Retrofitting Louisiana - 2018 Single Family

Standard Work Specifications

Field Guide for

Single-Family Homes

created by

Louisiana Housing Corporation

2 Health and Safety

2.01 Safe Work Practices

2.0100 Safe Work Practices

2.0100.1 Global Worker Safety

2.0102 Insulation

2.0102.1 Insulation Worker Safety

2.0103 Heating and Cooling Equipment

2.0103.1 Combustion Worker Safety

2.0103.2 Heating and Cooling Worker Safety

3 Air Sealing

3.10 Attics

3.1001 Penetrations and Chases

3.1001.1 Penetrations and Chases

3.1001.2 Chase Capping

3.1001.3 Walls Open to Attic—Balloon Framing and Double Walls

3.1003 Dropped Ceilings and Soffits

3.1003.1 New Ceiling Below Original—Old Ceiling Intact or Repairable

3.1003.2 Ceiling Leaks Not Repairable—No Air Barrier Above

3.1003.3 Above Closets and Tubs

3.1003.4 Dropped Ceilings

2.0100.1 - Global Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

2.0100.1a - Prevention through design

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Design will be incorporated to eliminate or minimize hazards (e.g., material selection, access to equipment for installation and maintenance, placement of equipment, ductwork and condensate lines)

Objective(s):
Prevent worker injuries

Reduce risk exposure to toxic substances and physical hazards

2.0100.1b - Hand protection

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

Objective(s):
Minimize skin contact with contaminants

Protect hands from hazards

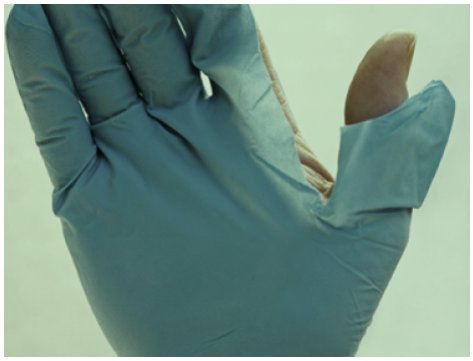
Unsafe

Recognize potential risks

Safe

Wear appropriate hand protection

GOOD: Wear nitrile gloves when handling mastic



Inspect gloves for holes and damage to minimize risk

2.0100.1c - Respiratory protection

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
If the risk of airborne contaminants cannot be prevented, proper respiratory protection will be provided and worn (e.g., N-95 or equivalent face mask)

When applying low pressure 2-component spray polyurethane foam, air purifying masks with an organic vapor cartridge and P-100 particulate filter will be used

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

Consult MSDS for respiratory protection requirements

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

Objective(s):

Minimize exposure to airborne contaminants (e.g., insulation materials, mold spores, feces, bacteria, chemicals)

Unsafe

Workers need to properly protect their airways when retrofitting

Best Practice

Retrofits can have multiple different respiratory protection requirements

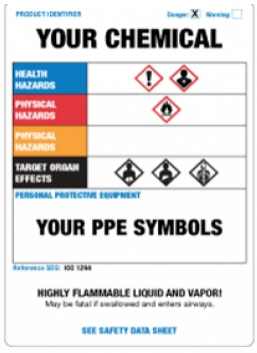
When web-enabled, click link to read OSHA 1910.134

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

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

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

When working with high-pressure



When unsure what level of protection

spray foam, use a Supplied Air Respirator	is necessary, check the Safety Data Sheets (SDS) for the materials to be used

2.0100.1d - Electrical safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
An electrical safety assessment will be performed

All electric tools will be protected by ground-fault circuit interrupters (GFCI)

Three-wire type extension cords will be used with portable electric tools

Worn or frayed electrical cords will not be used

Water sources (e.g., condensate pans) and electrical sources will be kept separate

Metal ladders will be avoided

Special precautions will be taken if knob and tube wiring is present

Aluminum foil products will be kept away from live wires

For arc flash hazards, NFPA 70E will be consulted

Objective(s):
Avoid electrical shock and arc flash hazards

Inspect house for unsafe electrical situations

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

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

Electrical wiring should not be located near a water source

Use fiberglass ladders in place of metal

Recognize if knob and tube wiring is present and take special precautions

Follow NFPA 70E guidelines for arc flash hazards

2.0100.1e - Carbon monoxide (CO)

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):
All homes will have a carbon monoxide alarm

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

Objective(s):
Protect worker and occupant health

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

Install carbon monoxide alarms

Tools:

1. CO meter

2.0100.1f - Personal Protective Equipment

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
MSDS and OSHA regulations will be consulted for equipment and protective clothing would be worn if contaminants are present(e.g., insulation materials)

Eye protection will always be worn (e.g., safety glasses, goggles if not using full-face respirator)

Objective(s):
Protect worker from skin contact with contaminants

Minimize spread of contaminants

Provide eye protection

Before

Workers should be aware of work required and dress appropriately

After

Ensure workers have proper protective equipment for work environment

2.0100.1g - Confined space safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Spaces with limited ingress and egress and restricted work area will be considered confined space

Access and egress points will be located before beginning work

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

Adequate ventilation will be provided

Use of toxic material will be reduced

Objective(s):
Prevent build-up of toxic or flammable contaminants

Reduce risk to the workers in the confined space

Provide adequate access and egress points

Prevent electrical shock

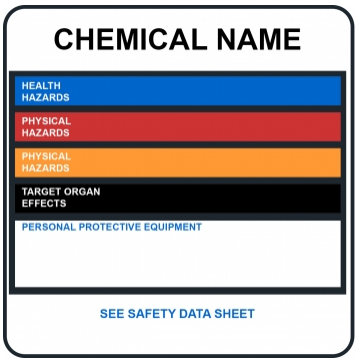
After

Locate all access and egress points of confined spaces before entering

Perform visual inspection of confined spaces before beginning work

Check for frayed or worn electrical wires

In confined spaces, use a ventilator



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

2.0100.1h - Power tool safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

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

All devices used will be verified as GFCI protected or double insulated

Exhaust gases from compressors and generators will be prevented from entering interior space

Objective(s):
Prevent power tool injuries

Prevent buildup of toxic or flammable contaminants

2.0100.1i - Chemical safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

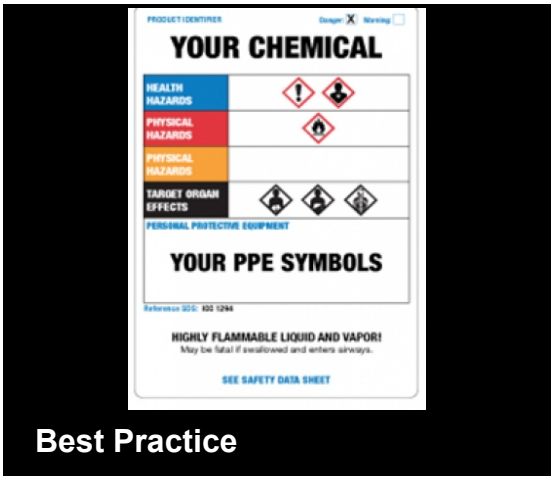
Specification(s):
Hazardous materials will be handled in accordance with manufacturer specifications, MSDS and OSHA standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers

Appropriate personal protective equipment (PPE) will be provided

Workers will be trained on how to use PPE

Workers will be expected to always use appropriate PPE during work

Objective(s):
Prevent worker exposure to toxic substances



New GHS/SDS labeling is clear and concise--workers should be familiar with how to read new Safety Data Sheets

Workers should be trained on how to wear PPE, be provided with proper PPE, and know when to use it

2.0100.1j - Ergonomic safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Appropriate PPE will be used (e.g., knee pads, bump caps, additional padding)

Proper equipment will be used for work

Proper lifting techniques will be used

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

Workers will take precautions to protect themselves on the job site

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

Tools:

1. Hard hats
2. Knee pads
3. Bump caps

2.0100.1k - Hand tool safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Hand tools will be maintained in safe working order and used for intended purpose

Objective(s):
Prevent injuries

2.0100.1l - Slips, trips, and falls

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Caution will be used around power cords, hoses, tarps, and plastic sheeting

Precautions will be taken when ladders are used, when working at heights, or when balancing on joists

Walk boards will be used when practical

When scaffolding is used, manufacturer set-up procedures will be followed

Appropriate footwear and clothing will be worn

Objective(s):
Prevent injuries due to slips, trips, and falls

2.0100.1m - Thermal stress

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Ensure staff is aware of risks during extreme weather including the symptoms of heat stroke, heat exhaustion, and hypothermia

Appropriate ventilation, hydration, rest breaks, and cooling equipment will be provided

911 will be dialed when necessary

Objective(s):
Prevent heat stroke, heat stress, and cold stress related injuries

Attics and crawl spaces can be dangerous work places in the heat and the cold


DO NOT HESITATE to call 911 in potential cases of heat stroke or hypothermia

Tools:

1. Cool vests
2. Ventilator

Keep workers comfortable with hydration and cool vests

Provide fresh and moving air when working in hot confined spaces

2.0100.1n - Fire safety

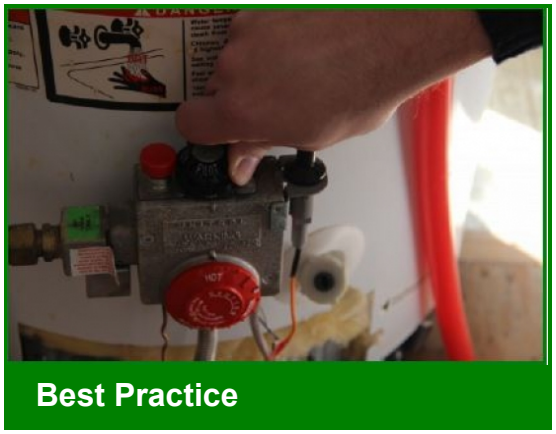
Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Ignition sources will be identified and eliminated (e.g., turn off pilot lights and fuel supply)

Use of flammable material will be reduced and fire-rated materials will be used

Objective(s):
Prevent a fire hazard

Fire hazards should be removed from the work area with the permission and/or assistance of the homeowner



Set combustion appliances to off or pilot to minimize risk of fire

2.0100.1o - Asbestos-containing materials (ACM)

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

If suspected ACM is in good condition, do not disturb

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

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

When working around ACM, do not:

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

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

Objective(s):
Protect workers and occupants from potential asbestos hazards

Before

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

Best Practice

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

Materials:

1. Containment shroud
2. Caution tape

Do not disturb ACM by vacuuming, dusting, or sweeping

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

2.0100.1p - Lead paint assessment

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

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

any more stringent state or federal standards

Objective(s):
Protect workers and occupants from potential lead hazards

Best Practice

In homes built before 1978, test paint before beginning renovation or assume presence of lead

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

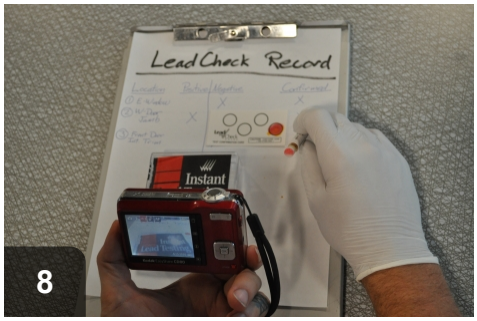
Break capsule and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative.

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

2.0100.1q - Site security

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Work site will be secured to prevent unauthorized entry

Temporarily disconnected eqipment will be locked up and tagged out

All loose or unbagged trash and unused materials will be removed from work site daily

Objective(s):
Protect the occupant from exposure to potential hazards

2.0100.1r - Crawl space safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):
The source of all contaminants (e.g., sewage,dead animals,needles) will be corrected,repaired,or removed before performing inspections that require complete access to the crawl space

If appropriate, the contaminant will be neutralized and/or a protective barrier will be installed in the area

Objective(s):
Ensure work safety

Prevent worker exposure to hazards

2.0102.1 - Insulation Worker Safety

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

2.0102.1a - Worker safety

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

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

Objective(s):
Prevent injury

Minimize exposure to health and safety hazards

2.0102.1b - Asbestos containing materials (ACM)

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

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

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

If suspected ACM is in good condition, do not disturb

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

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

When working around ACM, do not:

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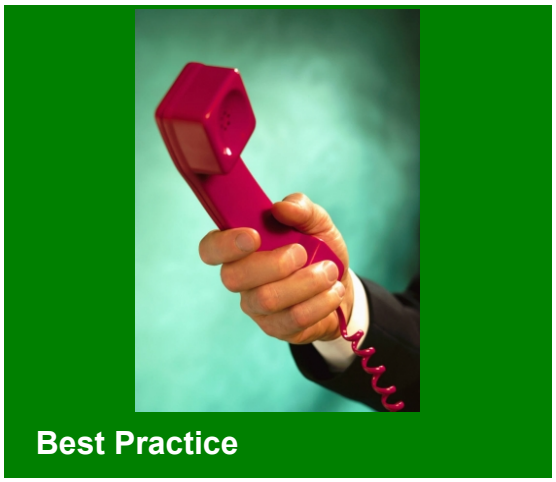
- Saw, sand, scrape, or drill holes in the material
- Use abrasive pads or brushes to strip materials

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

Objective(s):
Protect workers and occupants from potential asbestos hazards

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



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

Materials:

1. Containment shroud
2. Caution tape

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

Do not disturb ACM by vacuuming, dusting, or sweeping

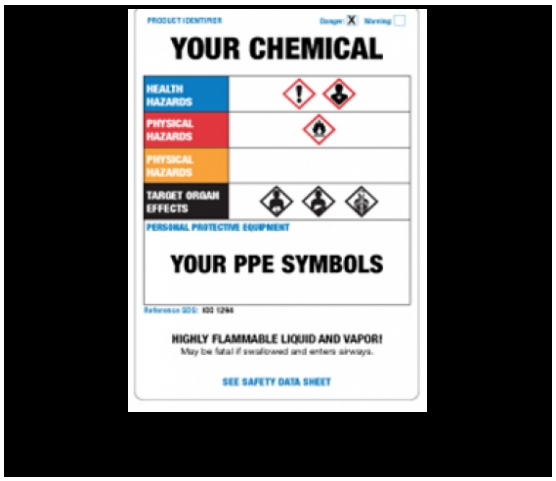
2.0102.1c - Materials

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

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

Objective(s):
Eliminate hazards associated with incorrect, defective, or improperly used or installed materials

Workers should be familiar with Safety Data Sheets for materials used and know where to locate SDS in case of emergency



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

2.0102.1d - Lead paint assessment

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

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation or assume presence of lead

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

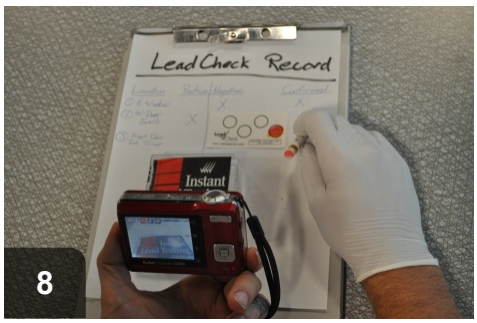
Break capsule and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative.

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

2.0103.1 - Combustion Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0103.1a - Worker safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

Objective(s):
Prevent injury

Minimize exposure to health and safety hazards

2.0103.1b - Carbon monoxide (CO)

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

Objective(s):
Protect worker and occupant health

STOP WORK if CO levels are higher than 70ppm!!

Install carbon monoxide alarm if none are found.

Tools:

1. CO meter

Louisiana WAP variances state: Ambient CO will be monitored and combustion testing discontinued if ambient CO level inside the home or work space exceeds 70 parts per million (ppm).

2.0103.1c - Raw fuel

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Raw fuel leaks will be monitored for before entering building spaces

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

Objective(s):
Protect worker and occupant health

Fuel leaks need to be repaired by appropriate professional

Notify occupant of any leaks

Tools:

1. Gas sniffer
2. Bubble solution

Check all raw fuel lines for leaks

Use multiple methods to test for leakage--bubble solution

If bubbles develop, leak is present. Notify occupant

Any leaks found should be reported to occupant and work stopped

Any leaks found should be reported to occupant and work stopped

2.0103.2 - Heating and Cooling Worker Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

2.0103.2a - Worker safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Follow all worker safety specifications in SWS 2.0100 Global Worker Safety section

Objective(s):
Prevent injury

Minimize exposure to health and safety hazards

2.0103.2b - Mercury

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

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

Unsafe

Mercury thermostats should be replaced and disposed of properly

Bad Practice

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

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

2.0103.2c - Asbestos

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

Workers will take precautionary measures to avoid exposure

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

Unsafe

Suspicious pipe insulation may contain asbestos

Best Practice

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

If exposure to ACM cannot be avoided, workers must wear P-100 masks and proper PPE to avoid ingestion or contamination

2.0103.2d - Personal protective equipment (PPE)

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

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

Objective(s):
Protect worker from exposure to hazards

Protect worker from skin contact with liquid nitrogen

Unsafe

When working with refrigerants, short sleeves are inappropriate

Safe

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

2.0103.2e - Combustible gas detection

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

Leaks will be repaired before work is performed

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

Unsafe

Fuel leaks need to be repaired

Safe

Repairs need to be tested and verified that they no longer leak

Tools:

1. Combustible gas detector
2. Testing solution

Paraphrased from 2012 IRC G2417: Leakage will be located using an approved combustible gas detector, a noncorrosive leak detection fluid or an equivalent nonflammable solution. Matches, candles, open flames or other methods that could provide a source of ignition cannot be used.Where leakage or other defects are located, the affected portion of the piping system will be repaired or replaced and retested.

Fuel leaks discovered during initial audit should be flagged for repair

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

Repeatedly test repair site for leakage over a 10 minute period

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

Confirm repair and remove flag

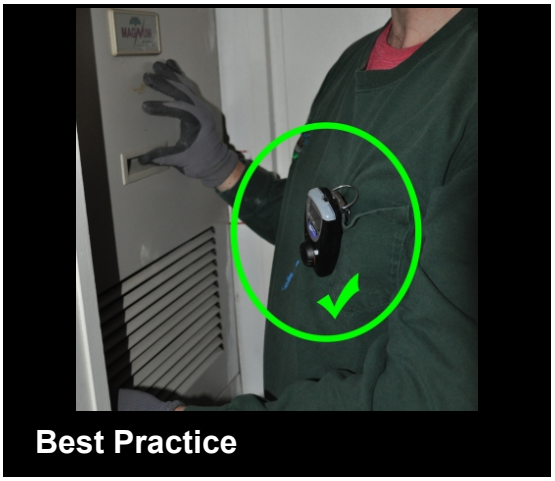
2.0103.2f - Carbon monoxide (CO)

Desired Outcome:
Work completed safely without injury or hazardous exposure

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

CO issues will be addressed before work is performed or continued

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



Workers will monitor CO levels throughout work day, wearing a personal CO detector at all times

All CO issues found during initial audit should be mitigated before work begins

Personal CO detectors should be calibrated outside in fresh, open air before entering a home

If at any point CO levels exceed 35ppm, work must stop immediately and the home must be evacuated

2.0103.2g - Sealant

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
Pipes will be sealed by a certified professional with an approved fastening process and sealant in accordance with manufacturer specifications (International Fuel Gas Code)

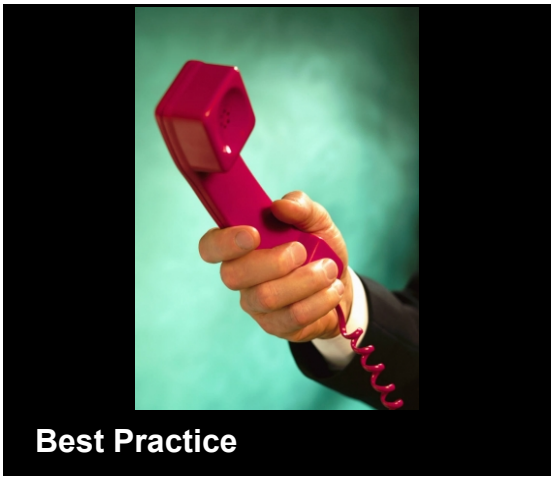
Gas lines will be leak free when tested with an electronic combustible gas leak detector and verified

with bubble solution

OR

Gas lines will be leak free when tested by a standing pressure test that meets the approval of the local code

Objective(s):
Install gas lines with no leaks



Call a licensed professional for gas line installations and repairs.

Test any new gas line connections with combustible gas detector, and verify lack of leaks with testing solution.

Tools:

1. Combustible gas detector
2. Testing solution

2.0103.2h - Safety devices

Desired Outcome:
Work completed safely without injury or hazardous exposure

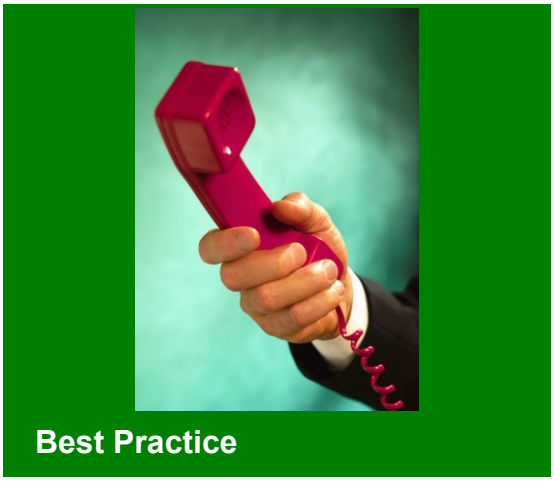
Specification(s):
A secondary LP safety detector system (valve, exhaust fan, alarm light) will be installed by a certified professional for propane piping installed below grade

When installing new equipment, a shut off valves will be installed by a certified professional at each gas appliance (ANSI Z21.15)

Objective(s):

Detect accumulation of dangerous levels of propane in below-grade areas

Isolate appliances from the rest of the system for emergencies, removal, or repairs



Best Practice

Call a certified professional

2.0107.2 - Basements and Crawl Spaces—Pre-Work Qualifications

Desired Outcome:
Site properly prepared for upgrade

2.0107.2a - Fuel leaks

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Fuel leaks will be repaired and inspected in accordance with the IRC

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

Fuel leaks need to be repaired

Repairs need to be tested and verified to no longer leak

Tools:

1. Combustion gas detector
2. Testing solution

Paraphrased from 2012 IRC G2417: Leakage will be located using an *approved* combustible gas detector, a noncorrosive leak detection fluid or an equivalent nonflammable solution. Matches, candles, open flames or other methods that could provide a source of ignition cannot be used. Where leakage or other defects are located, the affected portion of the *piping system* will be repaired or replaced and retested.

Fuel leaks discovered during initial audit should be flagged

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

Repeatedly test repair site for leakage over a 10min period

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

Confirm repair and remove flag

2.0107.2b - Electrical hazards

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Electrical hazards will be eliminated and inspected in accordance with NFPA 70 National Electric Code

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

2.0107.2c - Mold

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Appropriate remediation will be completed before upgrade

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

2.0107.2d - Plumbing and water leaks

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Plumbing leaks will be repaired before crawl space upgrade in accordance with the IRC

Objective(s):
Prepare site for upgrade

2.0107.2e - Pest and termite work

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Pest and termite treatment will be completed before crawl space upgrade and inspected in accordance with the IRC

Objective(s):
Prepare site for upgrade

2.0107.2f - Structural repairs, modifications

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Structural repairs and modifications will be inspected and completed before crawl space upgrade in accordance with the IRC

Objective(s):

Prepare site for upgrade

2.0107.2g - Appliance and heating, ventilation, and air conditioning (HVAC) system repairs and change outs

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Crawl space upgrades (e.g., sealing and insulation) are to be undertaken after appliance and HVAC system work has been completed and inspected

Objective(s):
Prepare site for upgrade

2.0107.2h - Correctable standing water

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Passive drains or sump pumps will be used to remove standing water

Objective(s):
Prepare site for upgrade

2.0107.2i - Non-correctable standing water

Desired Outcome:
Site properly prepared for upgrade

Specification(s):
Spaces with non-correctable standing water will not be considered for a closed crawl space

Objective(s):
Prevent possible damage to house

2.0107.3 - Basements and Crawl Spaces—Debris Removal

Desired Outcome:
Clean, safe, and easily accessible crawl space created

2.0107.3a - Debris removal

Desired Outcome:
Clean, safe, and easily accessible crawl space created

Specification(s):
Under-floor grade will be removed of all vegetation and organic material

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

Objective(s):
Minimize punctures in ground liner

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

Before

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

After

Rake up and clear away trash and overgrowth.

