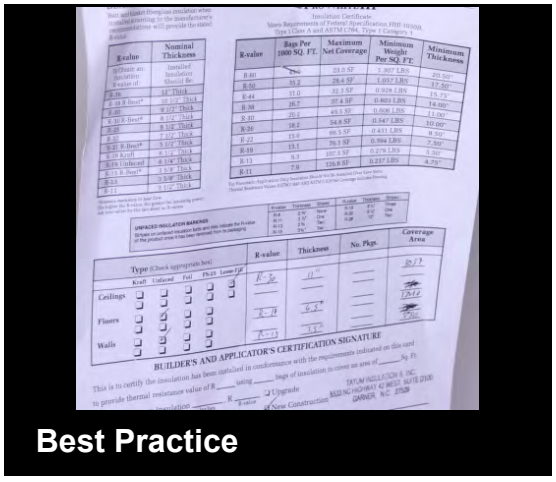
Confirm amount of insulation installed

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.

7.8104.3d

Desired Outcome:
Provide safe and reliable hot water that meets the needs of the occupant/building management/ building operations staff at the lowest possible life cycle cost

Specification(s):
All piping and fittings will be insulated with fixed insulation to IECC 2012 or ASHRAE 90.1-2010, at a minimum

Tanks will be insulated to a minimum of R-12.5

Insulation will be protected from damage (e.g., protected from underground water, contact, friction from pipe hangers, woodpeckers, ultraviolet radiation)

Objective(s):
Prevent the pipe from freezing

Minimize heat loss from the pipes

Reduce the risk of moisture damage

NOTE: Pipe insulation will be installed on water and AC lines located outside the conditioned area. See specification 7.8103.1c for water heater blankets.