Tools:

1. Rake
2. Shop vacuum
3. PPE

2.0107.3b - Debris disposal

Desired Outcome:
Clean, safe, and easily accessible crawl space created

Specification(s):
Debris will be properly disposed of according to type and jurisdiction

Objective(s):
Protect environment from damage

2.0201.1 - Combustion Appliance Zone (CAZ) Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.1a - Assessment

Desired Outcome:
Accurate information about appliance safe operation is gathered

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

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

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

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

Before

Unsafe combustion appliances indicate need for repair or replacement

After

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

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 - Fuel leak detection

Desired Outcome:
Accurate information about appliance safe operation is gathered

Specification(s):
Inspect and test for gas or oil leakage at connections of natural gas, propane piping, or oil systems

If leaks are found, immediate action will be taken to notify occupant to help ensure leaks are repaired

The report will specify repair for leaks and replacement for hazardous or damaged gas or oil connectors and pipes

Objective(s):
Detect fuel gas leaks

Determine and report need for repair

Fuel lines should be inspected for leakage

If leaks are found, notify occupant immediately to facilitate repair

Tools:

1. Gas sniffer
2. Spray bottle

Materials:

1. Bubble solution

Inspect exterior gas and oil lines for leaks and damage

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

2.0201.1c - Venting

Desired Outcome:
Accurate information about appliance safe operation is gathered

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

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

Objective(s):

Determine if a regulator is present and working

Determine whether vent system is in good condition and installed properly

Unsafe

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

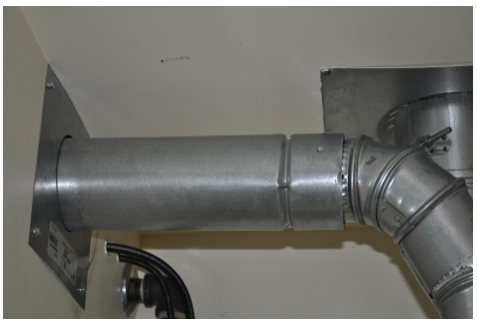
Safe

Properly vented appliances make a house healthier and more efficient

Determine if a draft regulator is installed and working

Inspect venting systems for damage

Inspect venting systems for disconnected pipes



Inspect venting systems for inadequate slope

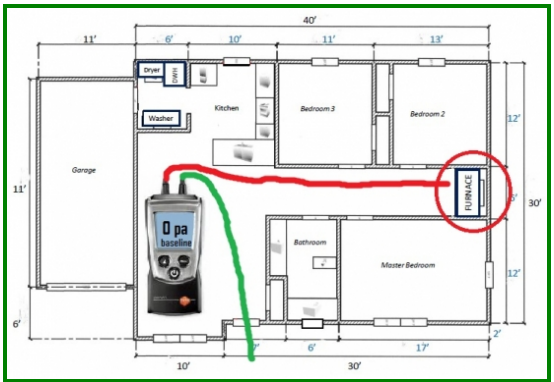
Inspect for missing draft diverter

2.0201.1d - Base pressure test

Desired Outcome:
Accurate information about appliance safe operation is gathered

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

Objective(s):
Measure pressure difference between combustion zone and the outside under natural conditions



Best Practice

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

Tools:

1. Manometer

2.0201.1e - Depressurization test

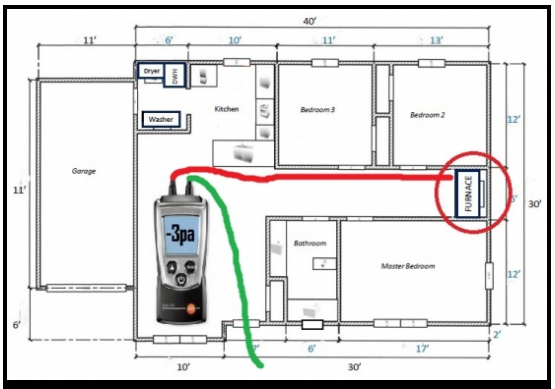
Desired Outcome:
Accurate information about appliance safe operation is gathered

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

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

Objective(s):

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

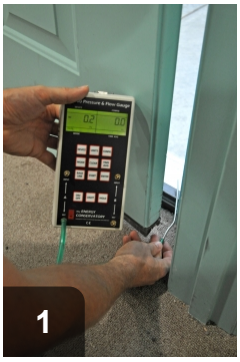


Best Practice

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

Tools:

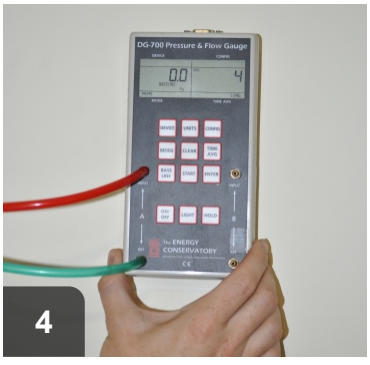
1. Manometer



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

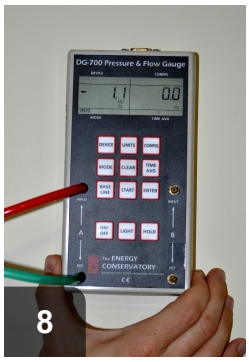


Take baseline reading

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



Check reading against the Depressurization Limits table. If reading is less negative than allowable limit, all is well

2.0201.2 - Combustion Safety - Make-up Air

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

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

2.0201.2a - Outside combustion make-up air

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

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

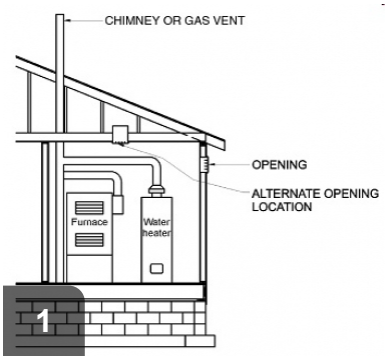
Objective(s):
Prevent combustion byproducts from entering the house

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

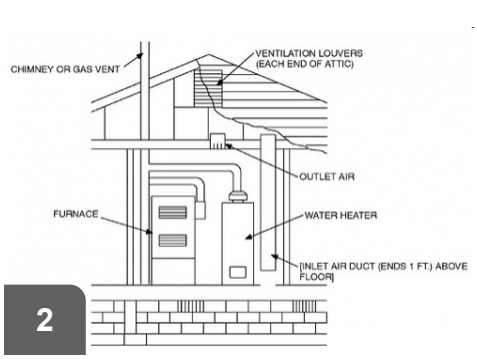
Image 2: For homes with two permanent vertical duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in2 per 4,000 Btu/h (550 mm2/kW) of total input rating of all appliances

Image 3: For homes with two permanent horizontal 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

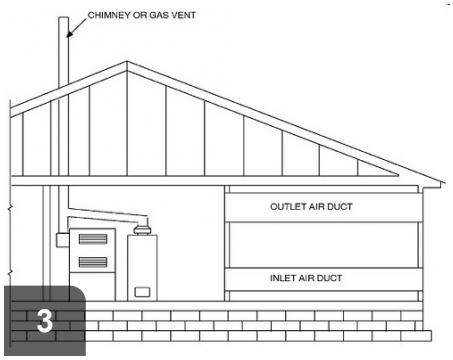
Engineered installations are also acceptable.



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

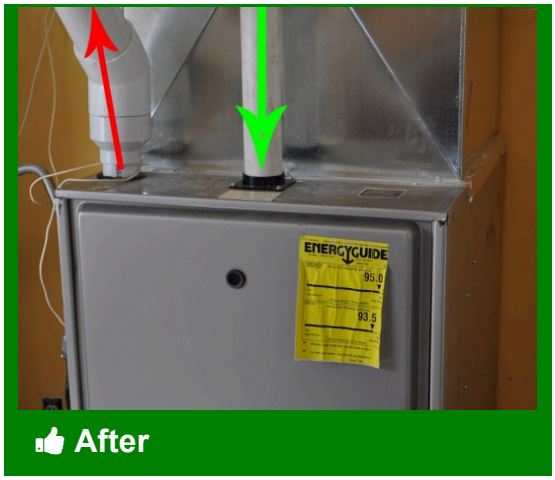
2.0201.2b - New appliances

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

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

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

Damaged combustion appliances beyond repair should be replaced



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

Two-pipe 90% efficiency furnaces are viable replacement appliances

Direct vent combustion appliances are also viable replacements

2.0201.2c - CO detection and warning equipment

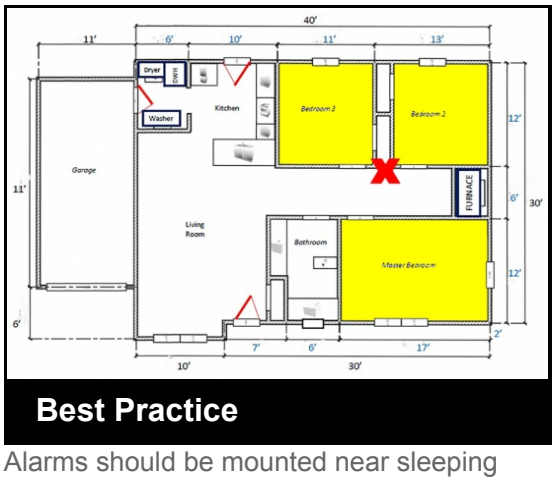
Desired Outcome:
Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):
CO detection or warning equipment will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in accordance with ASHRAE 62.2 and authority having local jurisdiction

Installation will be accomplished by a licensed electrician when required by local code

Objective(s):
Alert occupant to CO exposure

Carbon Monoxide alarms should be installed according to local codes



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

Tools:

1. Drill

Materials:

1. CO alarm
2. Fasteners

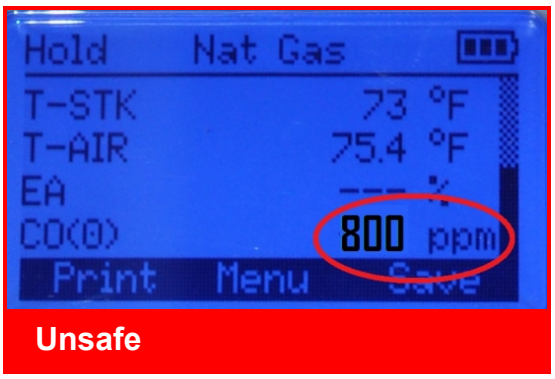
2.0201.2d - Gas ovens

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

Specification(s):
Gas ovens will be tested for CO

A clean and tune will be conducted if measured CO in the undiluted flue gases of the oven vent at steady state exceeds 225 ppm as measured

Objective(s):
Ensure clean burn of gas ovens



In Louisiana: Clients with ovens that test over 800 ppm CO air-free should be advised to clean the oven

Test gas oven for carbon monoxide using a combustion gas analyzer

Tools:

1. Combustion analyzer with probe

Louisiana WAP variances state: Gas ovens will be tested for CO at steady state ppm air-free.

LA variance: If measured CO in the flue gases of the oven vent at steady state exceed 800 ppm air-free, the client will be advised to clean the oven. If CO exceeds 1000 ppm air-free after cleaning, the client will be advised to replace the oven. If oven vent steady state CO is greater than 800 ppm measured air-free but less than 1000 ppm CO at steady state measured air-free after cleaning or replacement, then a range vent hood must be installed and vented to daylight, with the range vent hood exhausting outside the building envelope that produces a minimum of 100 cfm. If oven CO

measured at steady state air-free is greater than 1000 ppm after cleaning or replacement, the unit will be deferred until this is resolved. Client education, recommendations and deferral if needed will be documented in the unit file.

2.0201.2e - Gas range burners

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

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

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

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

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

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

2.0201.2f - Solid fuel burning appliances

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

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

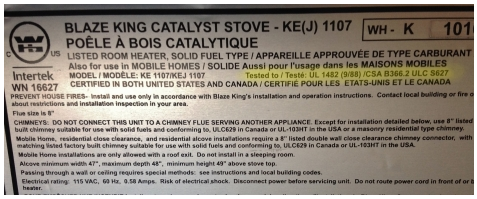
Objective(s):
Ensure safe operations of solid fuel burning appliances

Unsafe solid fuel burning appliances should be replaced

New appliances should be UL-listed and EPA-certified

Since 1988, the EPA has regulated particulate emissions from wood heaters. The limit is 7.5 grams per hour for non-catalytic appliances, and 4.1 grams per hour for catalytic appliances.

Locate data plate to find out appliance ratings



Check appliance rating plates for EPA and UL markings (or CSA, ETL, or WH markings)

2.0201.3 - Vented Combustion Appliance Safety Testing

Desired Outcome:
Accurate information about appliance safe operation is gathered

2.0201.3a - Spillage Test

Desired Outcome:
Accurate information about appliance safe operation is gathered

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

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

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

Objective(s):
Detect excessive spillage of combustion gases

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 not be uniform

Tools:

1. Smoke pencil
2. Timer

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

Desired Outcome:
Accurate information about appliance safe operation is gathered

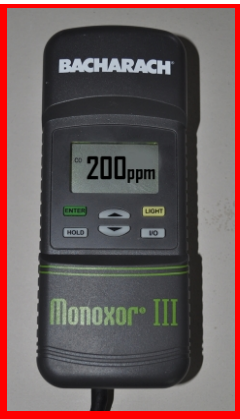
Specification(s):
CO will be tested for in undiluted flue gases of combustion appliances

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

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

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

Objective(s):
Measure CO and report excessive levels



Unsafe

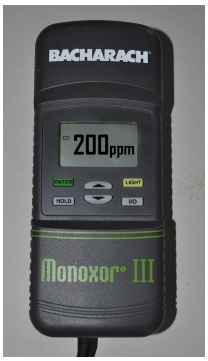
CO levels cannot exceed 200ppm as measured, unless to manufacturer specs

Best Practice

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

Tools:

1. Combustion analyzer with probe



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

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

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

Test accessible exhaust outlets for direct-vent appliances

Test accessible exhaust outlets for power-vented appliances

2.0201.3c - Final test out

Desired Outcome:
Accurate information about appliance safe operation is gathered

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

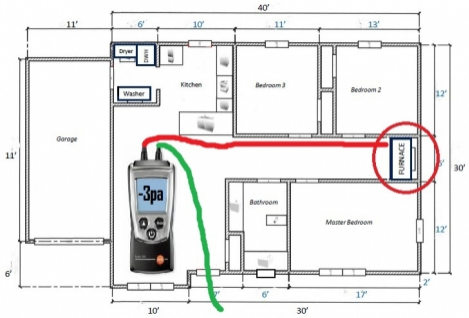
Objective(s):
Ensure safe operation of combustion appliance within the whole house system after any repair project

Unsafe

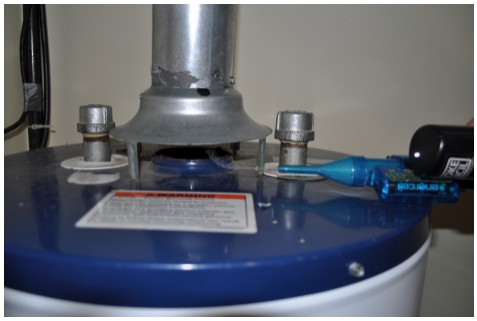
Conduct spillage and depressurization testing at the end of the work day

Tools:

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



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

Complete carbon monoxide testing

combustion appliances	using a CO detector or combustion analyzer

2.0203.2 - Combustion Flue Gas—Orphaned Water Heaters

Desired Outcome:
Flue gasses successfully removed from the house

2.0203.2a - Spillage testing

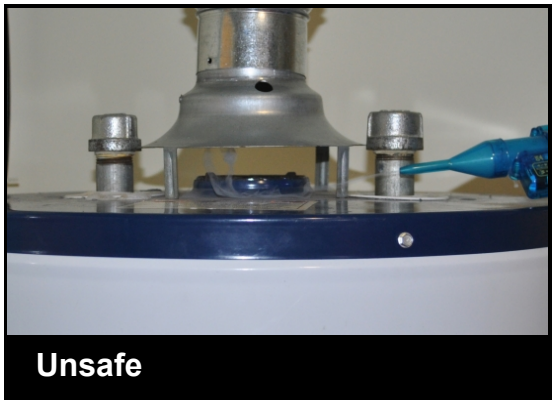
Desired Outcome:
Flue gasses successfully removed from the house

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

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

Objective(s):
Detect excessive spillage of combustion gases

Orphaned water heaters have oversized flues after a furnace is removed



Spillage should not exceed 2 minutes, if present

Tools:

1. Smoke pencil
2. Timer

2.0203.2b - Flue gas removal (chimney liner or approved

methods)

Desired Outcome:
Flue gasses successfully removed from the house

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

Objective(s):
Allow water heater to vent properly

Prevent damage to the chimney

Before

Unlined masonry chimney

After

Flue liner with rain cap

Tools:

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

Materials:

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

Connect chimney liner to appliance in accordance with applicable codes.

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

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

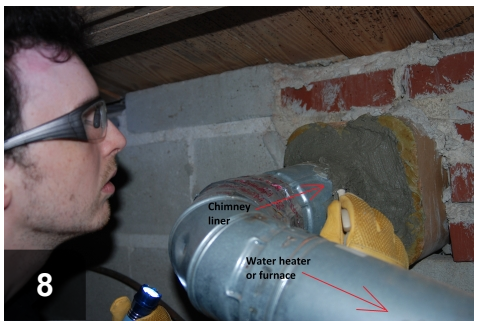
Measure and mark the flexible chimney liner at 4 inches above the chimney

Cut the flexible chimney liner to length

Install top plate over opening and attach it to the liner

Fasten the rain cap to the chimney liner

Seal around penetrations in chimney with refractory (furnace) cement



Connect appliance vent to the chimney liner

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

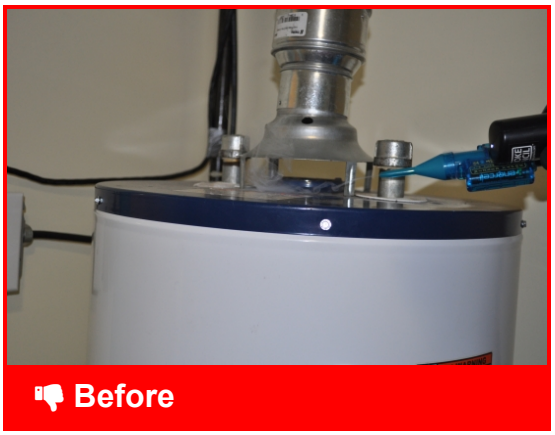
2.0203.2c - Retesting spillage

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 with a warm vent



If spillage continues to exceed 2 min, additional repairs are required

Repipe the flue to eliminate the oversized chimney. After repairs, spillage should no longer occur beyond 2 minutes

Tools:

1. Smoke pencil
2. Timer

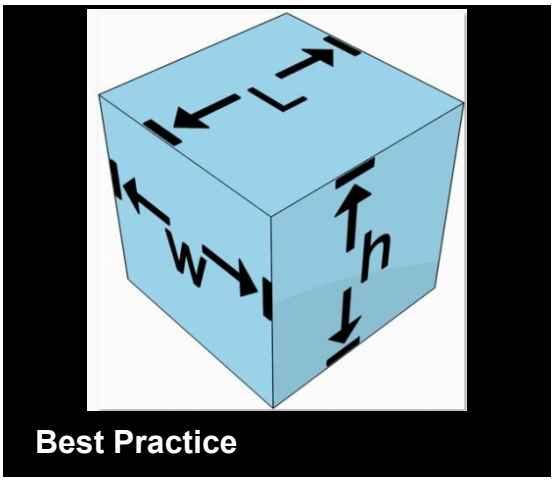
2.0203.2d - Required combustion air

Desired Outcome:
Flue gasses successfully removed from the house

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

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

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



Best Practice

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

Safe

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

Tools:

1. Measuring tape
2. Calculator

Measure the CAZ width.

Measure the CAZ length.

Measure the CAZ height.

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

Desired Outcome:
Flue gasses successfully removed from the house

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

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

Before

Combustion appliance in a confined space

After

Additional combustion air supplied by high and low vents

Tools:

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

Materials:

1. Metal ducts

2.0203.4 - Occupant Education

Desired Outcome:
Ensure persistence of resident safety

2.0203.4a - Occupant health and safety

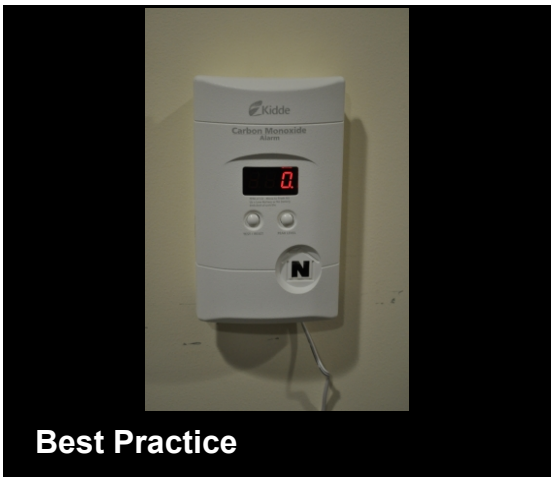
Desired Outcome:
Ensure persistence of resident safety

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

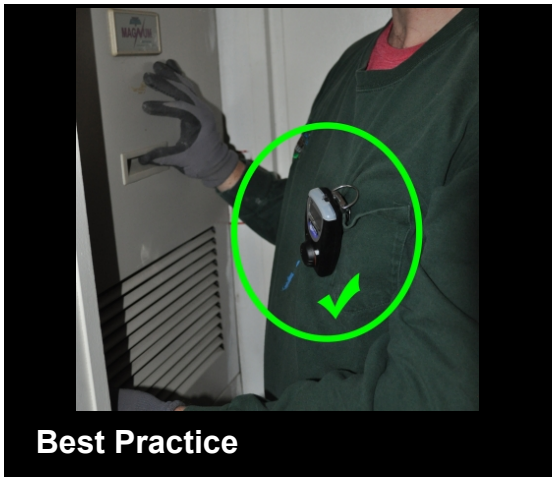
If CO levels in interior living spaces exceed outdoor levels, potential sources will be investigated and appropriate action taken to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weather stripping or conduct air sealing between the garage or crawl space and the home)

Objective(s):
Ensure occupant health and safety

Ensure indoor CO levels do not exceed outdoor CO levels



ALL houses must have carbon monoxide detectors installed near sleeping areas



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

Tools:

1. Combustion analyzer with probe
2. Personal CO monitor

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

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

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

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

2.0203.4b - Occupant education

Desired Outcome:
Ensure persistence of resident safety

Specification(s):
Occupants will be educated on the operation and maintenance of the CO alarm

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

Occupant will be provided information regarding the health effects and risk of high CO concentrations; EPA provides possible expanded actions and offers client education information in an appendix to the protocols

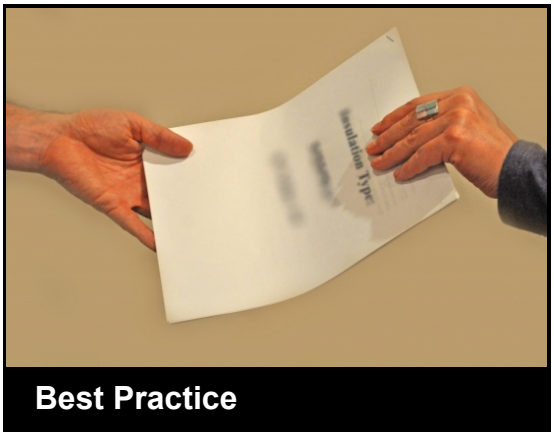
Objective(s):

Ensure occupant can operate and maintain installations

Inform occupant regarding possible CO hazards

Best Practice

Review CO alarm maintenance with occupant



Best Practice

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

2.0301.1 - Smoke Alarm

Desired Outcome:
Properly installed smoke alarms

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

2.0301.1a - Smoke alarm (hardwired)

Desired Outcome:
Properly installed smoke alarms

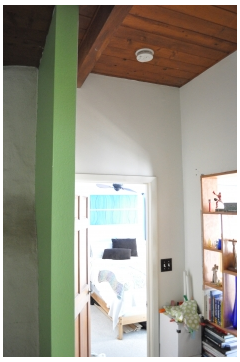
Specification(s):
When installing hardwired smoke alarms, it will be listed and labeled in accordance with UL 217 and installed in accordance with the IRC or as required by the authority having jurisdiction

Objective(s):
Ensure proper installation

Hard-wired smoke alarm mount wth alarm missing

Installation of hard-wired smoke alarm

When web-enabled, click link for IRC R314 on Smoke Alarm locations.



All homes should have smoke alarms installed near every sleeping area.

2.0301.1b - Smoke alarm (battery operated)

Desired Outcome:
Properly installed smoke alarms

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

Objective(s):
Ensure proper installation

2.0301.2 - Carbon Monoxide Alarm or Monitor

Desired Outcome:
Properly installed CO alarms or monitors

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

2.0301.2a - CO detection and warning equipment (hardwired)

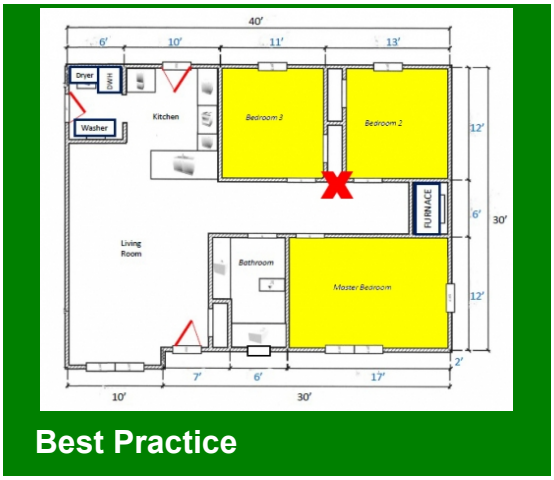
Desired Outcome:
Properly installed CO alarms or monitors

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

Installation will be accomplished by a licensed electrician when required by the authority having jurisdiction

Objective(s):
Ensure proper installation

All homes should have a carbon monoxide detector installed, whether hardwired or battery operated



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

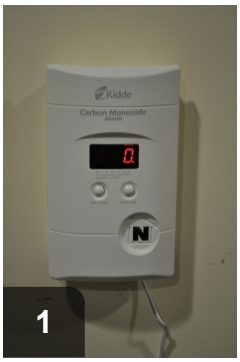
Tools:

1. Screwdriver

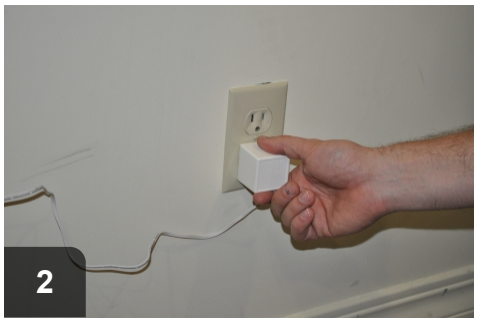
Materials:

1. Screws

Per WPN 17-7, full compliance with ASHRAE 62.2-2016 is required.



Mount alarm to wall close to bedrooms



Plug alarm into outlet. In addition, cord can be stapled into place.

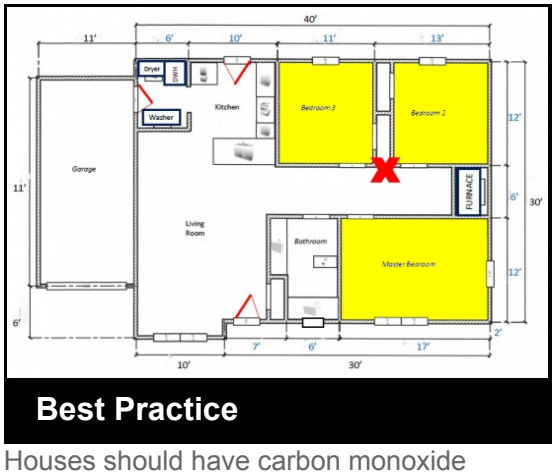
2.0301.2b - CO detection and warning equipment (battery operated)

Desired Outcome:
Properly installed CO alarms or monitors

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

Objective(s):
Ensure proper installation

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



Houses should have carbon monoxide monitors installed near sleeping areas

Tools:

1. Screwdriver

Materials:

1. Screws

Paraphrased from 2012 IRC R315: An approved CO alarm will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in all dwelling units. CO detectors will comply with UL 2075. Single-station CO alarms will comply with UL 2034 and will be installed in accordance with this code and the manufacturer's installation instructions. Per WPN 17-7, full compliance with ASHRAE 62.2.2016 and NFPA 720 is required.

2.0403.1 - Vented Crawl Spaces—Ground Moisture Barrier

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

2.0403.1a - Material Integrity

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

Specification(s):
Care will be taken to prevent punctures during installation

Objective(s):
Protect ground moisture barrier from damage during other crawl space work

2.0403.1b - Coverage

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

Specification(s):
A ground moisture barrier that covers the exposed crawl space floor will be installed

Objective(s):
Reduce ground moisture entering the crawl space

Uncovered crawl space floors can cause moisture damage

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

Materials:

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

2.0403.1c - Material specification

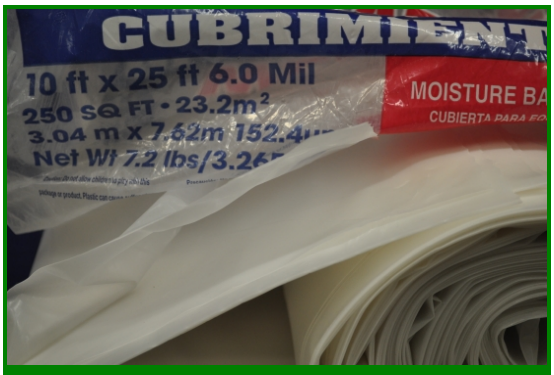
Desired Outcome:
Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

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

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

Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home (5 years), and it will need replacing to remain effective

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



After

Barrier must be at least 6 mil and able to withstand puncture

Materials:

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

The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of ≤0.1 (which translates to 6 mil or thicker). From 2007 IRC definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).

2.0403.1d - Overlap seams

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

Specification(s):
When seams exist, they will be overlapped a minimum of 12" using reverse or upslope lapping technique

Objective(s):
Keep water under the liner

Reduce the likelihood of damage at seams

Ground moisture barriers help keep moisture from permeating floor.

Ground moisture barrier overlaps at least 12 in and is securely fastened

Tools:

1. Stapler
2. Utility knife
3. Drill

Materials:

1. Ballast
2. Plastic sheeting (at least 6 mil)
3. Furring strips
4. Seam tape - moisture resistant

Securely fasten moisture barrier to wall at least 6 inches from ground

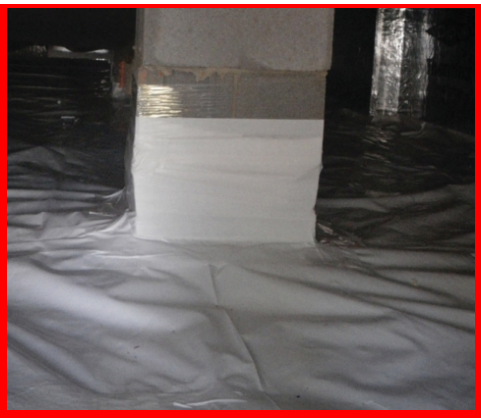
Overlap seams at least 12 inches, using a shingle method to keep water out

2.0403.1e - Fastening

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

Specification(s):
When ground moisture barrier is installed on sloping ground, may be exposed to wind, or accessed for routine maintenance or storage it will be fastened to ground with durable fasteners or ballast(s)

Objective(s):
Prevent movement of the ground moisture barrier



Before

Fastening of moisture barrier is required

After

Ground moisture barrier should extend up the wall and be held in place

Tools:

1. Stapler
2. Drill

Materials:

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

Seams can be taped to prevent water leakage

Ballast or fasteners can hold barrier in place securely

2.0403.2 - Closed Crawl Spaces—Ground Moisture Barriers

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

2.0403.2a - Material Integrity

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

Specification(s):
Care will be taken to prevent punctures during installation

Objective(s):
Protect ground moisture barrier from damage during other crawl space work

2.0403.2b - Coverage

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

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

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

Objective(s):
Reduce ground moisture entering the crawl space

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

Uncovered crawl space floors can lead to moisture issues

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

Materials:

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

2.0403.2c - Material specification

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

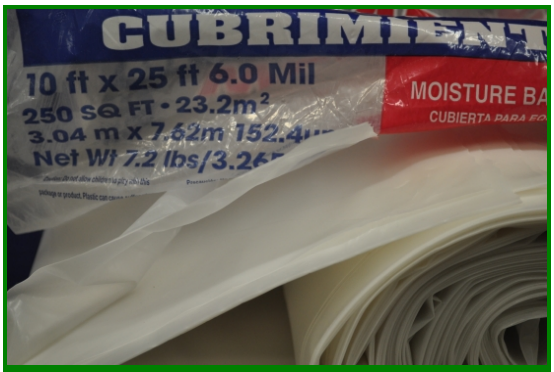
Specification(s):
A ground moisture barrier with a rating of no more than 0.1 perm will be used

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

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

Objective(s):
Reduce ground vapor entering the crawl space

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



Best Practice

Barrier must be at least 6 mil and able to withstand puncture

Materials:

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

The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of ≤0.1 (which translates to 6 mil or thicker). From 2007 IRC definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).

2.0403.2d - Overlap seams

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

Specification(s):
When seams exist, they will be overlapped a minimum of 12" with reverse or upslope lapping technique

For wall to floor connection, the wall moisture barrier will be installed under the ground moisture barrier

Objective(s):
Keep water under the liner

Ground moisture barriers help keep moisture from permeating floor

Ground moisture barrier overlaps at least 12 in and is securely fastened

Tools:

1. Stapler
2. Utility knife
3. Drill

Materials:

1. Ballast
2. Plastic sheeting (at least 6 mil)
3. Furring strips
4. Moisture-resistant adhesive tape

Securely fasten moisture barrier to wall at least 6 inches from ground

Overlap seams at least 12 inches, using a shingle method to keep water out

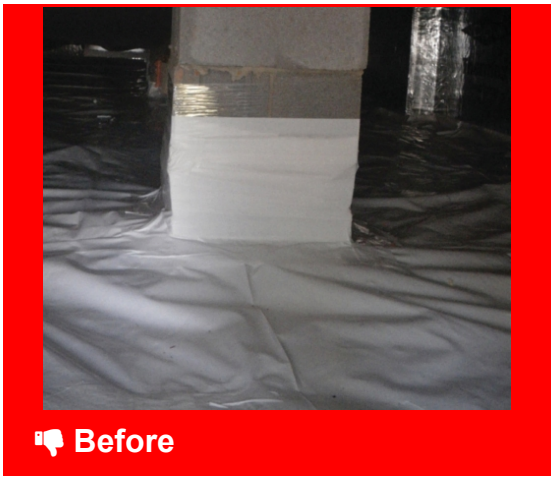
2.0403.2e - Fastening

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

Specification(s):
When ground moisture barrier is installed on sloping ground, or accessed for routine maintenance or storage it will be fastened to ground with durable fasteners or ballast(s)

Objective(s):

Prevent movement and uplift of the air barrier and ground moisture barrier



Before

Moisture barrier needs to be held in place with more permanent fasteners

After

Ballast or fasteners should be used to hold barrier in place securely

Tools:

1. Drill
2. Stapler

Materials:

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

2.0403.2f - Sealing seams

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

Specification(s):
A durable sealant compatible with the air barrier and ground moisture barrier will be used

Objective(s):
Maintain continuous air barrier and ground moisture barrier

Before

Crawl spaces lacking moisture barrier risk moisture penetration of floor

After

Ground moisture barriers in unvented spaces should be sealed

Tools:

1. Utility knife

Materials:

1. Moisture-resistant adhesive tape

Tape wall seams and press to ensure airtight bonding of adhesive

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

2.0403.2g - Air barrier, ground moisture barrier penetrations, including fastener penetrations

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

Physical attachments will be provided where practical (e.g., masonry columns, footings)

Objective(s):

Maintain continuous air barrier and ground moisture barrier

2.0403.2h - Drainage

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

Specification(s):
The air barrier and ground moisture barrier will not interfere with the established drainage pattern

Objective(s):
Ensure proper drainage

2.0403.2i - Drainage points

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

Specification(s):
Interior drainage collection points will be accessible from above and below the air barrier and ground moisture barrier

Objective(s):
Remove water above and below the air barrier and ground moisture barrier

2.0601.1 - Knob and Tube Wiring

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

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

2.0601.1a - Knob and tube identification

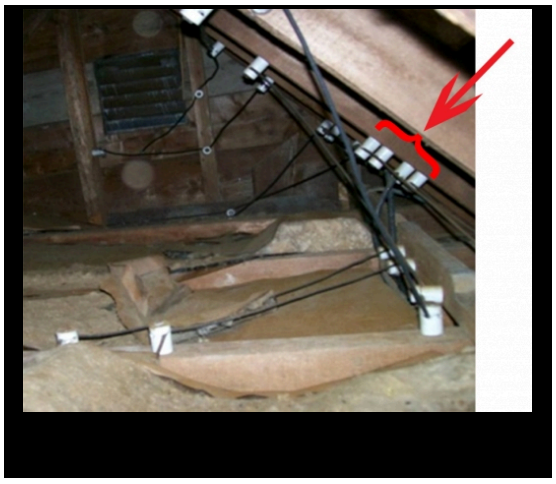
Desired Outcome:
Live unsafe wiring identified and brought to local codes

Specification(s):
Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring

Objective(s):
Ensure occupant safety

Preserve the integrity and safety of the house


Knob and tube wiring should be identified before work begins


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

2.0601.1b - Live wire testing

Desired Outcome:

Live unsafe wiring identified and brought to local codes

Specification(s):
Non-contact testing method will be used to determine if wiring is live

Objective(s):
Protect occupant safety

Preserve the integrity and safety of the house

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

Live wiring should be dammed or professionally disabled before insulating

Tools:

1. Non-contact wire tester

2.0601.1c - Isolation and protection

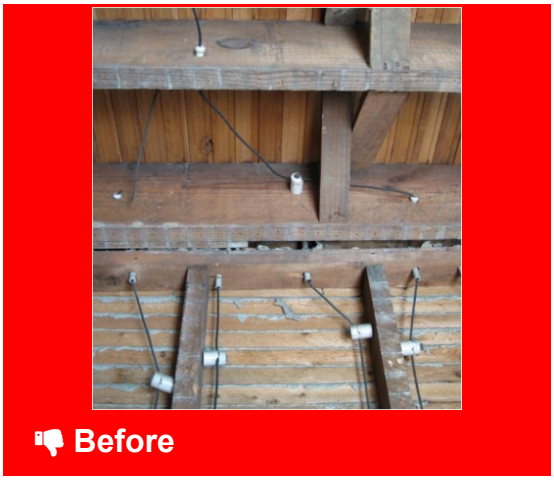
Desired Outcome:
Live unsafe wiring identified and brought to local codes

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

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

Objective(s):
Ensure occupant safety

Preserve the integrity and safety of the house



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. Check your local codes.

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

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

Warning sign should remind to contact certified electrician for repairs

Many jurisdictions require a sign in Spanish as well

Damming should extend above installed height of insulation

With dams in place, insulation can begin

2.0601.1d - Replacement

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

Specification(s):
Wiring will be replaced with new appropriate wiring in accordance with the NEC National Electrical Code and local codes

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

Objective(s):
Ensure occupant safety

Preserve the integrity and safety of the house

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

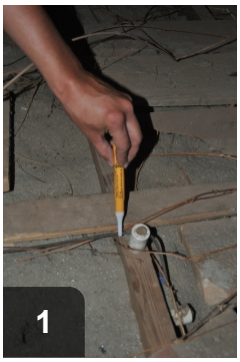
Tools:

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.



The entire knob and tube system should be disabled

Many electricians will remove old exposed wiring to prevent reactivation

Exposed knob and tube should be replaced with modern wiring

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

2.0701.2 - Crawl Space Information Sign

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

Note:

2.0701.2a - Sign specifications

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

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

A minimum expected service life of 10 years will be ensured

Objective(s):
Prevent damage to the crawl space after upgrade

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

Best Practice

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

2.0701.2b - Sign content

Desired Outcome:
Posted signs inside of the crawl space provide essential safety and maintenance information to

occupant and users of the crawl space

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

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

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

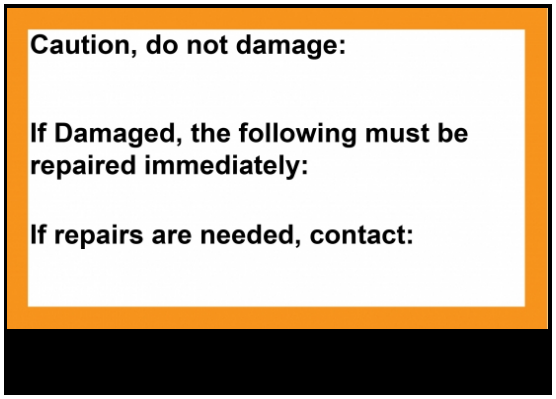
Objective(s):
Prevent damage to the crawl space after upgrade

Educate anyone entering the crawl space

Provide occupants with a way to contact the installer

Best Practice

Mount sign where clearly visible to anyone entering crawl space



Be sure sign includes relevant information to aid occupant in repairs

Tools:

1. Printer
2. Staple gun

Materials:

1. Paper
2. Laminant
3. Staples

Cuidado, no dañar:

Si está dañado, estos deben ser reparados inmediatamente:

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

Hacer la señal en español también

2.0701.2c - Hazard warning

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

Specification(s):
Language prohibiting storage of hazardous and flammable materials will be provided on site

Objective(s):
Prevent storage of hazardous or flammable materials in the crawl space

Maintain indoor air quality

Prevent a fire hazard

Best Practice

Mount sign where anyone entering the crawl space can see it

PROHIBITED: DO NOT store Hazardous or Flammable Materials in this space

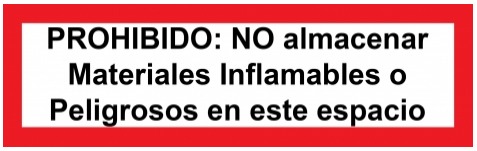
Alert those entering the crawl space never to store hazardous materials

Tools:

1. Staple gun
2. Printer

Materials:

1. Paper
2. Laminant
3. Staples



Hacer la señal en español también

3.1001.1 - Penetrations and Chases

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

3.1001.1a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a chase

Repairs will be completed before work

Objective(s):
Repair moisture-related issues

3.1001.1b - Backing and infill

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

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

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

Objective(s):
Minimize hole size to ensure successful use of sealant

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

Ensure sealant does not fall out

3.1001.1c - Sealant selection

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

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

Sealants will allow for differential expansion and contraction between dissimilar materials

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

Objective(s):
Select permanent sealant

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

3.1001.1d - High temperature application

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

Specification(s):
Only non-combustible sealant will be used in contact with chimneys, vents, and flues

Local codes will be referenced

Objective(s):
Prevent a fire hazard

Before

Gaps around combustion exhaust flues need to be sealed

After

Sealed penetrations and chases should utilize high-temperature materials

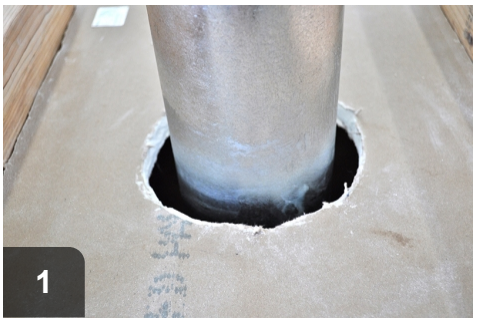
Tools:

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

Materials:

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

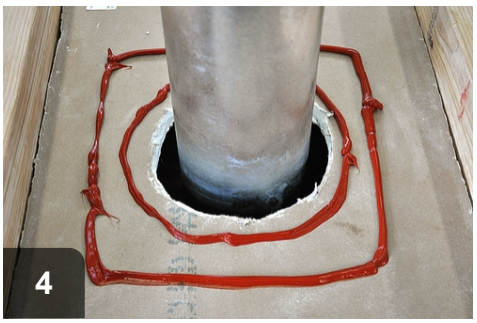
See 3.1402.1c for Clearance Requirements

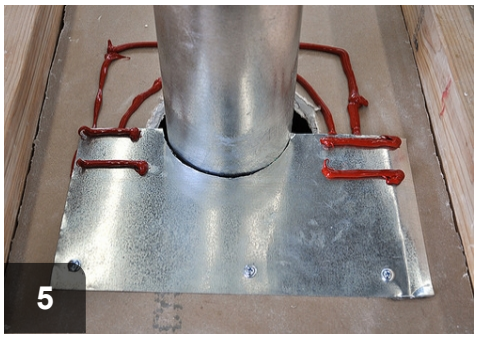


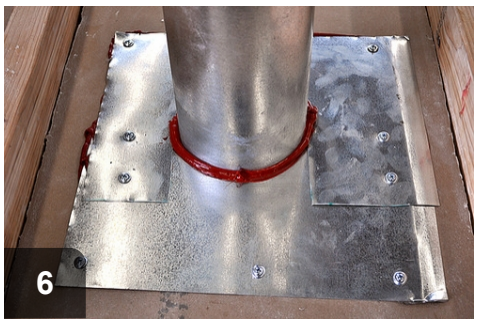
Prepare work area by removing any insulation and debris

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 (26-gauge steel) and apply additional caulking	Fasten rigid material to cover penetration and seal against flue with caulk

3.1001.2 - Chase Capping

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

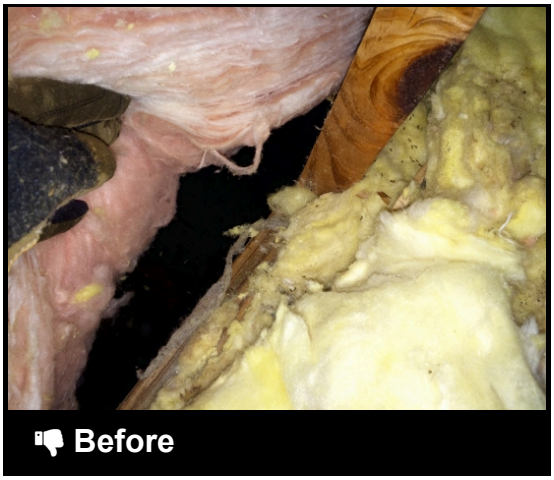
3.1001.2a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a chase

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues



Investigate under insulation in chases to verify they are undamaged

Water damage in chase due to hole to the outside

Tools:

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

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

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

Clear away insulation and debris to allow inspection

Carefully investigate areas with high potential for water leaks

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

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

Specification(s):
Entire opening will be spanned with rigid material

Material will be cut to fit and fastened as required

Objective(s):
Reduce opening to what can be sealed with sealant

Unsealed standard chases covered with drywall can be leakage points

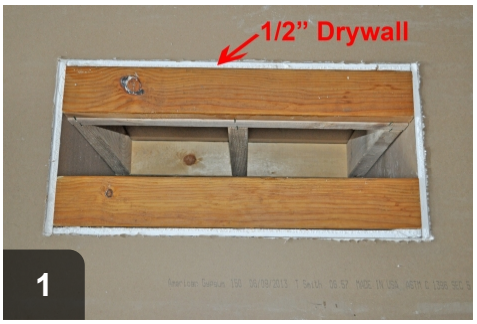
The air barrier is be maintained by capping chases with rigid material

Tools:

1. Drill/screwdriver
2. Caulk gun

Materials:

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



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

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

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

Objective(s):
Prevent a fire hazard

Before

Paneled drop soffits typically are more combustible than plain drywall

After

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

Tools:

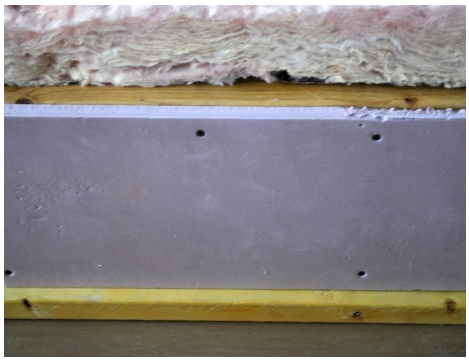
1. Drywall saw
2. Tape measure
3. Caulk gun
4. Drill

Materials:

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

EPS or bead-board are not acceptable materials.

Sealing with drywall reduces overall combustibility of paneled chases



Sealing with XPS also reduces overall combustibility of paneled chases

3.1001.2d - Support

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

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

Objective(s):
Ensure seal stays in place and does not sag

Spans greater than 24 inches require additional bracing before capping

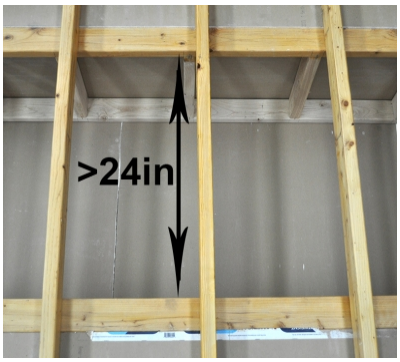
Support should prevent cap from sagging or moving

Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners



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

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

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

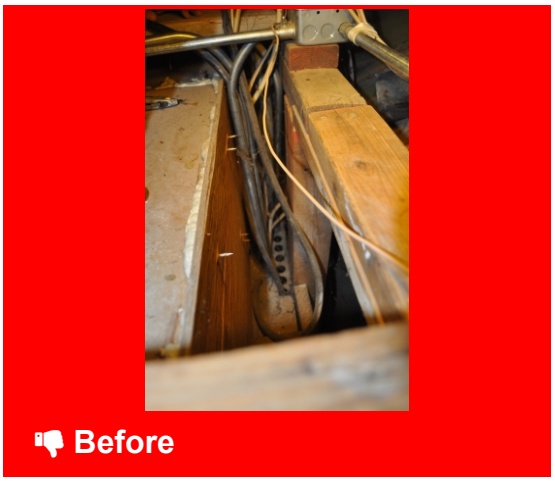
Once chase is capped, it is now ready to be sealed along framing

3.1001.2e - Joint seal

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

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag



Chases need to be capped and sealed to prevent leakage

Chase is sealed along all cracks, gaps, and penetrations

Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk

Always wear protective gloves when working with sealants.

Chase has been capped but needs to be sealed

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

Cap is sealed

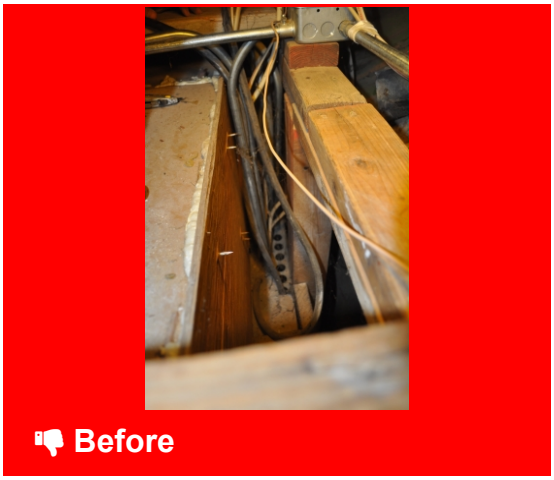
3.1001.2f - Adjacent framing

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

Specification(s):
All remaining gaps at the top of the chase will be sealed

Objective(s):

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



Chases need to be capped and sealed to prevent leakage

Chase is sealed along all cracks, gaps, and penetrations

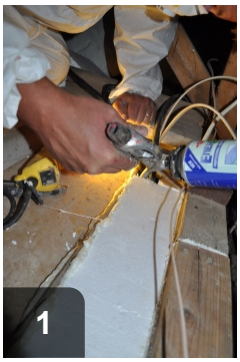
Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk

Always wear gloves when working with sealant.



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

Extend seal along adjacent framing

3.1001.3 - Walls Open to Attic—Balloon Framing and Double Walls

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

3.1001.3a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues

3.1001.3b - Sealing methods

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

Specification(s):
Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

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

Wall cavities are open to attic

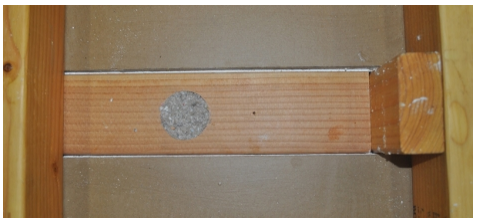
Whatever option chosen, test for visible air movement with smoke pencil

Tools:

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

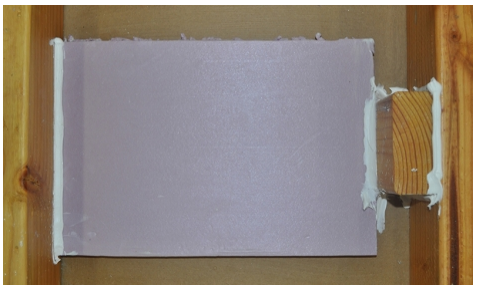
Materials:

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


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

3.1001.3c - Support

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

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

Objective(s):
Ensure seal stays in place and does not sag

Spans greater than 24 inches require additional bracing before capping

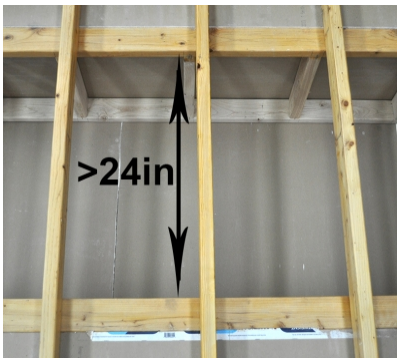
Support should prevent cap from sagging or moving

Tools:

1. Saw
2. Drill
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners



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

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

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

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

3.1001.3d - Joint seal

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

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag

Balloon framing needs to be capped and sealed to prevent leakage

All edges of the cap should be sealed to surrounding surfaces

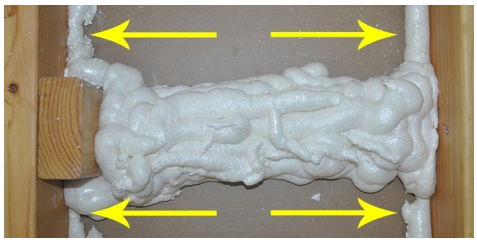
Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk

For rigid material applications, extend sealant along all seams



Extend sealant or SPF along joist to seal all gaps

3.1001.3e - Adjacent framing

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

Specification(s):
All remaining gaps at the top of the opening will be sealed

OR

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

Objective(s):

Ensure airtight seal from one finished side of the wall assembly to the other

Before

Balloon framing needs to be capped and sealed to prevent leakage

After

All edges of the cap should be sealed to surrounding surfaces, including adjacent framing

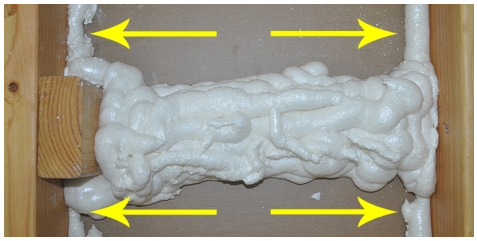
Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam (SPF)
2. Caulk

For rigid material applications, sealant should be applied to framing



When using SPF to bridge cavity, extend SPF along joist and adjacent framing

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

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

Note:

3.1003.1a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues

3.1003.1b - Sealing methods

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

Specification(s):
Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

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

OR

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with SPF

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

Objective(s):
Prevent air leakage from dropped ceiling to attic

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

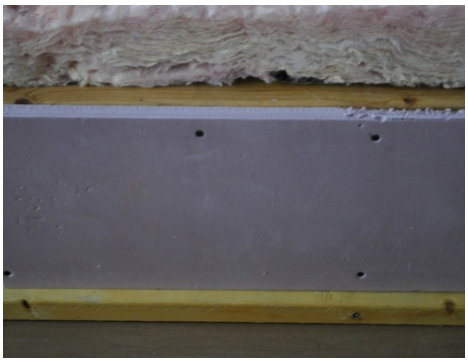
Materials:

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

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

3.1003.1c - Support

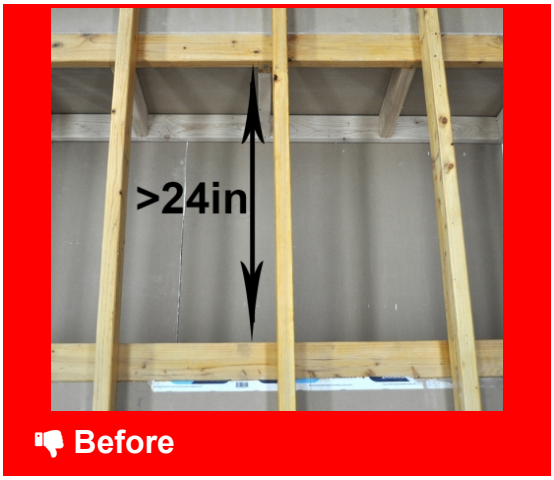
Desired Outcome:

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

Specification(s):

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

Objective(s):
Ensure seal stays in place and does not sag



Spans greater than 24 inches require additional bracing before capping

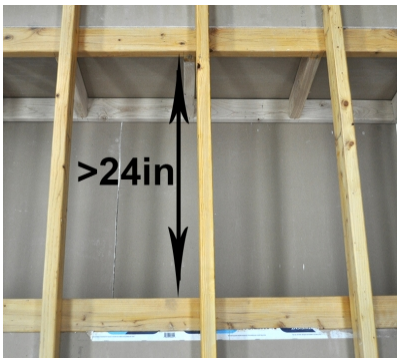
Support should prevent cap from sagging or moving

Tools:

1. Saw
2. Drill
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners



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


When supporting from above, apply adhesive between drywall and bracing


Bracing can be screwed to drywall before capping chase

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

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

3.1003.1d - Joint seal

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

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag

Damage to an old ceiling reveals a newer ceiling below

No gaps should remain after sealant is applied

Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Caulk
2. Spray foam

Apply sealant to surrounding surfaces before setting cap in place

Sealant should extend along joists and into seams at top plates

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

3.1003.1e - Adjacent framing

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

Specification(s):
All remaining gaps will be sealed at the top of the dropped ceiling

OR

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

Objective(s):
Provide airtight framing from one finished side of the dropped ceiling to the other

Damage to an older ceiling reveals the new ceiling below

No gaps should remain after spray foam is applied

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Spray foam
2. Caulk sealant

Caulk along all joists before setting cap

Use sealant to fill all remaining gaps

3.1003.2 - Ceiling Leaks Not Repairable—No Air Barrier Above

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

Note:

3.1003.2a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues

3.1003.2b - Sealing methods

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

Specification(s):
Ceiling or roof and wall air and thermal barriers will be connected with a rigid airtight connection around the perimeter

OR

If ceiling will support an air barrier and insulation, a rigid airtight barrier (e.g., gypsum) will be attached to current ceiling either above or below

OR

Intermediate framing will be used to support air and thermal barrier

OR

Rigid airtight thermal barrier will be installed at the roof sheathing

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

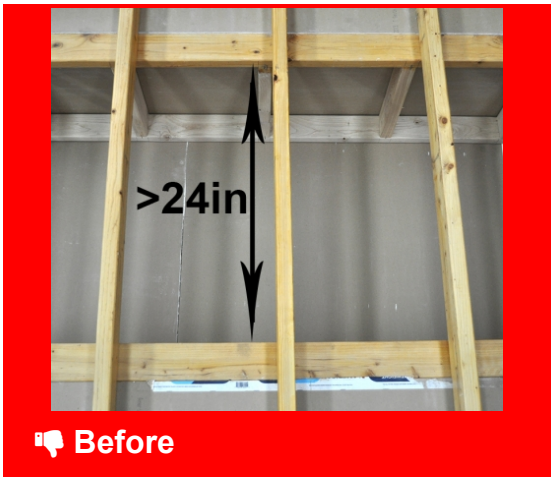
Objective(s):
Prevent air leakage from dropped ceiling to attic

3.1003.2c - Support

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

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

Objective(s):
Ensure seal stays in place and does not sag



Spans greater than 24 inches require additional bracing before capping

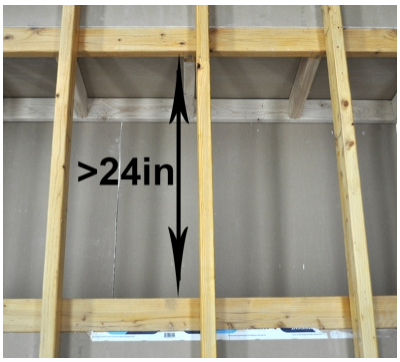
Support should prevent cap from sagging or moving

Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners



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

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

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

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

3.1003.2d - Joint seal

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

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag

Before

Dropped soffits need to be capped and sealed to prevent leakage

After

No gaps should remain after sealant is applied

Tools:

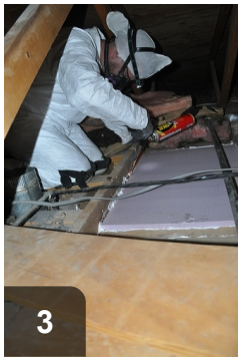
1. Caulk gun
2. Spray foam gun

Materials:

1. Spray foam
2. Caulk

Apply sealant to surrounding surfaces before setting cap in place

Sealant should extend along surround joist and into seams at top plates



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

3.1003.2e - Adjacent framing

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

Specification(s):
All remaining gaps will be sealed at the top of the dropped ceiling

OR

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

Objective(s):

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

Dropped soffits need to be capped and sealed to prevent leakage

No gaps should remain after sealant is applied along adjacent framing

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Spray foam
2. Caulk sealant

Sealant should have been along all joists and adjacent framing before cap was set

Additional sealant should fill in all remaining gaps after cap has been set

3.1003.3 - Above Closets and Tubs

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

Note:

3.1003.3a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues

3.1003.3b - Above closets and tubs

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

Specification(s):
Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

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

OR

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with SPF

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

Objective(s):
Prevent air leakage from dropped ceiling to attic

Before

Unsealed drop soffits over tubs and closets can be a point of leakage

After

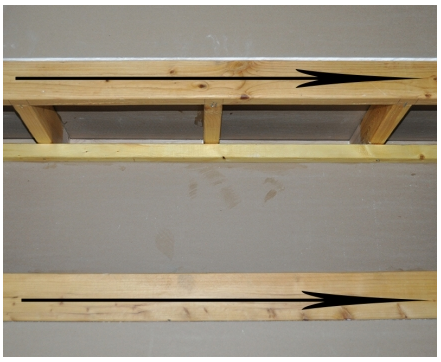
Capped soffits minimize leakage to and from unconditioned spaces

Tools:

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

Materials:

1. XPS
2. Drywall
3. Plywood
4. Caulk
5. Spray foam
6. Dense packable insulation
7. Fasteners
8. Wrapped fiberglass batts



Option 1, Step 1: Apply sealant to top-plates or other relevant surfaces

Option 1, Step 2: Cover soffit with rigid material, such as drywall

Option 1, Step 3: Secure the rigid material with screws

Option 2: Cover face of stud bay with rigid material, like XPS or plywood

Option 3: Dense pack cavity through fastened wood cap

Option 4: Bridge stud bay with wrapped fiberglass and spray foam

All Options: Test with smoke pencil to verify no air movement

3.1003.3c - Support

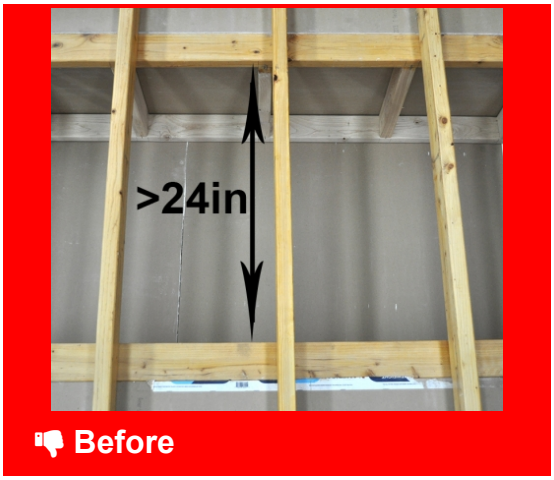
Desired Outcome:

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

Specification(s):

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

Objective(s):
Ensure seal stays in place and does not sag



Spans greater than 24 inches require additional bracing before capping

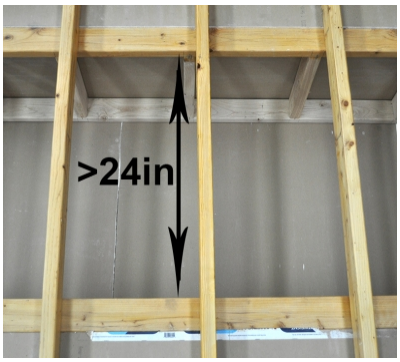
Support should prevent cap from sagging or moving

Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners



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


When supporting from above, apply adhesive between drywall and bracing


Bracing can be screwed to drywall before capping chase

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

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

3.1003.3d - Joint seal

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

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag

Uninsulated soffits can cause leakage to and from unconditioned spaces

No gaps should remain after spray foam is applied

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Caulk
2. Spray foam

Caulk surrounding surfaces before setting cap in place

Sealant should extend along surround joist and into seams at top plates

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

3.1003.3e - Adjacent framing

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

Specification(s):
All remaining gaps at the top of the dropped ceiling will be sealed

Objective(s):
Provide airtight framing from one finished side of the dropped ceiling to the other

Dropped soffits need to be capped and sealed to prevent leakage

No gaps should remain after sealant is applied along adjacent framing

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Caulk sealant
2. Spray foam

Apply sealant to surrounding surfaces before setting cap in place

Sealant should extend along adjacent framing and into seams at top plates

Additional sealant should fill in all remaining gaps after cap has been set

3.1003.4 - Dropped Ceilings

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

3.1003.4a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues

3.1003.4b - Sealing methods

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

Specification(s):
Entire opening will be spanned with rigid material installed 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

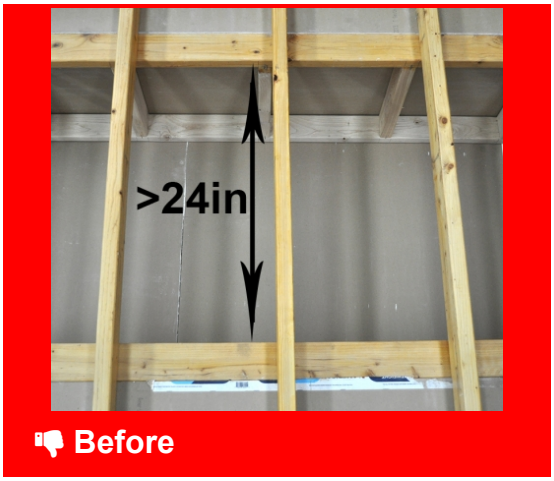
Objective(s):
Prevent air leakage from dropped ceiling to attic

3.1003.4c - Support

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

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

Objective(s):
Ensure seal stays in place and does not sag



Spans greater than 24 inches require additional bracing before capping

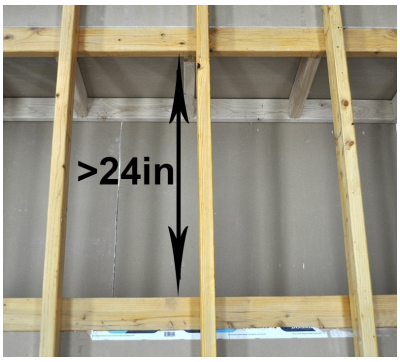
Support should prevent cap from sagging or moving

Tools:

1. Saw
2. Drill
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners



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

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

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

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

3.1003.4d - Joint seal

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

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Pre-fabricated units may be used when meeting the desired outcome

Objective(s):
Provide airtight, durable seal that does not move, bend or sag

Before

Dropped soffits need to be capped and sealed to prevent leakage

After

No gaps should remain after spray foam is applied

Tools:

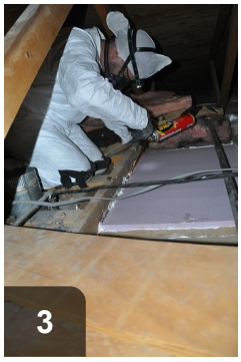
1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk sealant

Caulk surrounding surfaces before setting cap in place

Sealant should extend along surround joist and into seams at top plates



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

3.1003.4e - Adjacent framing

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

Specification(s):
All remaining gaps will be sealed at the top of the dropped ceiling

OR

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

Objective(s):

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

Before

Dropped soffits need to be capped and sealed to prevent leakage

After

No gaps should remain after sealant is applied along adjacent framing

Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk

1

Sealant should have been along all joists and framing before cap was set

2

Additional sealant should fill in all remaining gaps after cap has been set

3.1003.6 - Dropped Soffits

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

Note:

3.1003.6a - Pre-inspection

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

Specification(s):
An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):
Repair moisture-related issues

3.1003.6b - Soffit general

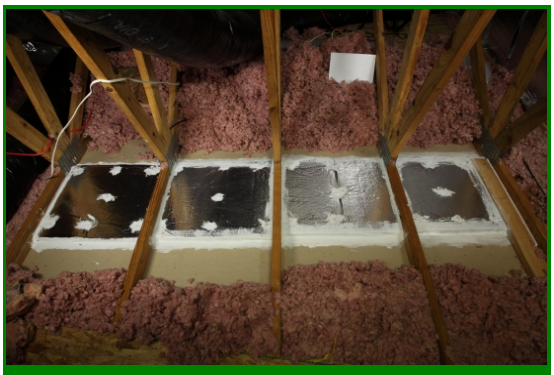
Desired Outcome:
Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):
Air flow will be blocked at soffit in locations where access allows

Objective(s):
Provide continuous air barrier across soffit openings

Before

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



After

Completely sealed drop soffits and chases minimize heat transfer

Tools:

1. 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 is a variety of ways to seal soffits. Please examine 3.1003.6c and 3.1003.6d for more information.

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

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

Specification(s):
Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

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

Reduce opening to what can be sealed with sealant

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

Bring soffit into thermal boundary

Standard soffits are often open to the attic and uninsulated

Rigid material encloses the soffit into the conditioned living space

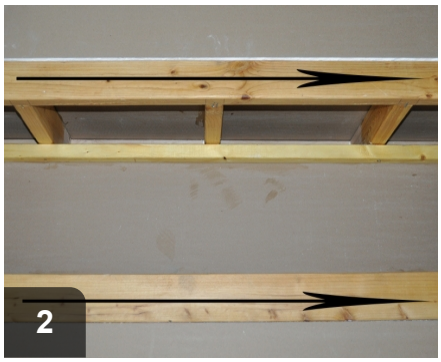
Tools:

1. Drill/screwdriver
2. Caulk gun

Materials:

1. Drywall
2. Sealant

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

Insulate over now-capped soffit

and create air barrier

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

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

Specification(s):
Each stud bay will be spanned with rigid material will be cut to fit and fastened as required

OR

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

OR

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

OR

A sealed rigid barrier will be installed at all transitions

Objective(s):
Prevent air leakage from wall to soffit

Reduce opening to what can be sealed with sealant

Ensure soffit is outside of the thermal boundary

Before

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

After

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

Tools:

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

Materials:

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

Clear work area of insulation and debris

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

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

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

3.1003.6e - Soffits containing non-IC rated recessed lights

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

Specification(s):
Insulation will be kept at least 3" away from the top and side of any fixtures

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

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

Objective(s):
Prevent light fixture from overheating

Bring light fixture inside of the air barrier

3.1201.1 - Double-Hung Wood Windows

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

3.1201.1a - Lead paint assessment

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

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

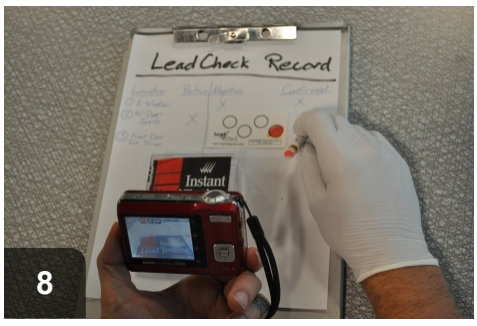
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative.

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

3.1201.1b - Weather stripping

Desired Outcome:

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

Specification(s):
Existing weather stripping and sash sealant will be removed

Surface where the sill meets the sash will be cleaned

Seal between the fixed components of the window (e.g., jambs, sill) will be continuous and complete while maintaining the operability of the window

Continuous and complete weather stripping will be installed on the bottom of the lower sash where it makes contact with the sill and at the top of the upper sash where it makes contact with the upper part of the window frame

Objective(s):
Form a complete seal from the outer edge of the sash to the jamb

Maintain operability of the window

3.1201.1c - Sash locks

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

Specification(s):
Locks will be installed so that the rails of the upper and lower sashes are flush and in full contact

No gaps will be visible between the two sashes

Locks will be installed to achieve compression of the two sashes

Objective(s):
Form a secure connection between the two sashes

3.1201.1d - Replacement sills

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

Specification(s):
Beveled sill will be flush with interior wall and sloped to the exterior

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

Sill will be water-sealed and primed

Objective(s):
Form a complete seal from the bottom of the lower sash to the sill

Maintain operability of the window

Allow for drainage to the exterior

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


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

3.1201.1e - Sash replacement

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

Specification(s):
Lower sash will have the same bevel on the bottom rail as the sill

Sash will be water-sealed and primed

Objective(s):
Ensure sash remains in a fixed position when open or partially open

Maintain operability of the window

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

3.1201.1f - Adjust stops

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

Specification(s):
Stops will be adjusted to eliminate visible gaps between the stops and the jamb while maintaining operability of the window

Objective(s):
Form a complete seal between the jamb, sash, and stop

Maintain operability of the window

3.1201.1g - Replace stops

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

Specification(s):
Stops will be installed to keep the window securely in place

Stops will be adjusted to eliminate visible gaps between the stops and the jamb while maintaining operability of the window

Objective(s):
Form a complete seal between the jamb, sash, and stop

Maintain operability of the window

3.1201.2 - Single-Unit Window and Fixed Frame with Wood Sash

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

Note:

3.1201.2a - Lead paint assessment

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

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

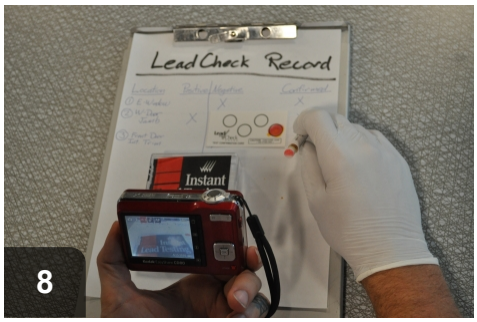
Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

Break capsule and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative

If negative, verify validity of test with provided calibration card



Lead in calibration card should test positive and turn spot red	Record test results to maintain documentation

3.1201.2b - Operable windows

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

Specification(s):
All egress windows will be operable as required by local codes

Objective(s):
Maintain operability of egress windows

3.1201.2c - Air infiltration

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

Specification(s):
Details that reduce air infiltration will be repaired, replaced, sealed, or installed (e.g., new latch for meeting rail connection, pulley seals, rope caulking for other cracks, interior storm windows)

State Energy Conservation Code or local code requirements for air leakage should be met (whichever is more stringent)

Objective(s):
Reduce air infiltration

3.1201.2d - Water infiltration

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

Specification(s):
Details that reduce water infiltration will be repaired, replaced, or installed (e.g., replace missing glazing compound on sash, exterior caulking, exterior storm windows)

Objective(s):
Reduce water infiltration

3.1201.2e - Occupant education and maintenance

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

Specification(s):
Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window

Objective(s):
Ensure long-term weather tightness

3.1201.3 - Exterior Doors

Desired Outcome:
Doors operable and weather tight

Note:

3.1201.3a - Lead paint assessment

Desired Outcome:
Doors operable and weather tight

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

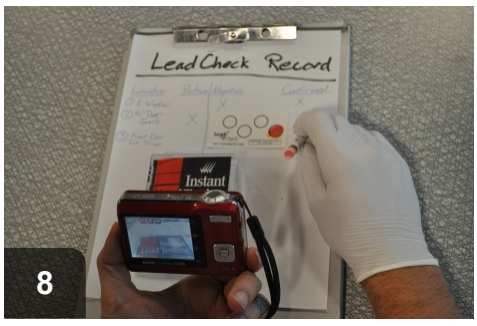
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

3.1201.3b - Door operation and fit

Desired Outcome:

Doors operable and weather tight

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

Objective(s):
Ensure proper operation of the door

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

With proper adjustment, doors should hang true and minimize leakage

Tools:

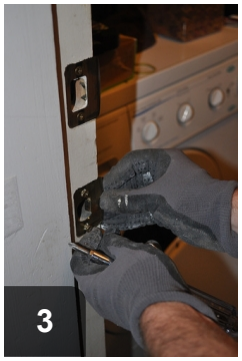
1. Screwdriver
2. Planer

Materials:

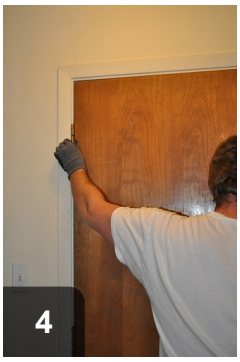
1. Shims

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 - Air infiltration

Desired Outcome:
Doors operable and weather tight

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

Objective(s):
Reduce air infiltration

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

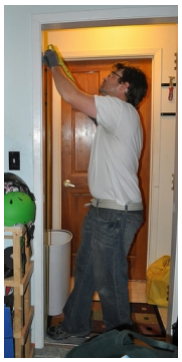
Remove leaky door in order to affix door bottom

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

Trimming to allow for door bottom

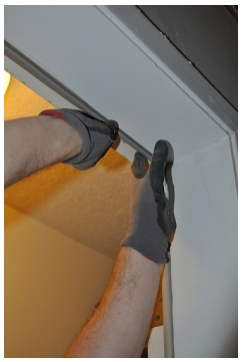
Cut door bottom to width of door

Ensure door bottom fits snugly around door and fasten into place

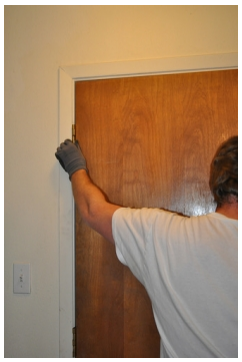


Measure doorway for weatherstripping

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 - Water infiltration

Desired Outcome:
Doors operable and weather tight

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

Objective(s):
Reduce water infiltration

Daylight visible under exterior doors indicate water can leak in

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

Tools:

1. Caulk gun
2. Screwdriver
3. Pry bar

Materials:

1. Caulk sealant

Adjust threshold to minimize gap and keep water out

Caulk along threshold from inside and outside to prevent water infiltration

3.1201.3e - Occupant education and maintenance

Desired Outcome:
Doors operable and weather tight

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

Objective(s):
Ensure long-term weather tightness

3.1202.1 - Fixed Frame with Wood Sash—Older House

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

3.1202.1a - Lead paint assessment

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

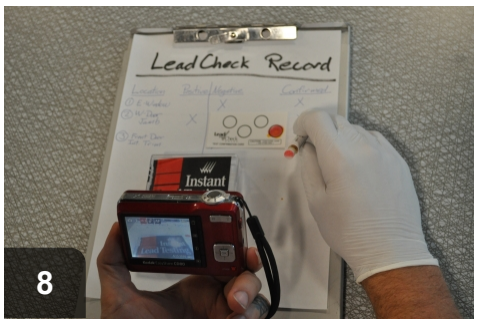
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

3.1202.1b - Broken glass removal

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):

Putty and push points will be removed

Broken or cracked glass will be removed

Objective(s):

Safely remove old glass

Broken glass with failed repairs needs to be replaced

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

Tools:

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

Materials:

1. Tape

Always wear heavy work gloves when handling broken or cut glass. See also 2.0100.1b for Hand Protection.

Cut through caulk bead and glazing to

Remove old putty and glazing to

Wear heavy work gloves when

ease removal

expose metal points holding glass in place

working with broken or cut glass

With sash cleared of debris, measure opening for replacement pane

Cut replacement glass 1/8" smaller than measured opening

3.1202.1c - Sash preparation

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):
Opening will be cleaned

Objective(s):
Prepare opening for new glass

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

Mount new glass onto a clean surface

Tools:

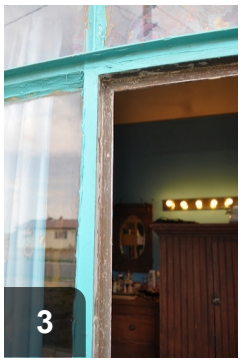
1. Chisel
2. Utility knife

Materials:

1. Sand paper
2. Cleaning solution
3. Rags

Debris in the sash can cause new glass to seal improperly

Check closely to remove all pieces of broken glass and debris



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

3.1202.1d - New glass installation

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):
Glass will be sized 1/8" to 3/16" smaller than opening to allow for movement of frame

Safety glass will be installed in accordance with local codes

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

Glazing compound will be added in accordance with manufacturer specifications

Objective(s):
Ensure glazing compound will adhere to sash

Install, seal, and secure new glass in place

Allow glazing compound to harden to ensure secure installation

Before

With sash prepared, installation of new pane can begin

After

Replacement glass should be securely fixed with points and glazing

Tools:

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

Materials:

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

Always wear heavy work gloves when handling broken or cut glass. See also 2.0100.1b for Hand Protection.

With broken glass removed, measure opening for replacement glass

Cut replacement glass 1/8" smaller than measured opening

Wear heavy work gloves when working with broken or cut glass

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

3.1202.2 - Single-Unit Window, Mounted on Rough Opening—Newer House

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

3.1202.2a - Lead paint assessment

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

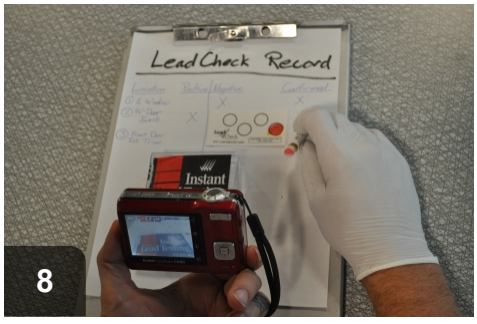
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

3.1202.2b - Broken glass removal

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):

Window stops and damaged glass will be removed

Objective(s):

Safely remove old glass

Broken glass with failed repairs needs to be replaced

After larger pieces are removed, the sash still needs preparation

Tools:

1. Putty knife
2. Chisel
3. Utility knife
4. Shop vaccuum
5. Tape measure
6. Gloves

Materials:

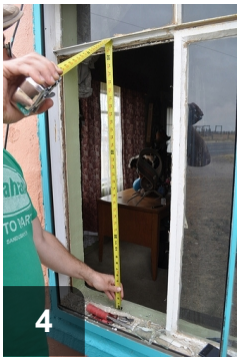
1. Tape

Always wear heavy work gloves when handling broken or cut glass. See also 2.0100.1b for Hand Protection.

Cut through caulk or glazing to simplify removal

Remove old putty and glazing from glass to expose pin nails holding glass

Always wear heavy work gloves when handling broken or cut glass



With sash cleared of debris, measure opening for replacement pane

Cut replacement glass 1/8" smaller than measured opening

3.1202.2c - Opening preparation

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):
Opening will be cleaned

Glazing tape will be removed or replaced

Objective(s):
Prepare opening for new glass

Remove all debris, glazing tape, and glass from sash

Sash surface must be clean before mounting new glass

Tools:

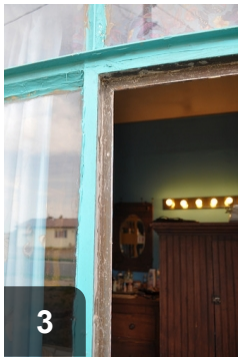
1. Chisel
2. Utility knife

Materials:

1. Cleaning solution
2. Rags

Debris in the sash can cause new glass to seal improperly

Check closely to remove and collect all broken glass and debris



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

3.1202.2d - New glass installation

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):
Replacement glass will be sized to original width, height, and depth

Stops will be replaced or installed

Wood stops will be sealed to glass with appropriate sealant

Glass will be selected with comparable tint and coating (color and look)

Tempered glass will be installed as required by local codes

Glazing compound will be added in accordance with manufacturer specifications

Objective(s):
Install, seal, and secure new glass in place

Allow glazing compound to harden to ensure secure installation

With sash prepared, new pane installation can begin

Replaced glass should be held in place while glazing sets

Tools:

1. Caulk gun
2. Tape measure
3. Light-duty hammer

Materials:

1. Trim

Always wear heavy work gloves when handling broken or cut glass. See also 2.0100.1b for Hand Protection.

With broken glass removed, measure rough opening for replacement glass size

Cut replacement glass 1/8" smaller than measured opening

Wear heavy work gloves when working with broken or cut glass

With sash prepared, shim glass to center in opening and reinstall stops

Apply window glazing to air seal new pane

3.1203.1 - Replacement Window in Existing Window Frame

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

3.1203.1a - Lead paint assessment

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

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

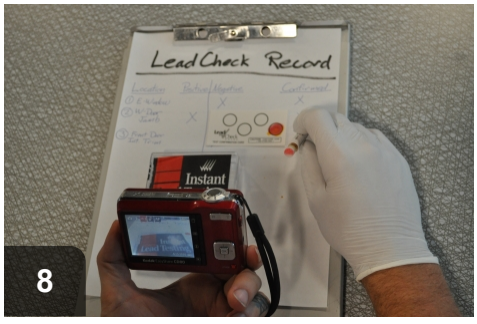
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative

If negative, verify validity of test with provided calibration card

Lead in calibration card should test positive and turn spot red



Record test results to maintain documentation

3.1203.1b - Opening preparation

Desired Outcome:

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

Specification(s):
Interior stops, sashes, parting strips, and pulleys will be removed

Opening will be cleaned

Objective(s):
Provide a clean opening for replacement window unit

Wooden window still in opening

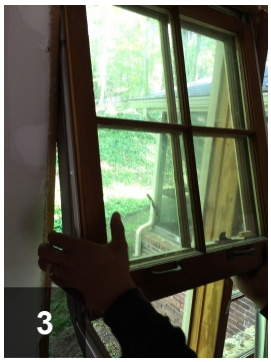
Wood window with sashes removed before replacement

Tools:

1. Stiff bladed scraper or putty knife
2. Single-edge razor blade scraper

Wood double-hung window

Remove stop moulding (non-lead based paint). For lead based paint work requirements, visit http://www2.epa.gov/lead



Remove sashes and balances (tracks). Remove sash cords and pry pulleys out of the jamb in older units

Scrape loose paint and thoroughly clean opening

3.1203.1c - Replacement window installation

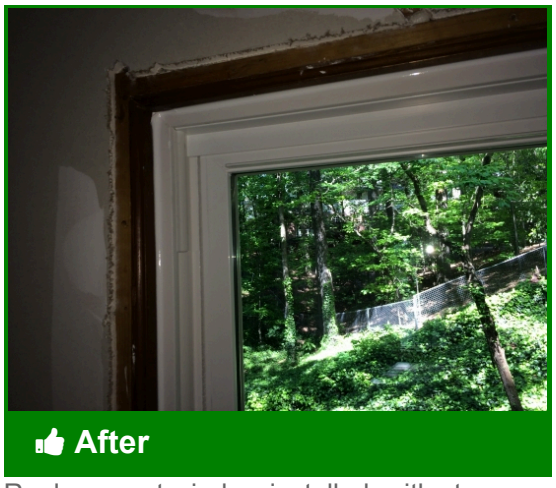
Desired Outcome:
Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

Specification(s):
Replacement window will be installed in accordance with manufacturer specifications, ensuring that the exterior stops are caulked

Objective(s):
Ensure replacement window operates properly

Ensure replacement window has a weather tight fit

Window opening ready to receive replacement window



Replacement window installed, with stop molding replaced and caulked

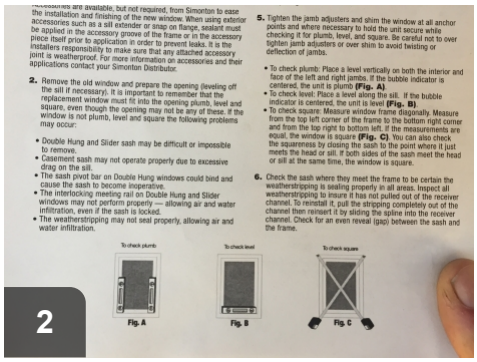
Tools:

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

Materials:

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

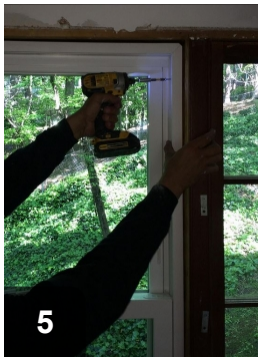
Prepare and clean opening before installing new window



Check opening for plumb, level, and square

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

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



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

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

Caulk new window to existing stop molding

Reinstall and caulk interior stop molding

Completed installation

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

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

Note:

3.1203.2a - Lead paint assessment

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

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

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

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

Materials:

1. Cleaning solution or cleaning wipes
2. Bag or folded paper to catch debris
3. Nitrile gloves
4. Dust mask

EPA RRP certification required to conduct Lead Paint assessment.

Clean tools and sample site to prevent contamination

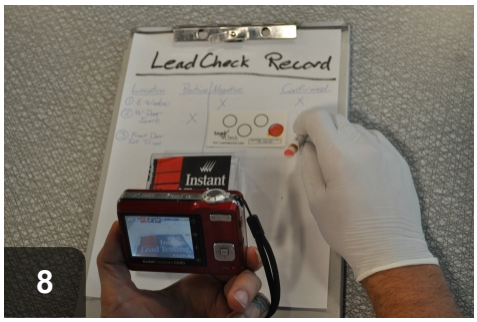
Place catchment bag under sample site to catch any debris. Cut sample site at an angle to expose all older paint layers

Break capsules and shake to mix reagents. Swab sample site for 30 seconds

Check swab for reaction

Red indicates lead positive. White is lead negative

If negative, verify validity of test with provided calibration card



Lead in calibration card should test positive and turn spot red

Record test results to maintain documentation

3.1203.2b - Opening preparation

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

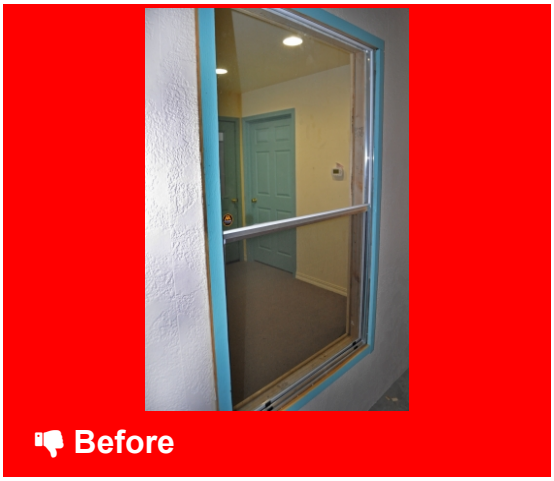
Specification(s):
Replacement window will be laid out with trim

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

Existing window will be removed

Window opening will be flashed in accordance with accepted industry standards

Objective(s):
Provide a clean and properly flashed opening for replacement window unit



Single pane window in newer home

Window is removed to allow for replacement with double pane unit

Tools:

1. Pry bar
2. Utility knife
3. Drill

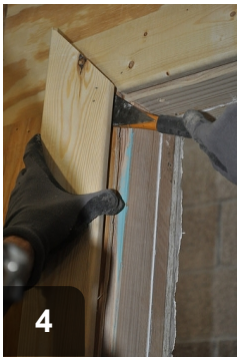
Materials:

1. Window and door flashing

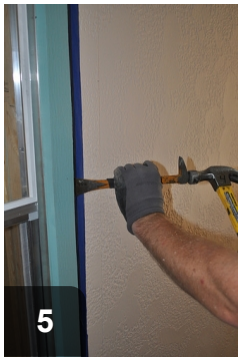
Single pane window needs to be replaced with double pane

Cut through caulk at stops to break seal

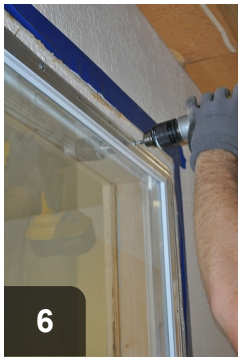
Remove stops while attempting to keep damage to rough opening to minimum



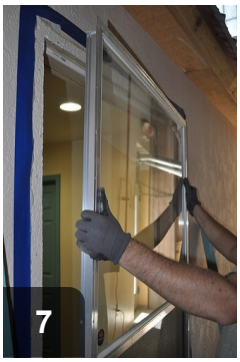
Remove interior trim



Remove exterior trim



Remove exterior fasteners to free window



Remove window from rough opening

Clean rough opening to remove old caulk and debris

Install flashing along sides and bottom of rough opening

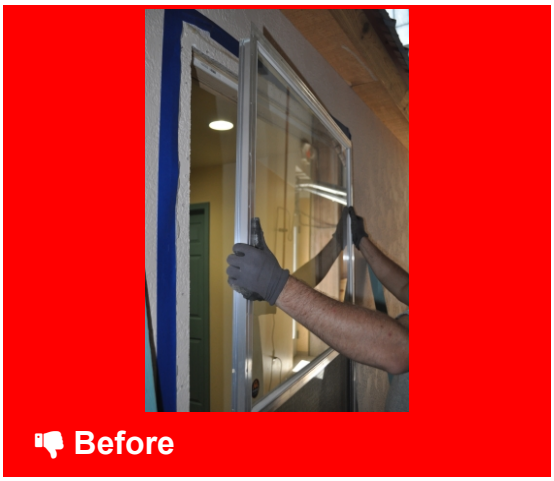
3.1203.2c - Replacement unit preparation

Desired Outcome:

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

Specification(s):
Mounting detail will be determined based on depth of window and location of window liner

Objective(s):
Allow for good fit and finish of replacement window



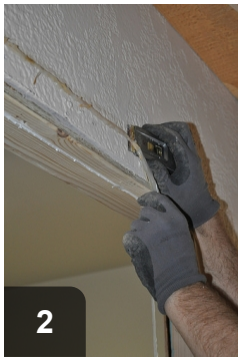
Single pane window is being removed

Double-pane unit replaces previous single-pane one

Tools:

1. Tape measure
2. Utility knife

Measure rough opening depth to determine best method of installation



Clean old sealant off exterior surface to allow for flange installation

Install unit following appropriate detail for rough opening and unit depth

3.1203.2d - Replacement window installation

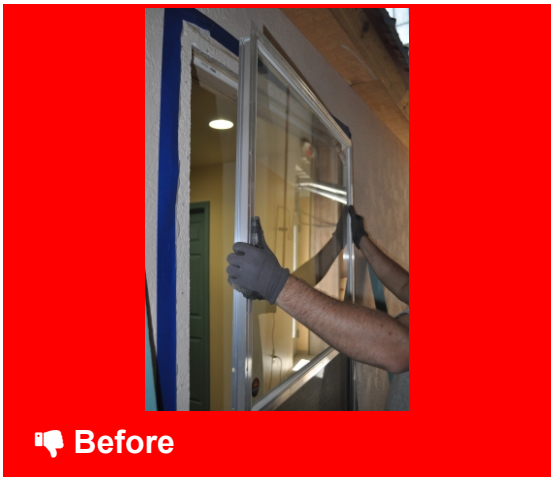
Desired Outcome:
Replacement window provides weather tight fit; improved energy efficiency performance of fenestration

Specification(s):
Replacement windows will be installed in accordance with manufacturer specifications and will be integrated with flashing

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

Objective(s):
Ensure replacement window operates properly

Ensure replacement window is weather tight



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


Install flashing to manufacturer specs


Flanges have been folded out to allow

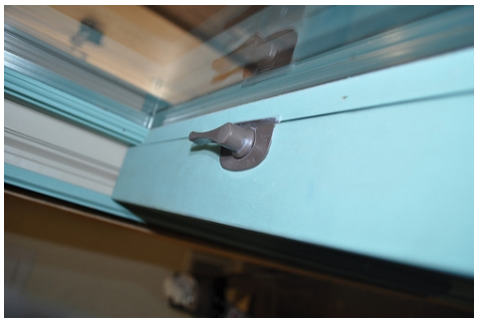

Fasten window flange securely around

and industry standards

for easy installation

exterior of entire window

With window secured in place, check for proper function



Check that sash locks align properly, indicating window is plumb

Fill interior gap with compressible foam or appropriate sealant

Prime and replace interior trim and, if needed, sill

Replace exterior trim and patch exterior siding or finish as needed

3.1402.1 - Crawl Spaces—Sealing Floor Penetrations

Desired Outcome:
Air leakage prevented and indoor air quality protected

Note:

3.1402.1a - Backing and infill

Desired Outcome:
Air leakage prevented and indoor air quality protected

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

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

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

Ensure sealant does not fall out

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

Gaps should be sealed to maintain air barrier

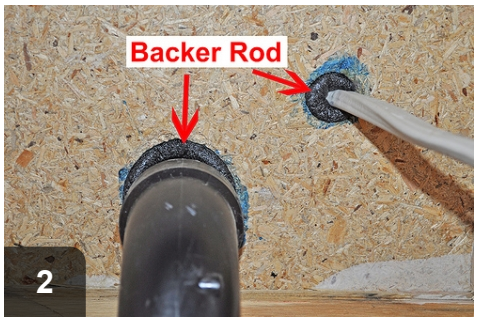
Tools:

1. Headlamp

Materials:

1. Backer rod
2. Sealant

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 - Sealant selection

Desired Outcome:
Air leakage prevented and indoor air quality protected

Specification(s):
Sealants will be used to fill holes no larger than recommended by manufacturer specifications

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

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

Objective(s):
Create a permanent seal

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

Bad Practice

Avoid sealants that do not allow for expansion between dissimilar materials

Best Practice

Flexible sealants compensate for differential expansion and maintain a seal

Tools:

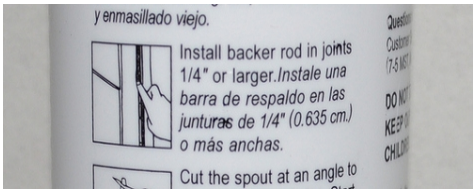
1. Caulk gun
2. Spray foam gun

Materials:

1. Caulk
2. Spray foam

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

3.1402.1c - High temperature application

Desired Outcome:
Air leakage prevented and indoor air quality protected

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

Objective(s):
Prevent a fire hazard

Gaps around floor penetrations allow air and moisture movement

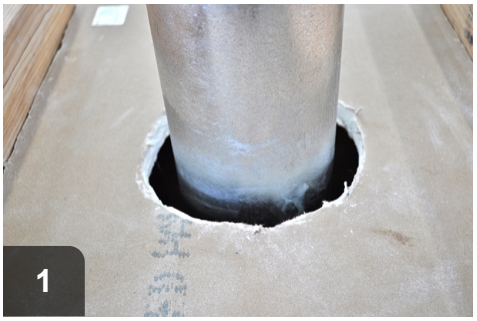
Use non-combustible materials, like 26-gauge steel and high-temp caulk

Tools:

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

Materials:

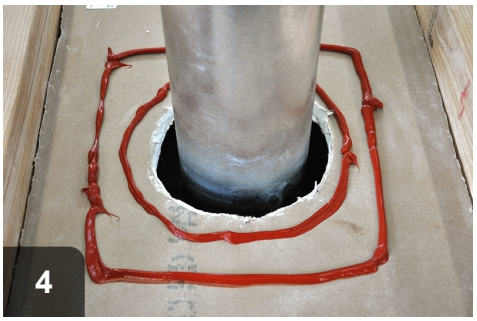
1. High-temperature caulk
2. 26-gauge steel sheeting



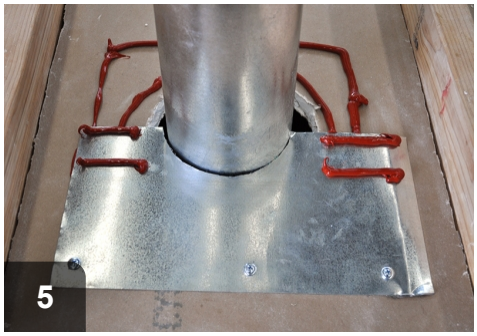
Prepare work area by removing any insulation and debris

Use high-temperature caulking (600F min)

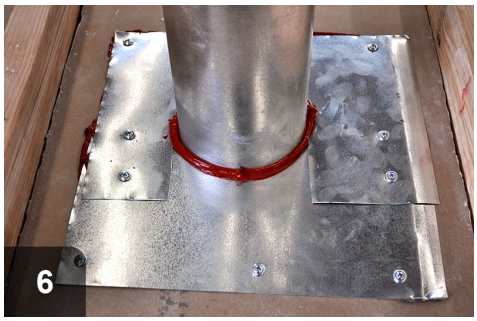
Apply first ring of caulking to match shape of opening



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



Fasten rigid material (26-gauge steel) and apply additional caulking



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

3.1402.3 - Closed Crawl Spaces—Air Sealing Exterior Wall

Desired Outcome:
Well-sealed exterior wall prevents leakage and pests

3.1402.3a - Seal penetrations

Desired Outcome:
Well-sealed exterior wall prevents leakage and pests

Specification(s):
Penetrations will be sealed with a durable material

A minimum expected service life of 10 years will be ensured

Objective(s):
Prevent air and moisture penetration into crawl space

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. Sprayfoam gun
3. Metal snips
4. Drill

Materials:

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

Measure holes to determine the best backing and fill strategy


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


Sprayfoam or caulk seal the hole

3.1402.3b - Pest exclusion

Desired Outcome:
Well-sealed exterior wall prevents leakage and pests

Specification(s):
If penetration is greater than ¼ inches, caulking, steel wool, or other pest-proof material will be used to fill the penetration before sealing

Objective(s):
Prevent pest entry

For bigger holes, extra steps should be taken to keep out pests

Choose the backing and infill strategy that works best for the hole size

Tools:

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

Materials:

1. Caulk
2. Sprayfoam
3. Metal mesh
4. Rigid backing

For holes larger than 1/4", rigid backing should be used to keep pests out

Metal mesh or other rigid materials should be cut to fill the space

Sprayfoam can be used to seal the hole and hold mesh in place

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

Desired Outcome:
Openings from garage sealed to prevent leakage

3.1501.1a - Penetrations

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations will be sealed

Objective(s):
Prevent air leakage and pollutant entry

Penetrations between the garage and house can leak hazardous fumes

Seal penetrations to minimize risks and air leakage

Materials:

1. Backer Rod
2. Caulk
3. Spray foam

3.1501.1b - Ductwork

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
All joints and connections in ductwork will be fastened and sealed with UL 181B or 181B-M welds, gaskets, adhesive mastics, or mastic-plus- embedded-fabric systems

Objective(s):
Prevent air leakage and pollutant entry

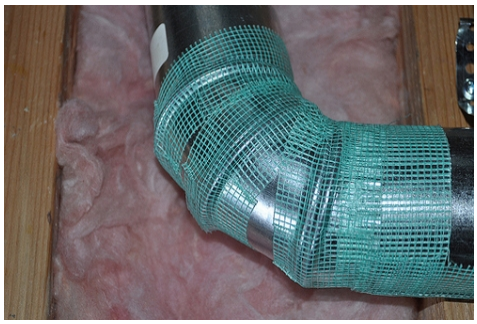
Unsealed joints and connections need to be sealed to prevent health risks.

Sealed ductwork connections help prevent leakage.

Materials:

1. Mesh tape
2. Mastic


Prepare work area by assessing any safety concerns.


Wrap joint with fiberglass mesh tape.


Apply UL 181 mastic to seal joint.

3.1501.1c - Cracks

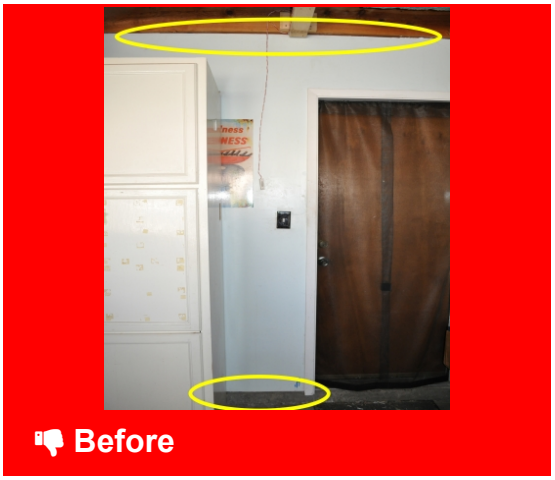
Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):

All cracks in house and garage separation wall will be sealed, including cracks between mud sill, rim joists, subfloors, and bottom of gypsum board, ensuring the air sealing enhances the integrity of the fire resistance construction of that wall

All cracks in ceiling surfaces will be sealed

Objective(s):
Prevent air leakage and pollutant entry



Cracks in shared walls of attached garages are a potential leakage site

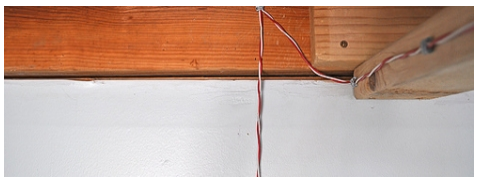
Air sealing reduces pollutant entry, but does not diminish fire resistance

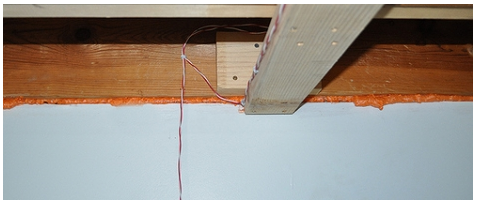
Materials:

1. Sprayfoam
2. Fire-block caulk

Determine which walls are shared between garage and living space


Inspect wall and ceiling for cracks and penetrations


Clear work area of obstacles and debris



Apply appropriate sealant dependent upon size of crack and location

Ensure sealant does not decrease wall's fire resistance

3.1501.1d - Garage to house door

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
Weather stripping, door sweep, and threshold will be installed to stop air leakage

Objective(s):
Prevent air leakage and pollutant entry

Daylight visible under door to garage indicates leakage

Door sweep, with weatherstripping, will minimize air exchange with garage

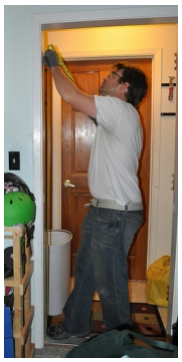
Tools:

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

Materials:

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

Remove door for access to work space and to install sweep



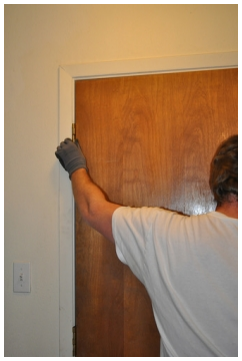
Measure for weatherstripping around door

Install weatherstripping into rabbit around door

Corners of weatherstripping should be snug and secure

Adjust threshold to minimize contaminant and water infiltration

Caulk along threshold to minimize water and contaminant infiltration



Cut door sweep to width of the door

Ensure door sweep fits tightly against bottom of door and fasten in place

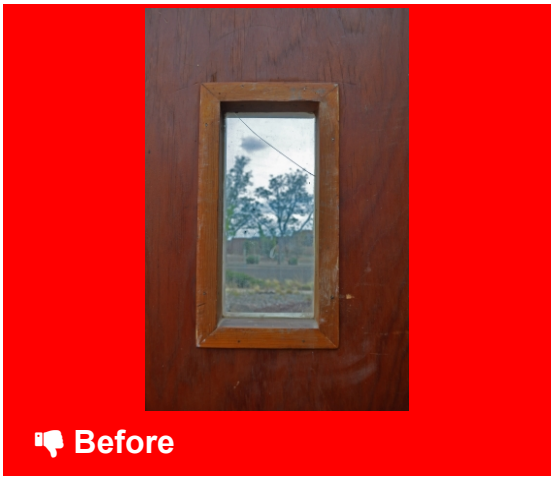
Rehang door to verify snug fit and smooth operation

3.1501.1e - Glass

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

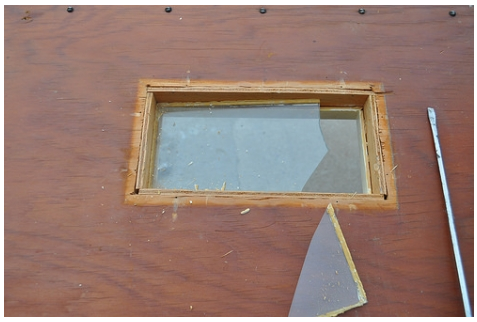
Tools:

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

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

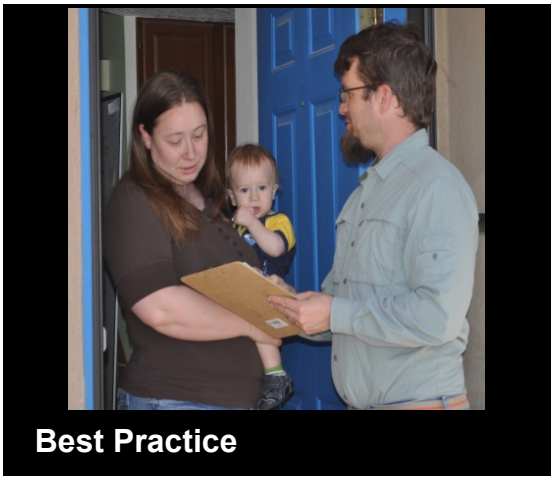
3.1501.1f - Carbon monoxide (CO) alarm

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
CO alarms will be installed in accordance with ASHRAE 62.2, applicable codes and manufacturer specifications

Objective(s):
Warn occupants of CO exposure from attached garage

Carbon monoxide alarms should be installed throughout the house



Occupants should be alerted to CO alarm locations and maintenance

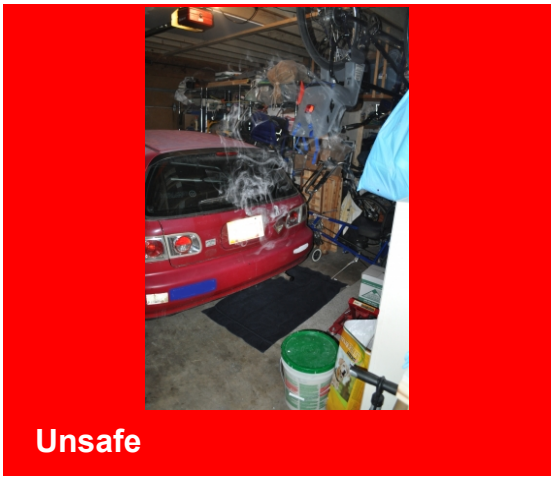
CO alarms should be installed one per floor and near sleeping areas.

3.1501.1g - Occupant education

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
Occupant will be educated on need to keep door from garage to house closed and not to warm up vehicles or use any gas engine appliances or grills in the garage, even if the main door is left open

Objective(s):
Reduce risk of CO poisoning inside of garage and adjacent rooms



Communicate importance of never running vehicles in a closed garage

Speak with occupant about hazards of using gas appliances in the garage

Occupants should never run vehicles in a closed garage

Occupants should not light combustibles inside garages

Speak with occupant about hazards of using gas appliances in the garage

3.1601.3 - Support

Desired Outcome:
Ducts and plenums properly supported

3.1601.3a - Support (applies to all duct types)

Desired Outcome:
Ducts and plenums properly supported

Specification(s):
Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 ½" wide material

Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction

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

Objective(s):
Eliminate falling and sagging

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

Properly supported ducts minimize heat loss and and maximize duct run

3.1601.3a - Support (applies to all duct types)

Tools:

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

Materials:

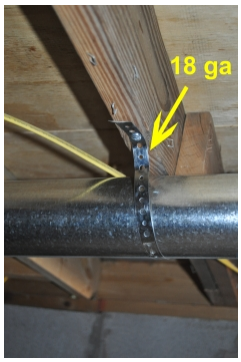
1. 18 gauge metal strap (at least 1/2" wide)
2. 12 gauge galvinized wire
3. Fabric support straps (at least 1 1/2" wide)
4. Staples
5. Fasteners

BAD: Make sure supports DO NOT compress insulation or duct

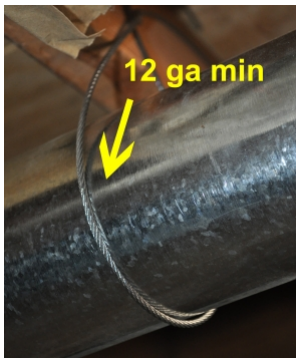
Flex ducts should have supports no less than every 4 feet

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

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



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



Metal wire should be at least 12 gauge and galvanized

3.1602.1 - Air Sealing Duct System

Desired Outcome:
Ducts and plenums sealed to prevent leakage

3.1602.1a - New component to new component sealant selection

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Any closure system used will be in accordance with IRC Chapter 16

Objective(s):
Ensure effectiveness of air sealing system

3.1602.1b - New component to existing component

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic

Mastic alone will be acceptable for holes less than ¼" that are more than 10' from air handler

Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:

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

Objective(s):
Eliminate air leakage into or out of ducts and plenums

Ensure adhesion of primary seal (mastic and fiberglass mesh) to the duct

Reinforce seal

Support mastic and fiberglass mesh during curing

3.1602.1c - Existing component to existing component

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using UL 181 fiber-embedded mastic

Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:

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

Seams, cracks, joints, holes, and penetrations larger than ¾" will be repaired using rigid duct material

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

Objective(s):
Eliminate air leakage into or out of ducts and plenums

Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct

Reinforce seal

Support fiberglass mesh and mastic during curing

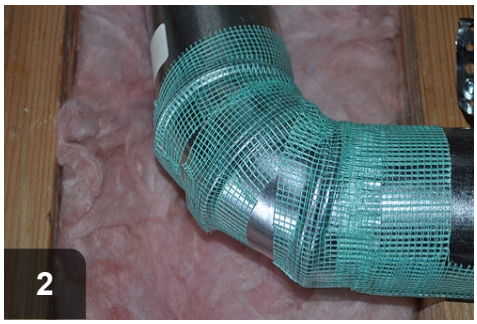
Unsealed joints and connections need to be sealed to prevent health risks

Sealed ductwork connections help prevent leakage

Materials:

1. Mastic
2. Fiberglass mesh tape

Prepare work area by assessing any safety concerns



Wrap joint with fiberglass mesh tape

Apply UL 181 mastic to seal joint

3.1602.4 - Air Sealing System Components

Desired Outcome:
Ducts and plenums sealed to prevent leakage

3.1602.4a - Duct boot to interior surface

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
All gaps between boot and interior surface that defines conditioned space will be air sealed

Gypsum edge will be wetted before applying water-based sealant

Sealants will be continuous and be in accordance with IRC

Objective(s):
Prevent air leakage

Prevent a fire hazard

Before

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

After

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

Tools:

1. Utility knife
2. Spray bottle
3. Putty knife

Materials:

1. Mastic
2. Mesh tape

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 - Wooden plenums and building cavities

Desired Outcome:
Ducts and plenums sealed to prevent leakage

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

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

Locate unsealed ducts constructed from building cavities

Return plenum lined with fiberglass duct board and sealed with mastic

Tools:

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

Materials:

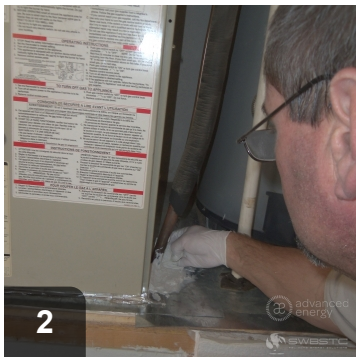
1. mastic
2. fiberglass duct board
3. UL 181 listed mastic tape
4. sheet metal
5. screws

Use approved materials to seal ductwork; cover organic materials with airtight, non-organic material such as mastic, metal, or duct board.

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

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

Identify building cavities used as ducts



Seal penetrations around AC lineset and wiring

Cut and Install appropriate board material to create an airtight duct

Seal all seams and joints with duct mastic

3.1602.4c - Air handler cabinet

Desired Outcome:
Ducts and plenums sealed to prevent leakage

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

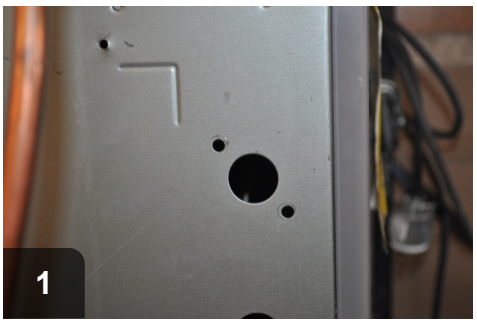
Objective(s):
Reduce air leakage while maintaining accessibility

Unnecessary holes in the air handler cabinet need to be sealed

Use removable foil tape to seal holes

Materials:

1. Foil tape



Unnecessary holes in the air handler cabinet should be sealed

Removable foil tape should be used to seal

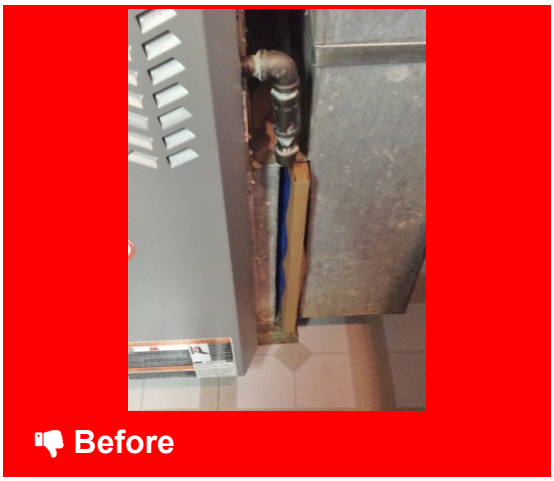
Fully cover holes with tape to seal completely

3.1602.4d - Filter slot

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
A pre-manufactured or site manufactured durable filter slot cover will be installed

Objective(s):
Reduce air leakage while maintaining accessibility



Before

Uncovered filter slots are a point of leakage

After

Filter slots should be covered

3.1602.5 - Return—Framed Platform

Desired Outcome:
The return duct installed to prevent air leakage

3.1602.5a - Preparation

Desired Outcome:
The return duct installed to prevent air leakage

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

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

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 - Infill and backing

Desired Outcome:
The return duct installed to prevent air leakage

Specification(s):

Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space

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

Material will be rated for use in return duct systems

Objective(s):
Minimize hole size to ensure successful use of sealant

Ensure closure is permanent and supports any load (e.g., return air pressure)

Ensure sealant does not fall out

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, such as drywall

Tools:

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

Materials:

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

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

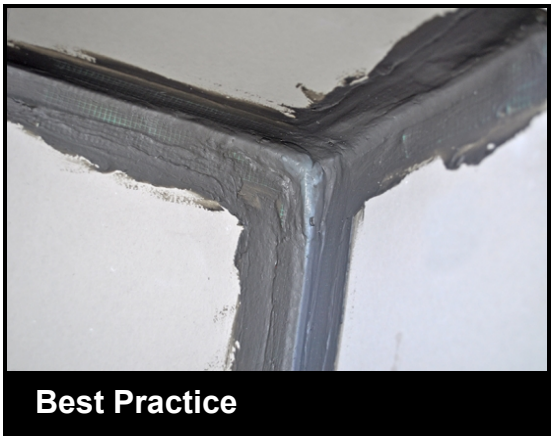
3.1602.5c - Sealant selection

Desired Outcome:
The return duct installed to prevent air leakage

Specification(s):
Sealants will be continuous and be in accordance with IRC

Objective(s):
Select permanent sealant

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



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

4.1001.1 - Non-Insulation Contact (IC) Recessed Light

Desired Outcome:
Ensure safety from fire and prevent air leakage

4.1001.1a - Air barrier system

Desired Outcome:
Ensure safety from fire and prevent air leakage

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

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

OR

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

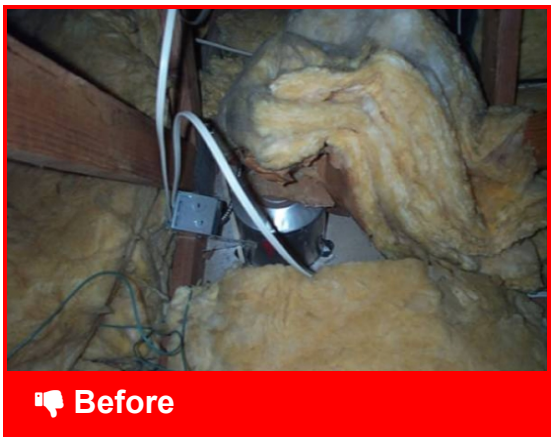
OR

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

ORAir 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

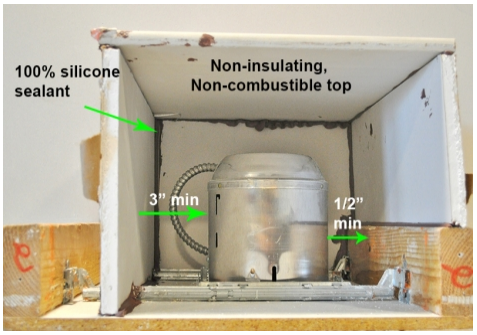
Sealed box around non-IC light should be taller than surrounding insulation

Tools:

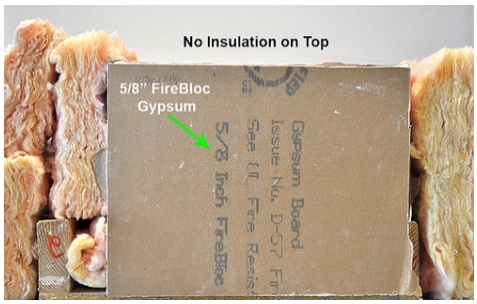
1. Utility knife
2. Tape measure

Materials:

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



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 - Enclosure top

Desired Outcome:
Ensure safety from fire and prevent air leakage

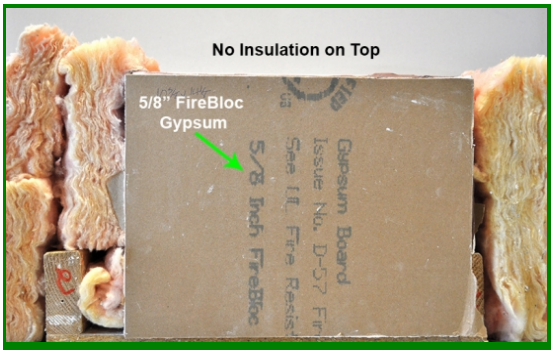
Specification(s):
The top-fire rated enclosure material will have an R-value of 0.56 or less

The top of the enclosure will be left free of insulation

Objective(s):
Prevent heat build up

Before

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



After

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

Tools:

1. Utility knife
2. Caulk gun

Materials:

1. Drywall

4.1001.1c - Clearance

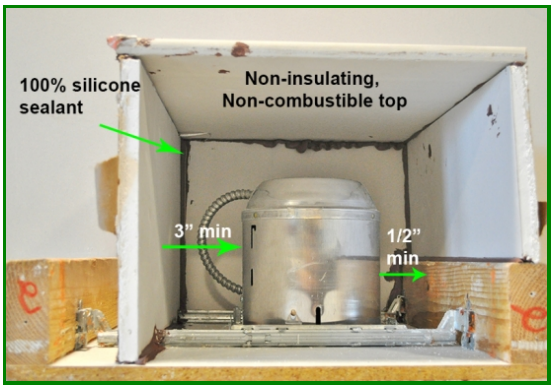
Desired Outcome:
Ensure safety from fire and prevent air leakage

Specification(s):
The entire closure will maintain a 3" clearance between the closure and the fixture including wiring, box, and ballast

Objective(s):
Keep an air space around the fixture

Before

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



After

A 3 inch clearance should be kept from boxing materials

Tools:

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

Materials:

1. Fire-rated sealant
2. Drywall

4.1001.1d - Sealants and weather stripping

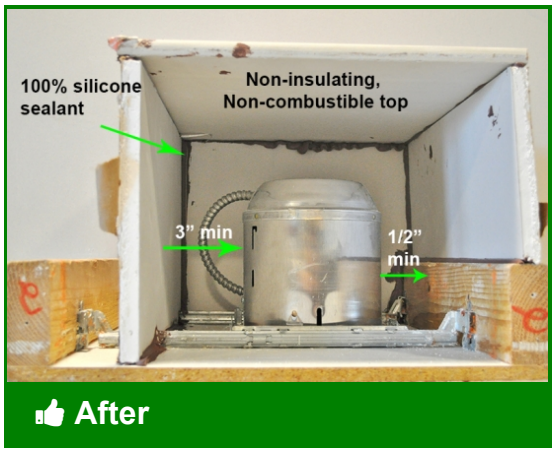
Desired Outcome:
Ensure safety from fire and prevent air leakage

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

Objective(s):
To prevent air leakage, completely adhere the sealant to all surfaces to be sealed

Before

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



After

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

Tools:

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

Materials:

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

4.1001.2 - Knob and Tube Wiring

Desired Outcome:
Insulation kept away from contact with live wiring

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

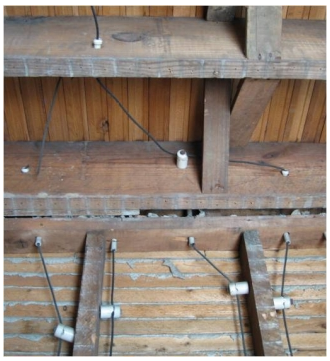
4.1001.2a - Identifying knob and tube wiring

Desired Outcome:
Insulation kept away from contact with live wiring

Specification(s):
Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring

Objective(s):
Determine if knob and tube wiring exists

Identify knob and tube wiring in homes to insulate properly and safely



More knob & tube wiring

Knob & tube wiring again

4.1001.2b - Testing to determine if live

Desired Outcome:
Insulation kept away from contact with live wiring

Specification(s):
Non-contact testing method will be used to identify live wiring

Objective(s):
Ensure safety of occupants, workers, and house

Plan where remediation is needed

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

4.1001.2c - Isolate or replace

Desired Outcome:
Insulation kept away from contact with live wiring

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

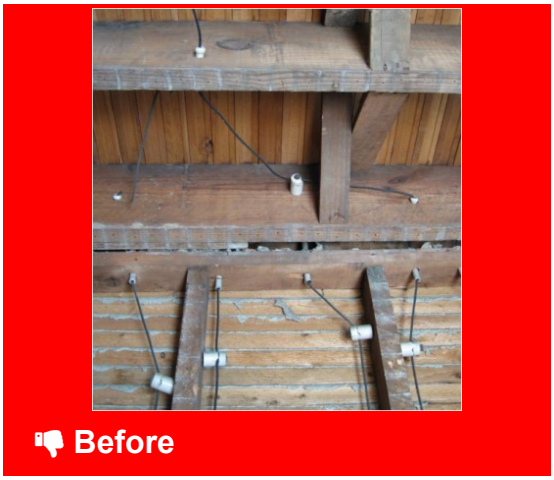
When required, a dam that does not cover the top will be created to separate insulation from the wire path

Objective(s):
Ensure work can be completed safely

Protect occupant and house

Ensure future work can be done safely

Prevent the overheating of the wiring



Knob & tube wiring radiates heat and cannot be insulated over

Before insulation, wiring should be dammed or disabled and replaced

Tools:

1. Non-contact wire tester
2. Drywall
3. Plywood
4. Saw
5. Drill
6. Tape measure

Materials:

1. Fasteners
2. Romex as needed

NEC guidelines and local jurisdictions often closely prescribe the treatment of knob & tube wiring. Check your local codes.

If electrician determines wiring is safe and keeps it active, isolate wires

To isolate, dams higher than intended insulation depth should be installed

Warning of knob & tube should be posted at all entrances to related spaces

Warning signs should encourage the use of certified electrician for repairs

Some jurisdictions require warning signs in Spanish as well

If knob & tube can be replaced, all existent k&t should be disabled

Many electricians will remove exposed wires to prevent reactivation

Modern wiring should replace all knob & tube

4.1001.3 - Fireplace Chimney and Combustion Flue Vents

Desired Outcome:
Combustible materials kept away from combustion sources

4.1001.3a - Verify attic prep

Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
Holes, penetrations, and bypasses will be sealed

Dams will be fixed in places that maintain required clearance

Objective(s):
Prevent air leakage

Ensure insulation dams maintain clearance

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

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

Tools:

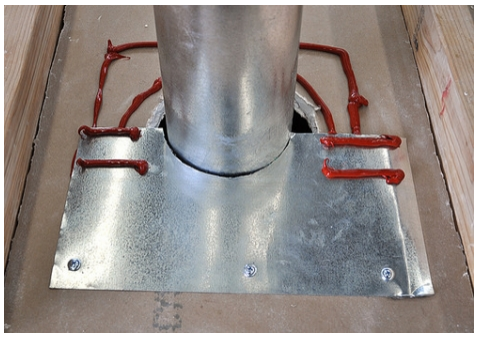
1. Metal snips
2. Caulk gun
3. Fasteners

Materials:

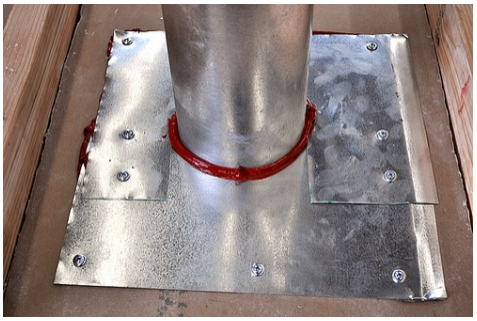
1. 26-gauge steel sheeting
2. High temperature caulk
3. Caulk
4. Backer rod
5. Spray foam

Gaps around flues and penetrations need to be sealed before insulating

High temperature caulk should be used for flues and chimneys



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



Only construct dam after sealing has been completed properly

Dammed chimneys, flues and light fixtures prevent fires

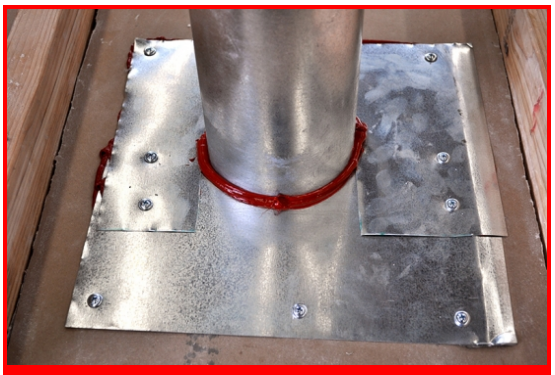
4.1001.3b - Required clearance

Desired Outcome:
Combustible materials kept away from combustion sources

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

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

Prevent a fire hazard



Before

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

After

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

Tools:

1. Metal snips

Materials:

1. 26-gauge steel sheeting
2. Fasteners

4.1001.3c - Safety

Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
Insulation will not be allowed between a heat-generating appliance and a dam unless material is rated for contact with heat generating sources

Objective(s):
Prevent a fire hazard

Before

Dams around flues, chimneys, and light fixtures should hold back insulation

After

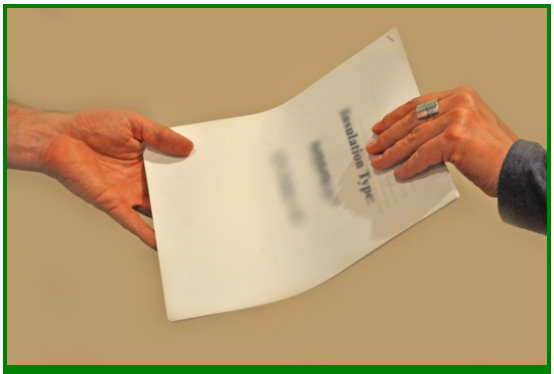
Clear dams of any loose insulation in order to minimize risk of fire

4.1001.3d - Occupant education

Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
Documentation of material and R-value will be provided to occupant

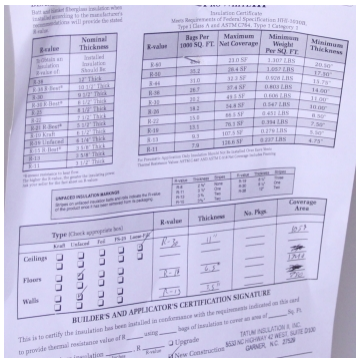
Objective(s):
Provide occupant with documentation of installation



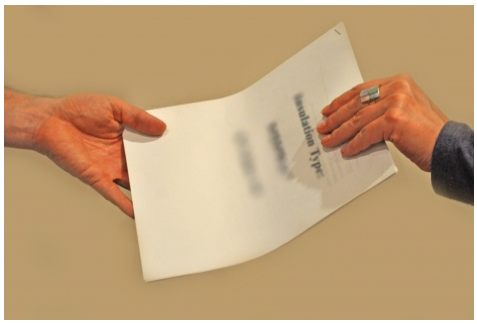
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1001.4 - Vented Eave or Soffit Baffles

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

Note:

4.1001.4a - Installation

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

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

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

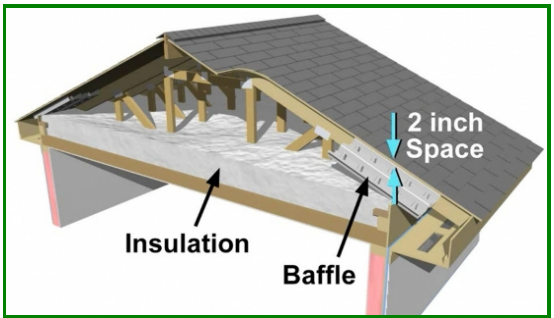
Installation will allow for the highest possible R-value above the top plate of the exterior wall

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

Maintain attic ventilation

Before

Insulation should not block vented eaves



After

Baffles installed in vented attics to allow air flow past insulation

Tools:

1. Stapler

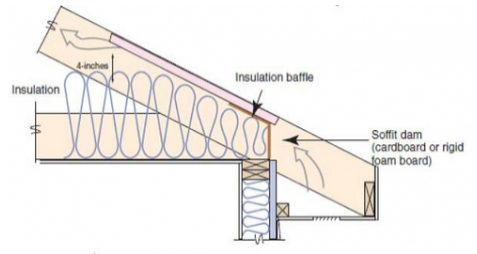
Materials:

1. Baffles
2. Staples

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

4.1003.3 - Unvented Flat Roof with Existing Insulation

Desired Outcome:
Insulation reduces heat flow through unvented roof

4.1003.3a - Ventilation

Desired Outcome:
Insulation reduces heat flow through unvented roof

Specification(s):
Code compliant ventilation will be installed before insulation

Objective(s):
Reduce possibility of moisture issues

Unvented flat roofs should have venting installed

Vents in the space below the roof help maintain proper air flow

Tools:

1. Saw
2. Grinder
3. Metal snips
4. Drill

Materials:

1. Metal lath
2. Stucco

Unvented flat roofs should have venting installed

Vents in the space below the roof help maintain proper air flow

Mushroom capped vents in the roof are equally important to air flow

4.1003.3b - Installation

Desired Outcome:
Insulation reduces heat flow through unvented roof

Specification(s):
Roof cavities will be blown with loose fill insulation (or roof cavities will be dense packed with insulation) without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):
Insulate to prescribed R-value

Vent reveals attic is insulated with old rug -- not adequate.

Attic will be dense packed to r-value specified on Work Order.

Tools:

1. Insulation machine

Materials:

1. Loose fillable or dense packable insulation

4.1003.3c - Occupant education

Desired Outcome:
Insulation reduces heat flow through unvented roof

Specification(s):
A dated receipt signed by the installer will be provided that includes:

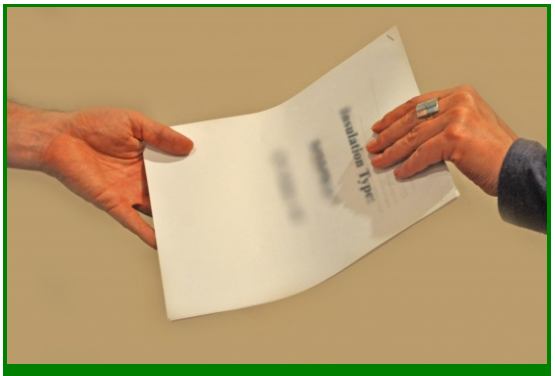
- Insulation type
- Coverage area
- R-value
- Installed thickness and minimum settled thickness
- Number of bags installed in accordance with manufacturer specifications

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

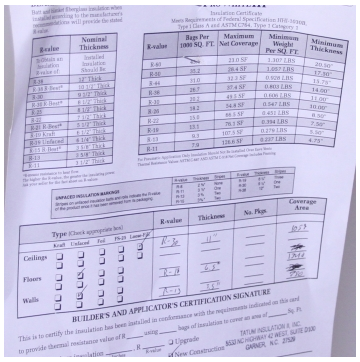
Comply with 16 CFR 460.17



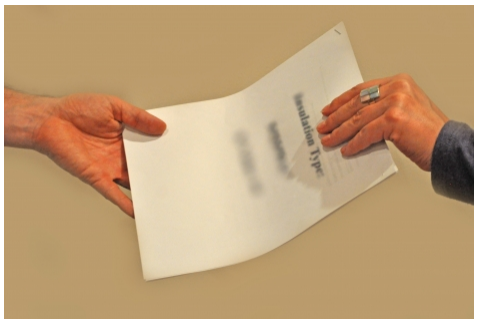
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1004.1 - Preparation for Dense Packing

Desired Outcome:
Airtight cavity and insulated knee wall

4.1004.1a - Backing

Desired Outcome:
Airtight cavity and insulated knee wall

Specification(s):
All knee walls will have top and bottom plate or blockers installed using rigid materials

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

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

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

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

Objective(s):
Eliminate bending, sagging, or movement that may result in air leakage

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

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

Before

Knee walls often need sealing and insulation

After

Knee wall is prepped for dense pack insulation

Tools:

1. Tape measure
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

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 - Installation

Desired Outcome:
Airtight cavity and insulated knee wall

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

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

Follow manufacturer's requirements for fiberglass dense pack applications

Objective(s):
Eliminate misalignment of existing insulation

Prevent insulation from settling or moving

Before

Existing batt insulation should be adjusted to fit properly

After

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

Attach furring strips to create pockets for dense-pack insulation

Insulation should meet manufacturer specifications for density.

4.1004.2 - Preparation for Batt Insulation

Desired Outcome:
Airtight cavity and properly insulated knee wall

4.1004.2a - Knee wall prep for batts

Desired Outcome:
Airtight cavity and properly insulated knee wall

Specification(s):
All knee walls will have a top and bottom plate or blockers installed using a Rigid material

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

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

Objective(s):
Eliminate bending, sagging, or movement that may result in air leakage

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

Create an air barrier

Top plate is missing from knee wall

New top plate is sealed to adjacent framing

Tools:

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

Materials:

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

Top plate has been cut and fit to size

Top plate has been sealed to adjacent framing

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

Bottom plate is cut to size

Bottom plate is placed in line with interior air barrier

Bottom plate is also sealed to surrounding joist and framing

4.1004.2b - Installation

Desired Outcome:
Airtight cavity and properly insulated knee wall

Specification(s):
Insulation will be installed using one of the following methods:

- New batts will be installed in accordance with manufacture specifications

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

Objective(s):
Eliminate misalignment of existing insulation

Knee wall with batts improperly installed and missing from stud bays

Properly fit insulation filling full volume of stud bay

Tools:

1. Utility knife
2. Tape measure

Materials:

1. Fiberglass batts


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

4.1004.2c - Backing knee wall

Desired Outcome:
Airtight cavity and properly insulated knee wall

Specification(s):

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

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

Objective(s):

Prevent insulation from settling or moving

Knee walls with batt insulation require covering

Foam sheathing? Needs to be covered with a fire barrier

Tools:

1. Utility knife
2. Tape measure
3. Drill

Materials:

1. Drywall
2. House wrap

Fiberglass batts in attic knee walls can be held in place by house wrap

If foam sheathing is used, it needs to be covered with a fire barrier

4.1005.1 - Accessible Floors—Batt Installation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

4.1005.1a - Preparation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee-wall attic floor spaces

All electrical junctions will be flagged to be seen above the level of the insulation

Open electrical junction boxes will have covers installed

Objective(s):
Access the workspace

Provide location of electrical junctions for future servicing

Prevent an electrical hazard

Before

Remove flooring in attic spaces to access floor cavities and insulate

After

Flag electrical junctions to make future maintenance and repairs easier

Tools:

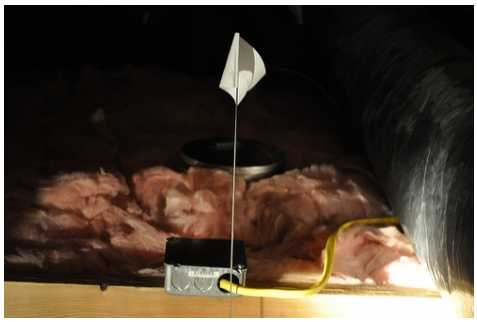
1. Hammer
2. Pry bar

Materials:

1. Flags

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

4.1005.1b - Installation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
Batt insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to the prescribed R-value

Objective(s):
Insulate to prescribed R-value

Accessible attic floors should be air sealed and insulated

Insulate floor cavities to prescribe R-value from the work order

Tools:

1. Hammer
2. Utility knife
3. Tape measure

Materials:

1. Fiberglass batts

Insert fiberglass batts into floor cavities, kraft-face down

Fill entire volume of floor cavity

Once insulated, flooring should be reinstalled

4.1005.1c - Occupant education

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness

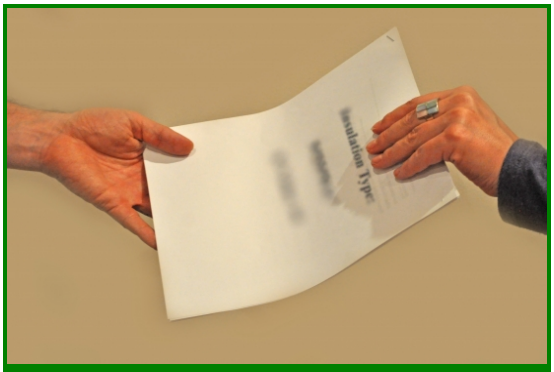
- R-value

  Objective(s):

  Document job completion to contract specifications

  Confirm amount of insulation installed

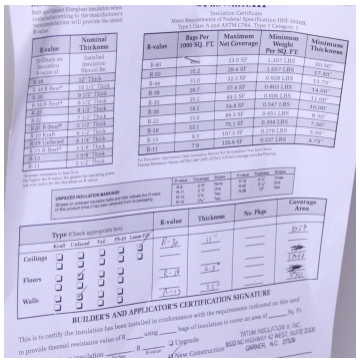
  Comply with 16 CFR 460.17



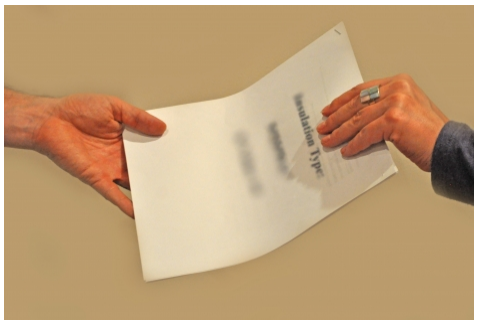
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1005.2 - Accessible Floors—Loose Fill Installation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

4.1005.2a - Preparation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee-wall attic floor spaces

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 boxes will be flagged to be seen above the level of the insulation

Open electrical junctions will have covers installed

Insulation dams and enclosures will be installed as required

Objective(s):
Access the workspace

Verify uniformity of insulation material

Provide location of electrical boxes 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

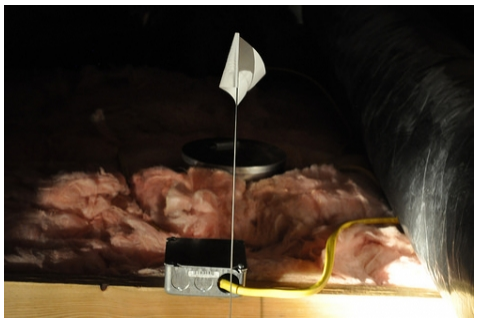
Tools:

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

Check cavity for electrical junctions and penetrations



Flag and install covers on electrical junctions

Seal any penetrations

Non-IC (insulation contact) can lights should be covered with a dam and have no insulation on top

Install depth markers and insulation dams above height of insulation

4.1005.2b - Air barrier

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
Existence of air barrier material in line with the knee walls will be installed or verified when dense packing

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

Objective(s):
Hold dense pack in place

When missing, bottom plates must be installed under knee walls

New bottom plates complete air barrier and hold insulation in place

Tools:

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

Materials:

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

Measure floor cavity for new bottom plate

Cut rigid material, such as XPS, to size to snugly fit into cavity

Align block with air barrier of conditioned space

Air seal around new bottom plate with spray foam

4.1005.2c - Installation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

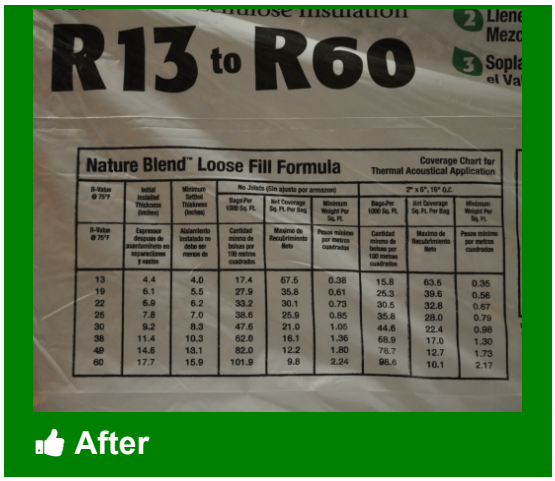
Specification(s):
All insulation will be installed to the minimum unsettled depth and the maximum coverage per bag to reach a consistent depth for desired R-value indicated on the manufacturer's coverage chart.

Objective(s):
Reduce heating and air conditioning costs

Improve comfort

Minimize noise

Accessible attic floor should be air sealed and insulated



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

Tools:

1. Insulation machine

Materials:

1. Loose fill insulation


Use depth markers to ensure insulation has reached prescribed R-value


Where flooring cannot be removed, verify insulation is meeting R-value goal

4.1005.2d - Onsite documentation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):

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

- Insulation type
- Coverage area
- R-value
- Installed thickness and settled thickness
- Number of bags installed in accordance with manufacturer specification

Objective(s):
Document job completion to contract specifications

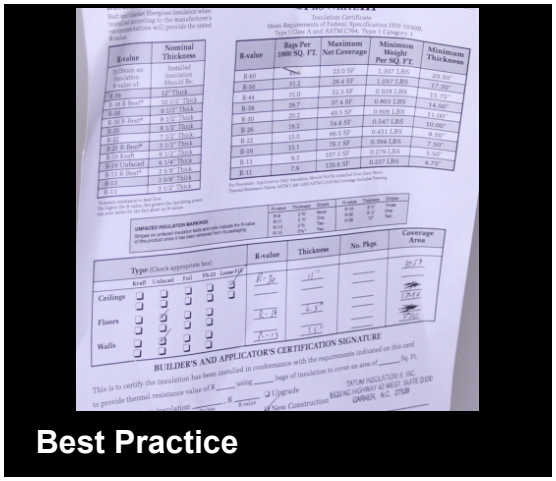
Confirm amount of insulation installed

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, depth, coverage area, etc.

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.

4.1005.3 - Accessible Floors—Batt Insulation Over Existing Insulation

Desired Outcome:
Insulation controls heat transfer through ceiling

4.1005.3a - Preparation

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
Existing insulation will be in contact with the air barrier prior to installing additional insulation on top

Objective(s):
Ensure proper performance of insulation

4.1005.3b - Installation

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
If the top of the existing insulation is below the top of the framing, new batts will be installed parallel with framing members

If the top of the existing insulation is above the top of the framing, new batts will be installed perpendicular to framing members

Objective(s):
Ensure uniform depth of insulation in continuous contact with existing insulation

Eliminate voids and gaps

4.1005.3c - Insulation

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):
Batts 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

4.1005.3d - Safety

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
Insulation will not be allowed on top of non-IC rated can light boxes or between a heat generating appliance and a dam, unless material is rated for contact with heat generating sources

Objective(s):
Prevent a fire hazard

4.1005.3e - Onsite documentation

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
A dated receipt signed by the installer will be provided that includes:

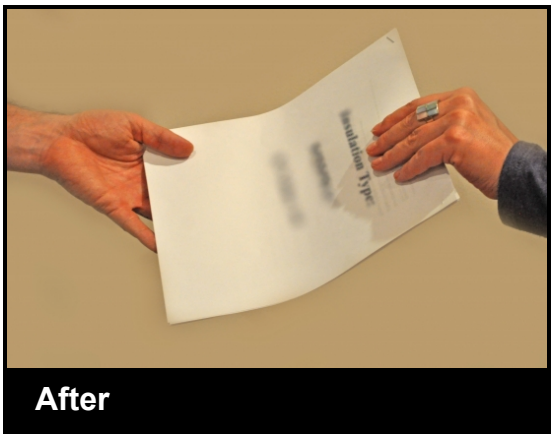
- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

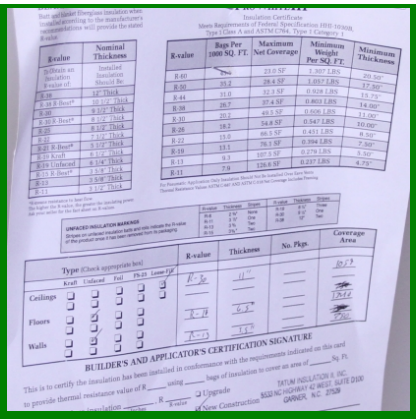
Ensure ability to match bags required for total area completed

Comply with 16 CFR 460.17



After

Provide occupant with documentation of and about insulation installed



Best Practice

Documentation should include insulation material and r-value

4.1005.4 - Accessible Floors—Loose Fill Over Existing Insulation

Desired Outcome:
Insulation controls heat transfer through ceiling

4.1005.4a - Preparation

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
Existing insulation will be in contact with the air barrier prior to installing additional insulation on top

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 junction boxes 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

Objective(s):
Ensure proper performance of insulation Verify uniformity of insulation material Provide location of electrical junctions for future servicing

Prevent an electrical hazard

4.1005.4b - Installation

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

Objective(s):
Insulate to prescribed R-value

4.1005.4c - Safety

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
Insulation will not be allowed on top of non-IC rated can light boxes or between a heat-generating appliance and a dam, unless material is rated for contact with heat generating sources

Objective(s):
Prevent a fire hazard

4.1005.4d - Onsite documentation

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

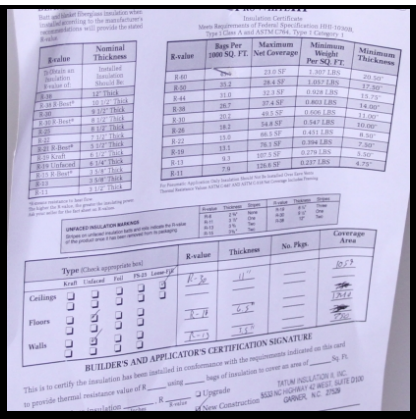
Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with 16 CFR 460.17

Best Practice

Written documentation of insulation type and efficiency will be provided



Best Practice

Information should include depth of loose fill installed and once settled

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.

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

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

4.1005.5a - Air barrier

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

Specification(s):
Existence of air barrier material in line with the knee walls will be installed or verified when dense packing

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

Objective(s):
Hold dense pack in place

This finished garage below a bonus room is an unconditioned space

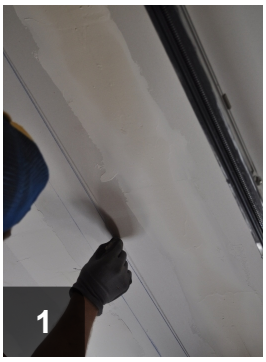
Rigid material forms an air barrier located under the bonus room stem wall

Tools:

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

Materials:

1. XPS or other rigid material
2. Fasteners



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

Cut through garage ceiling to access joist cavities below bonus room

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

Measure joist cavity depth

Measure joist cavity width

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

Rigid block should fit snugly into joist cavity and be fastened mechanically to prevent insulation leaks

Fastened rigid block will hold the insulation in place under the bonus room above

4.1005.5b - Fill floors

Desired Outcome:

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

Specification(s):

Each cavity will be 100% filled to consistent density:

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

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

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

Objective(s):
Eliminate voids and settling

Minimize framing cavity air flows

Before

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

After

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

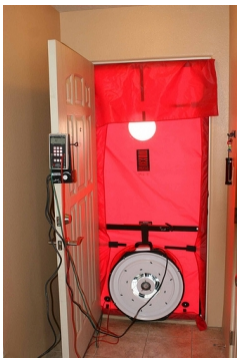
Materials:

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

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

4.1005.5c - Safety

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

Specification(s):
Insulation will not be allowed on top of non-IC rated can light boxes or between a heat-generating appliance and a dam, unless material is rated for contact with heat generating sources

Objective(s):
Prevent a fire hazard

Dams around flues, chimneys, and light fixtures should hold back insulation

Clear dams of any insulation or debris in order to minimize risk of fire

No insulation on top of non-insulation contatct (non-IC) rated fixtures

4.1005.5d - Onsite documentation

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

Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

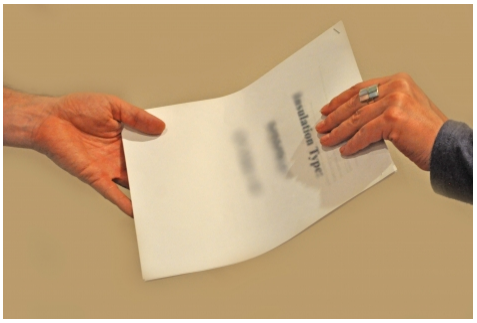
Confirm amount of insulation installed

Comply with 16 CFR 460.17

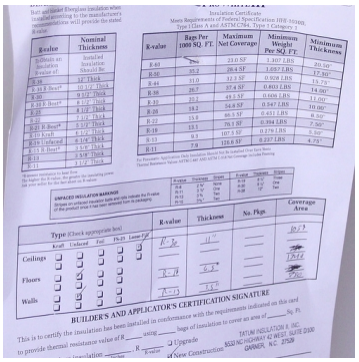
After

Documentation of insulation installed should be provided in writing

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 all insulation except loose-fill and aluminum foil, the receipt must show the coverage area, thickness, and R-value of the insulation you installed. The receipt must be dated and signed by the installer. To figure out the R-value of the insulation, use the data that the manufacturer gives you.



Rather than posting in the insulated space, a "receipt" may be provided



Information should include insulation type, r-value, coverage area, etc.

4.1006.1 - Pull-Down Stairs

Desired Outcome:
Pull-down attic stair properly sealed and insulated

4.1006.1a - Installation

Desired Outcome:
Pull-down attic stair properly sealed and insulated

Specification(s):
Top-side of the attic enclosure will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

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

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

Objective(s):
Achieve uniform R-value

Prevent loose insulation from entering the living area

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

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

4.1006.1b - Sealing

Desired Outcome:
Pull-down attic stair properly sealed and insulated

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

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

Objective(s):
Prevent air leakage

Before

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

After

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

Tools:

1. Caulk gun

Materials:

1. Weatherstripping
2. Spray foam
3. Caulk

Seal around frame of pull-down stairs with appropriate sealant

Weatherstrip around stair panel to encourage a tight seal

Remember to seal finish details and trim

Insulation and sealing should be airtight but openable

4.1006.2 - Access Doors and Hatches

Desired Outcome:
Attic access door properly sealed and insulated

4.1006.2a - Installation

Desired Outcome:
Attic access door properly sealed and insulated

Specification(s):
Hatches will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

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

Objective(s):
Achieve uniform R-value on the attic door or hatch

Achieve uniform R-value on the attic floor

Prevent loose attic floor insulation from entering the living area

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:

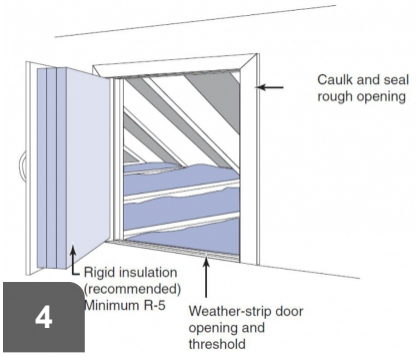
1. XPS
2. Lumber
3. Weatherstripping
4. Fasteners

Louisiana WAP variances state: Damming using non-rigid material, such as fiberglass, will be allowed in cases where there is an overhead space limitation.

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 - Sealing

Desired Outcome:

Attic access door properly sealed and insulated

Specification(s):

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

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

The measure must include a protective baffle or insulation barrier

Objective(s):
Prevent air leakage

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

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

Materials:

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


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 - Attachment

Desired Outcome:
Attic access door properly sealed and insulated

Specification(s):

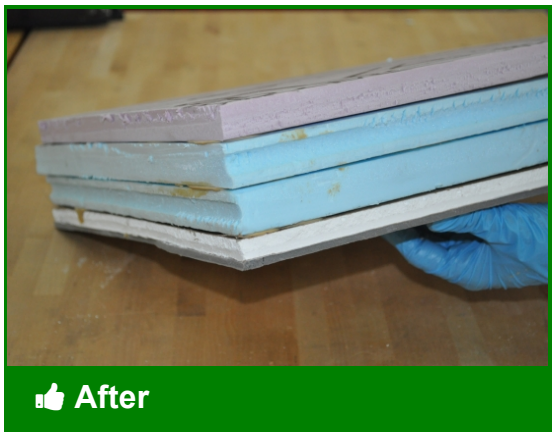
Insulation will be permanently attached and in complete contact with the air barrier

Objective(s):

Insulate to prescribed R-value

Before

Unsealed and uninsulated attic hatches and access doors allow leakage



After

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

Tools:

1. Caulk gun
2. Utility knife

Materials:

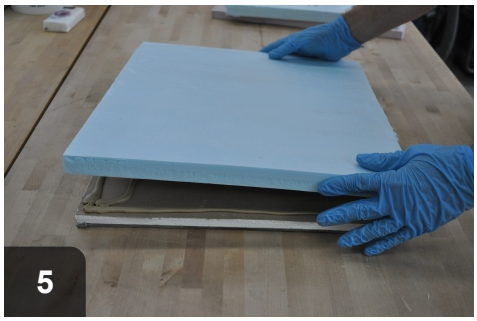
1. XPS
2. Adhesive

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

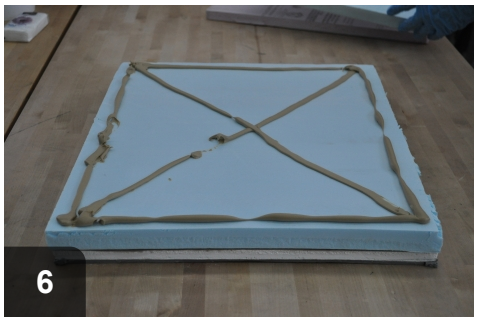
Ensure an air tight seal by making sure foam tape has no gaps

Apply strong adhesive to "cold-side" of hatch

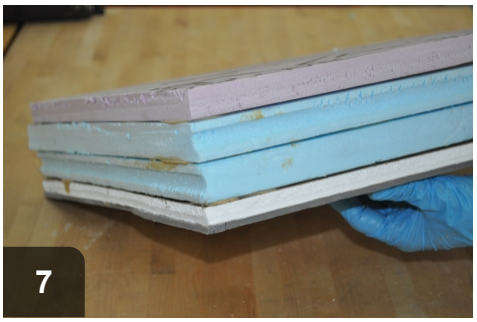
Adhesive should ring perimeter as well as criss-crossing hatch to ensure complete attachment of insulation



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

4.1088.3 - Skylights

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

4.1088.3a - Sealing

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

Specification(s):
Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):
Prevent air leakage

4.1088.3b - Installation

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

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

Insulation will be installed to prescribed R-value

Objective(s):
Insulate to prescribed R-value

Uninsulated, unsealed skylight well

Insulated, air sealed skylight well

Tools:

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

Materials:

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

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

Skylight well

Carefully seal all seams and joints

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

Install an attic-side air barrier.

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

4.1088.3c - Occupant education

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

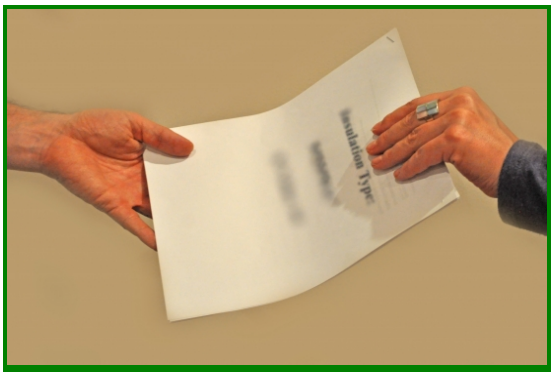
Specification(s):
A dated receipt signed by the installer will be provided that includes:

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

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

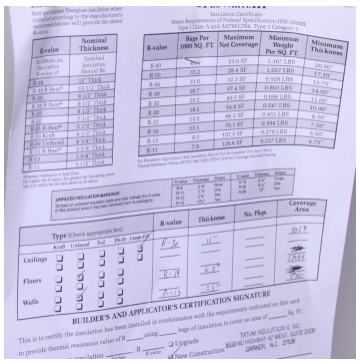
Comply with 16 CFR 460.17



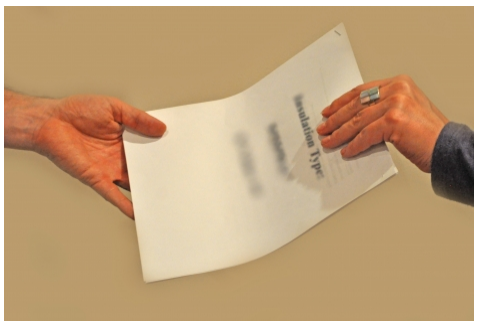
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1102.1 - Open-Cavity Wall Insulation—General

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

4.1102.1a - Sealing

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

Specification(s):
Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):
Prevent air leakage

Penetrations and bypasses create places where blown in insulation can leak

Sealed penetrations offer leakage protection and keep insulation in place

Tools:

1. Caulk gun

Materials:

1. Backer rod
2. Spray foam
3. Caulk

Open walls to be insulated and drywalled need air sealing

Penetrations and bypasses should be sealed to keep insulation in cavities

Use backer rod or other infill for larger penetrations

Seal penetration with caulk or fire-block, as appropriate

4.1102.1b - Installation

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

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

Insulation will be installed to prescribed R-value

Objective(s):
Insulate to prescribed R-value

Open walls should be insulated

Well-insulated rooms are significantly more comfortable in all seasons

Tools:

1. Insulation machine
2. Staple gun

Materials:

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

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

OR: Wall can be insulated using batts installed without gaps and face-stapled

4.1102.1c - Pre-drywall verification

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

Specification(s):
Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided

Objective(s):
Install insulation correctly

Verify insulation is properly installed before drywalling

Once proper installation is verified, begin drywalling to finish wall

Tools:

1. Hands
2. Eyes


Take a visual and physical inspection of insulation installation

4.1102.1d - Onsite documentation

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

Specification(s):
A dated receipt signed by the installer will be provided that includes:

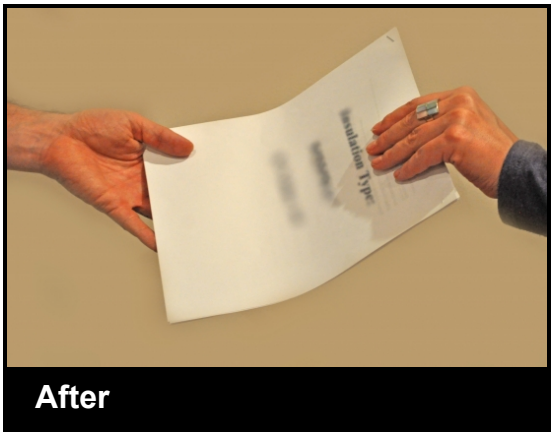
- Insulation type
- Coverage area
- R-value
- Installed thickness and settled thickness (settled thickness required for loose-fill only)
- Number of bags installed in accordance with manufacturer specifications (for loose-fill only)

Objective(s):

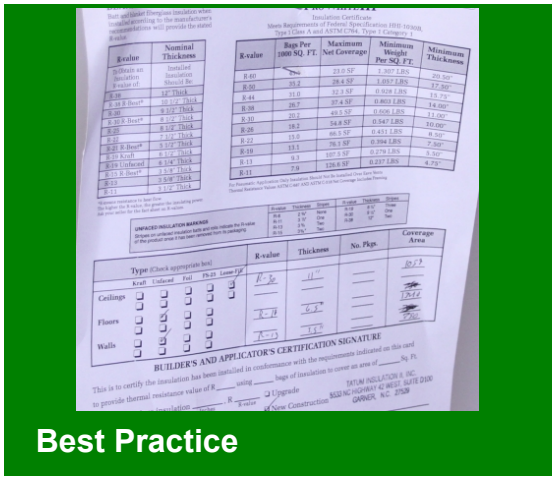
Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17



Provide occupant with documentation of and about insulation installed



Documentation should include insulation material and r-value

4.1103.1 - Dense Pack Exterior Walls

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

4.1103.1a - Exterior dense pack

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

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

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

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

Objective(s):
Eliminate voids and settling

Minimize framing cavity air flows

Make accurate count of insulation bags to be installed

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

Tools:

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

Materials:

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

Calculate the number of bags needed and verify the number you actually install.

Check that the static pressure at the blowing machine and at the hose end is at least 2.9 PSI.

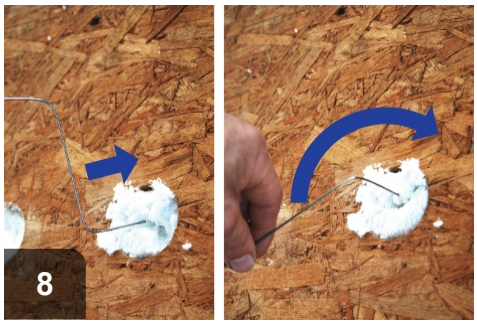
Adjust the pressure with the blower controls.

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

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

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

Check that cavities are filled and are the proper density.



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

Check for air leakage reduction after dense-pack insulation using a blower door at -50 Pascals and smoke

4.1103.1b - Onsite documentation

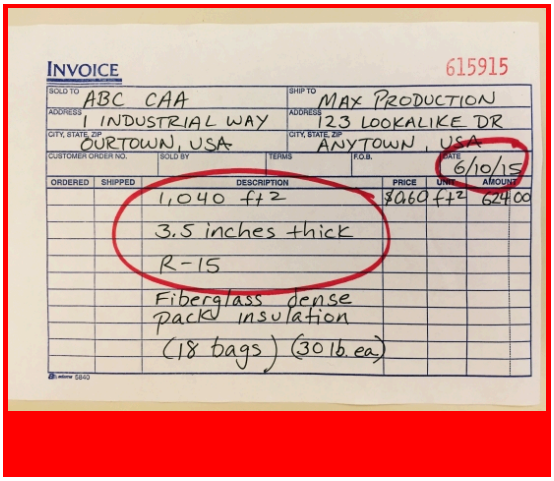
Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly

Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed Comply with 16 CFR 460.17



INVOICE 615915

SOLD TO ABC CAA
ADDRESS 1 INDUSTRIAL WAY
CITY, STATE, ZIP OURTOWN, USA
SHIP TO MAX PRODUCTION
ADDRESS 123 LOOKALIKE DR
CITY, STATE, ZIP ANYTOWN, USA
CUSTOMER ORDER NO. | SOLD BY | TERMS | F.O.B. | DATE 6/10/15

ORDERED	SHIPPED	DESCRIPTION	PRICE	UNIT	AMOUNT
		1,040 ft2	$0.60	ft2	624.00
		3.5 inches thick			
		R-15			
		Fiberglass dense pack insulation			
		(18 bags) (30 lb. ea)			

Installer shall provide a dated insulation receipt showing coverage area, R-value, and thickness

Obtain a dated insulation receipt showing coverage area, R-value, and thickness from the installer.

4.1103.2 - Additional Exterior Wall Cavities

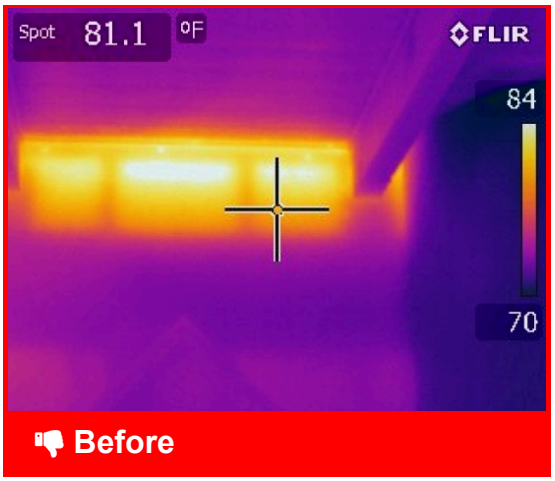
Desired Outcome:
Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

4.1103.2a - Location of cavities

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

Specification(s):
Details remaining in or between completed wall sections will be located and accessed

Objective(s):
Ensure the last gaps and framing edges in the thermal boundary, roof-wall joints, floor-wall joints, etc., are found and finished



Cavities missing insulation allow greater heat transfer than insulated ones

Either from inside or outside, using IR camera to locate cavities for fill

Tools:

1. Infrared camera
2. Drill
3. Hole saw
4. Tape measure
5. Probe

4.1103.2b - Sealing

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

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

Objective(s):
Ensure the air barrier is connected across all accessible house elements

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

4.1103.2c - Dense packing

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

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

- Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot

or greater density
- Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit airflow that corresponds to an air permeance value of 3.5 cfm/sq. ft. at 50 pascals, as measured using ASTM , SITE C 522, E 283, or E 2178
- The number of bags installed will be confirmed and will match the number required on the coverage chart

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

Objective(s):
Eliminate voids and settling

Minimize framing cavity air flows

Make accurate count of insulation bags to be installed


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

Tools:

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

Calculate the number of bags needed and verify the number you actually install.

Check that the static pressure at the blowing machine and at the hose end is at least 2.9 PSI.

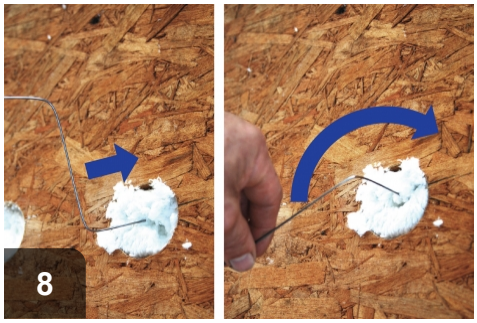
Adjust the pressure with the blower control knobs.

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

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

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

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



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

Check for air leakage reduction after dense-pack insulation using a blower door at -50 Pascals and smoke.

4.1103.2d - Quality assurance

Desired Outcome:

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

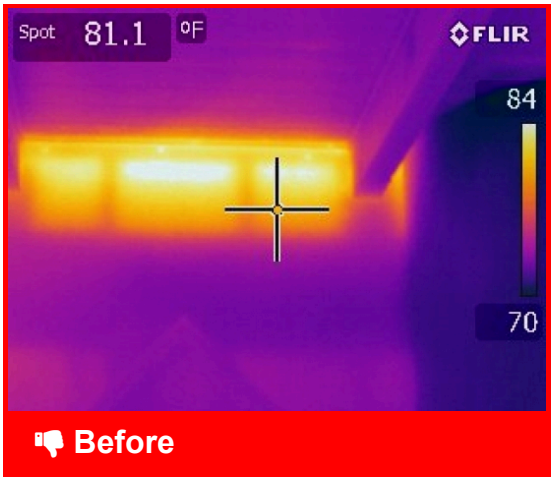
other treatments

Specification(s):
Completed wall sections will be viewed using infrared camera with blower door operating

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

Objective(s):
Establish air barrier and thermal boundary

Confirm no voids or hidden air flows remain



Unisulated exterior wall cavities to be insulated

Reduced temperature difference indicating insulated wall cavities

Tools:

1. Infrared camera


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


Inspect for voids and low density areas

Reduced temperature difference indicating insulated wall cavities

4.1103.2e - Close holes

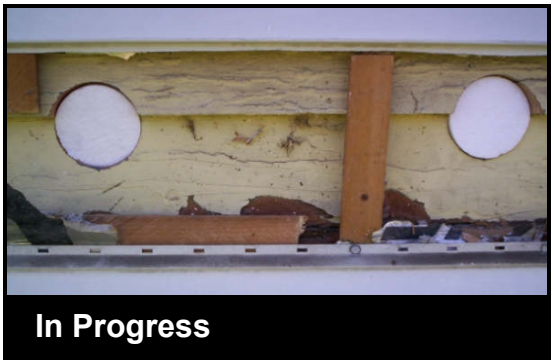
Desired Outcome:
Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

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

Louisiana WAP variances state: Interior holes will be coated with drywall mud or plaster and made

"paint ready" per agreement with the homeowner.

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

Once drywall patches are spackled, prime and paint.

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

4.1301.1 - Standard Floor System—Batt Installation

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

4.1301.1a - Sealing

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

Specification(s):
Sealing the floor system will be completed before insulating

Objective(s):
Ensure airtight envelope

Prevent leakage

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.1b - Installation

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

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

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

Insulation will be installed to prescribed R-value

Objective(s):
Insulate to prescribed R-value

Before

Uninsulated floors above unconditioned spaces are an energy drain

After

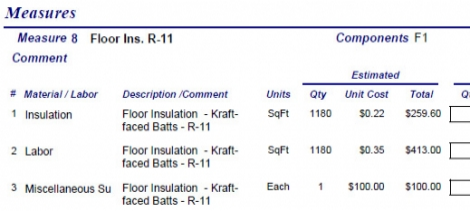
Batts should fill most of joist bay and be in full contact with subfloor

Tools:

1. Utility knife
2. Tape measure

Materials:

1. Kraft-faced fiberglass batts to work order specifications



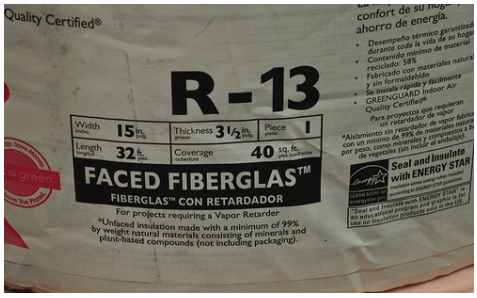
Measures

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

Comment

#	Material / Labor	Description /Comment	Units	Estimated Qty	Unit Cost	Total
1	Insulation	Floor Insulation - Kraft-faced Batts - R-11	SqFt	1180	$0.22	$259.60
2	Labor	Floor Insulation - Kraft-faced Batts - R-11	SqFt	1180	$0.35	$413.00
3	Miscellaneous Su	Floor Insulation - Kraft-faced Batts - R-11	Each	1	$100.00	$100.00

Order and install insulation as called for in Work Order



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

Install kraft-faced batts with paper against subfloor

Ensure batts are in full contact with subfloor and remain uncompressed

4.1301.1c - Securing batts

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

Specification(s):
Batts will be secured with physical fasteners

Objective(s):
Ensure insulation remains in contact with subfloor

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


Batt should be in contact with subfloor without being compressed


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

4.1301.1d - Occupant education

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

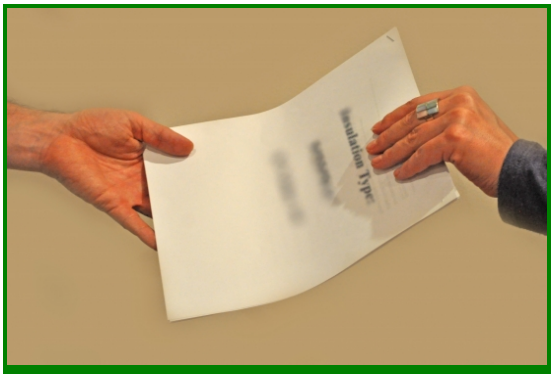
Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

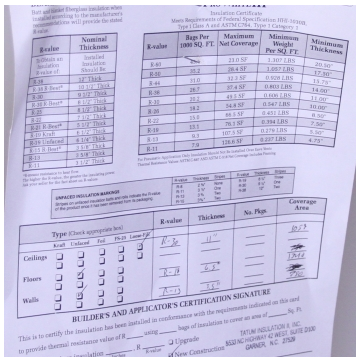
Comply with 16 CFR 460.17



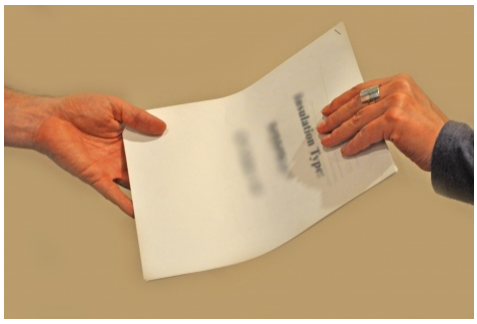
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.2 - Standard Floor System—Loose Fill with Netting

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

4.1301.2a - Sealing

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

Specification(s):
Sealing the floor system will be completed before insulating

Objective(s):
Ensure airtight envelope

Prevent leakage

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.2b - Netting, fabric

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

Specification(s):
When using netting or fabric, staples will be placed according to manufacturer specifications

Netting or fabric will meet local fire codes

Objective(s):
Secure insulation

Uninsulated floors above unconditioned spaces are an energy drain

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

Tools:

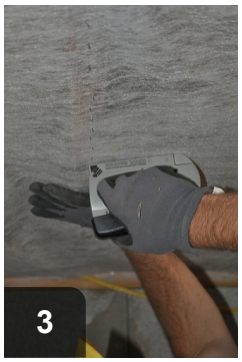
1. Utility knife
2. Scissors
3. Stapler

Materials:

1. Fabric netting
2. Staples

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 - Installation

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

Specification(s):
Insulation in netted or fabric cavities will be dense packed with loose fill insulation in accordance with manufacturer specifications

Insulation will be installed to prescribed R-value

Insulation will be in continuous contact with air barrier

Objective(s):

Insulate to prescribed R-value

Ensure a continuous thermal boundary between conditioned and unconditioned space

With netting in place, insulation can begin

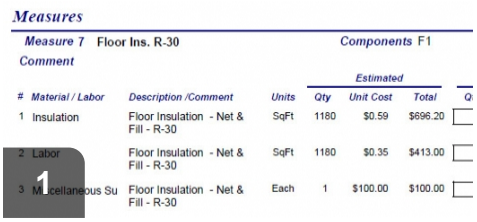
Cavities filled to manufacturer specs to achieve prescribed r-value

Tools:

1. Utility knife
2. Insulation machine

Materials:

1. Loose fill fiberglass or cellulose



Measures

Measure 7 Floor Ins. R-30 Components F1

Comment

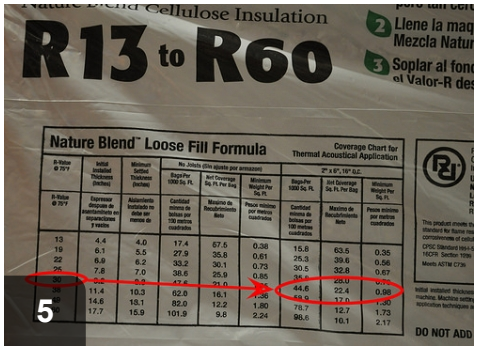
#	Material / Labor	Description /Comment	Units	Estimated Qty	Unit Cost	Total	Q
1	Insulation	Floor Insulation - Net & Fill - R-30	SqFt	1180	$0.59	$696.20	
2	Labor	Floor Insulation - Net & Fill - R-30	SqFt	1180	$0.35	$413.00	
3	Miscellaneous Su	Floor Insulation - Net & Fill - R-30	Each	1	$100.00	$100.00	

Order and install insulation based on specifications in work order

Always wear proper PPE when blowing in insulation

Cut holes in each individual cavity to insert insulation machine nozzle

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



Consult manufacturer specs on insulation packaging for proper installation

Blow in insulation to prescribed r-value

4.1301.2d - Occupant education

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

Specification(s):
A dated receipt signed by the installer will be provided that includes:

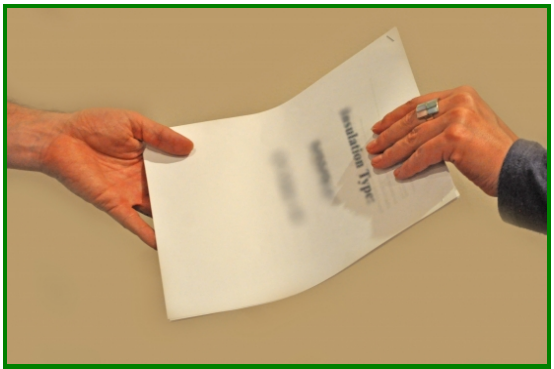
- Insulation type
- Coverage area
- R-value
- Installed thickness and minimum settled thickness
- Number of bags installed in accordance with manufacturer specifications

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

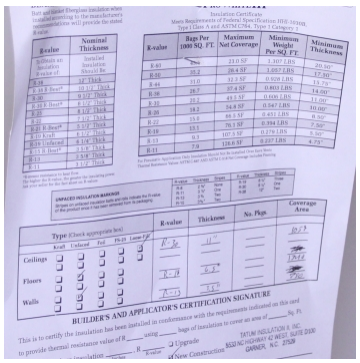
Comply with 16 CFR 460.17



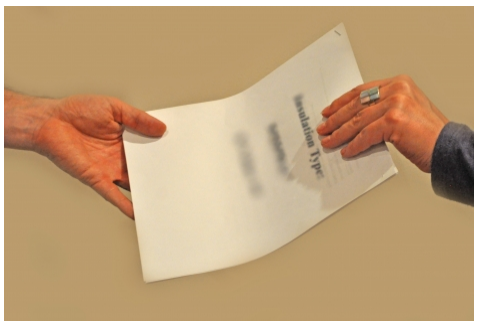
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.3 - Standard Floor System—Loose Fill with Rigid Barrier

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

4.1301.3a - Sealing

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

Specification(s):
Sealing the floor system will be completed before insulating

Objective(s):
Ensure airtight envelope

Prevent leakage

Gaps around penetrations cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Backer rod
2. Caulk
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.3b - Rigid air barrier

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 provide air sealing and create cavities for insulation

Tools:

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

Materials:

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

Attach barrier to joists using appropriate fasteners for chosen material

When possible, align seams with joist. Seal all seams with caulk

Pay particular attention to sealing at complex joints to prevent leakage

Remember to seal along sills as well

4.1301.3c - Installation

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

Specification(s):
Loose fill 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

Before

After

Once rigid barrier is sealed, insulation can be blown in

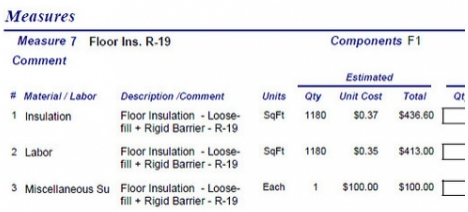
Tools:

1. Insulation machine
2. Caulk gun

Materials:

1. Loose fill insulation
2. Caulk

Make sure to wear proper PPE when working with insulation



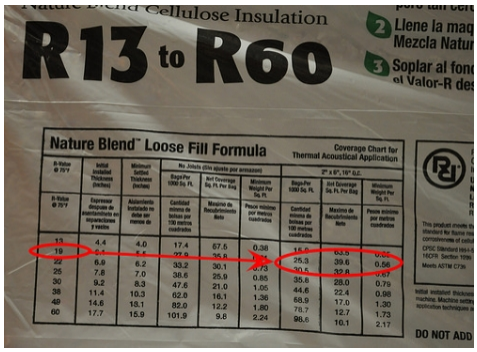
Measures

Measure 7 Floor Ins. R-19 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Estimated Unit Cost	Estimated Total	Qt
1	Insulation	Floor Insulation - Loose-fill + Rigid Barrier - R-19	SqFt	1180	$0.37	$436.60	
2	Labor	Floor Insulation - Loose-fill + Rigid Barrier - R-19	SqFt	1180	$0.35	$413.00	
3	Miscellaneous Su	Floor Insulation - Loose-fill + Rigid Barrier - R-19	Each	1	$100.00	$100.00	

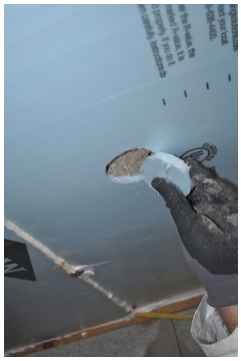
Purchase and install loose fill to r-value specified on Work Order



Check manufacturer specifications for proper density to reach r-value

Drill hole slightly larger than hose in

Loose fill cavities created by rigid



Once filled to prescribed density,

rigid barrier barrier prepare plug to preserve rigid barrier

Plug should be sealed in place to prevent leakage

4.1301.3d - Occupant education

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

Specification(s):
A dated receipt signed by the installer will be provided that includes:

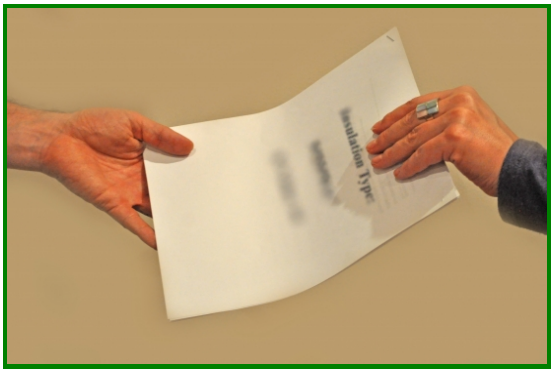
- Insulation type
- Coverage area
- R-value
- Installed thickness and minimum settled thickness
- Number of bags installed in accordance with manufacturer specifications

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

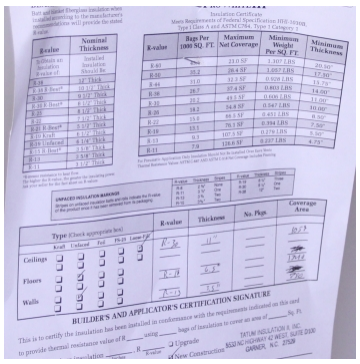
Comply with 16 CFR 460.17



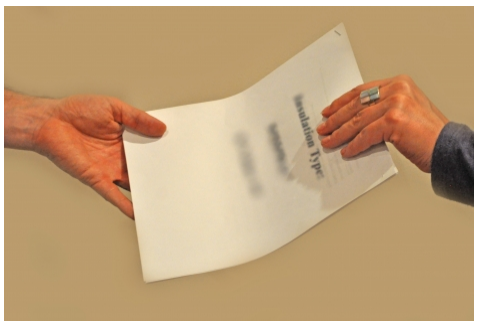
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.4 - Dense Pack Floor System with Rigid Barrier

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

4.1301.4a - Sealing

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

Specification(s):
Sealing the floor system will be completed before insulating

Objective(s):
Ensure airtight envelope

Prevent leakage

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealands and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk small gaps and to hold backer rod in place

4.1301.4b - Rigid air barrier

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

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 - Installation

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

Before

Once rigid barrier is sealed, insulation can be blown in

After

Rigid barrier should be resealed to maintain air barrier after filling

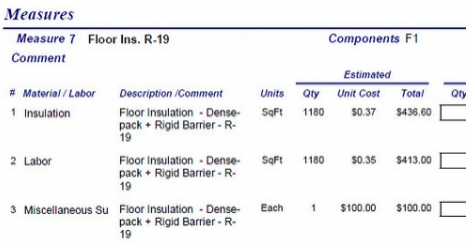
Tools:

1. Insulation machine
2. Caulk gun

Materials:

1. Dense packable insulation
2. Caulk

Ensure that proper PPE is worn while working with insulation



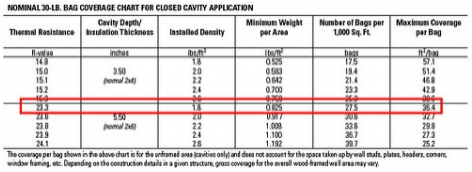
Measures

Measure 7 Floor Ins. R-19 — Components F1

Comment

#	Material / Labor	Description /Comment	Units	Estimated Qty	Unit Cost	Total	Qty
1	Insulation	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	$0.37	$436.60	
2	Labor	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	$0.35	$413.00	
3	Miscellaneous Su	Floor Insulation - Dense-pack + Rigid Barrier - R-19	Each	1	$100.00	$100.00	

Fill cavities to specified r-value from Work Order



NOMINAL 30-LB. BAG COVERAGE CHART FOR CLOSED CAVITY APPLICATION

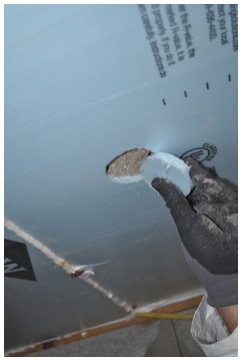
Thermal Resistance	Cavity Depth/ Insulation Thickness	Installed Density	Minimum Weight per Area	Number of Bags per 1,000 Sq. Ft.	Maximum Coverage per Bag
R-value	inches	lbs/ft³	lbs/ft²	bags	ft²/bag
14.9		1.8	0.525	17.5	57.1
15.0	3.50	2.0	0.583	19.4	51.4
15.1	(nominal 2x4)	2.2	0.642	21.4	46.8
15.2		2.4	0.700	23.3	42.9
15.3		2.6	0.758	25.3	39.5
22.3		1.8	0.625	27.5	36.4
22.6	5.50	2.0	0.917	30.6	32.7
23.0	(nominal 2x6)	2.2	1.008	33.6	29.8
23.9		2.4	1.100	36.7	27.3
24.1		2.6	1.192	39.7	25.2

The coverage per bag shown in the above chart is for the unframed area (cavities only) and does not account for the space taken up by wall studs, plates, headers, corners, window framing, etc. Depending on the construction details in a given structure, gross coverage for the overall wood-framed wall area may vary.

Check manufacturer specifications for r-value before filling

Drill hole slightly larger than nozzle

Dense pack insulation into floor



When filled to specified density and r-

into rigid barrier with hole saw cavities value, fill access hole

Plug access hole and seal to maintain air barrier

4.1301.4d - Occupant education

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

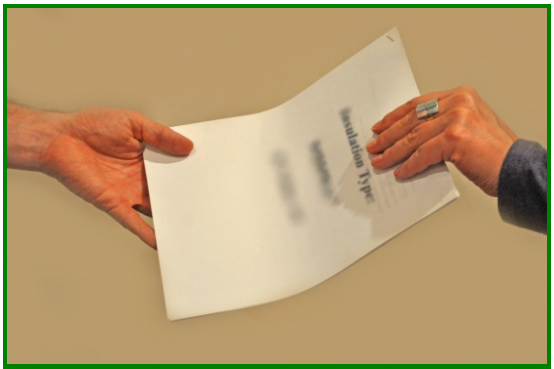
Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

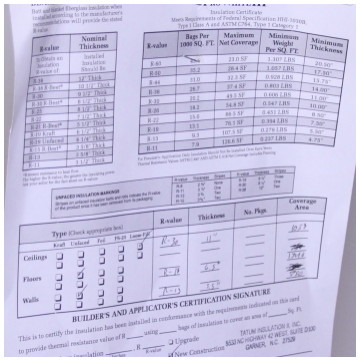
Comply with 16 CFR 460.17



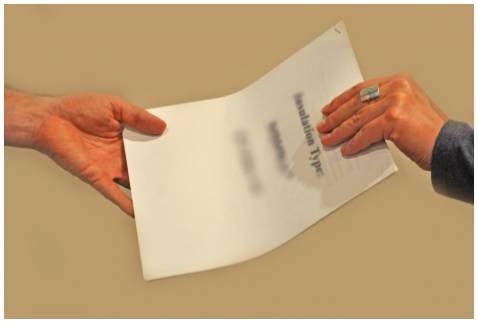
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.5 - Cantilevered Floor—Batt Installation

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

4.1301.5a - Air barrier

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

Specification(s):
Air barrier will be installed between joists and sealed

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

Objective(s):
Separate cantilevered floor from conditioned floor space

Allow for insulation

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

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

Tools:

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

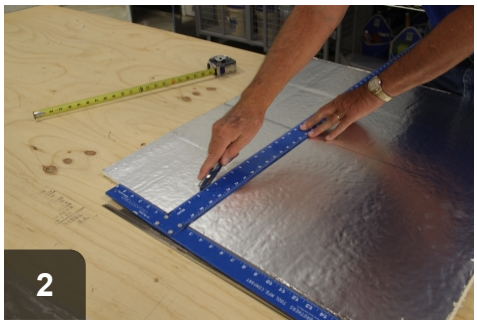
Materials:

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

1. Stuff the cavities with fiberglass insulation as a backer, and then apply two-part spray polyurethane foam to seal the openings. 2. Cut and install drywall, plywood, OSB, or rigid foam board in each cavity, then seal around the edges with foam or caulk. 3. Install dense-pack insulation in cantilevered area, being careful to extend it inward past the supporting wall (this also accomplishes insulating the cantilevered floor area).

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

Measure cavity to determine size necessary for blocking.



Measure and cut blocking to fit snugly between floor joists.

Ensure the blocking is placed to the most interior edge of the top plate of the wall below.

Air seal blocking around its perimeter edges with foam or caulk.

Cut batt insulation to match the size of the blocking.

4.1301.5b - Installation

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

Specification(s):
Air barrier will be insulated between joist from top plate of the wall below to subfloor above

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

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

Insulation will be installed to prescribed R-value

Objective(s):
Insulate to prescribed R-value

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

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

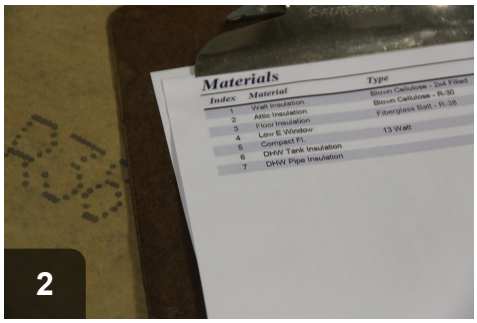
Tools:

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

Materials:

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

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



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

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

Ensure the batt is positioned correctly.

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

4.1301.5c - Attachment

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

Specification(s):
Batts will be secured with physical fasteners

Objective(s):
Ensure insulation remains in contact with subfloor and air barrier

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

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 - Exterior soffit

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

Cavities have been insulated but are still exposed.

After all accessible cavities have been air sealed and insulated, replace sheathing and siding to cover insulation.

Tools:

1. claw hammer
2. drill
3. mechanical fastners

Materials:

1. OSB/Plywood(where existing)
2. Vinyl Soffit(where existing)

Cantilevered floors should be insulated to preserve thermal boundary

Seal off floor cavities using previously removed materials, in this case OSB and vinyl soffit.

Re-install any materials that were removed, such as OSB, J-channels, and vinyl soffit.

Completed installation

4.1301.5e - Occupant education

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

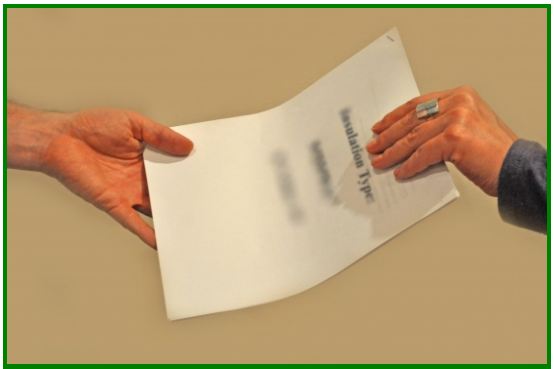
Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

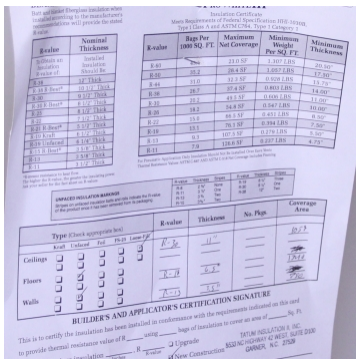
Comply with 16 CFR 460.17



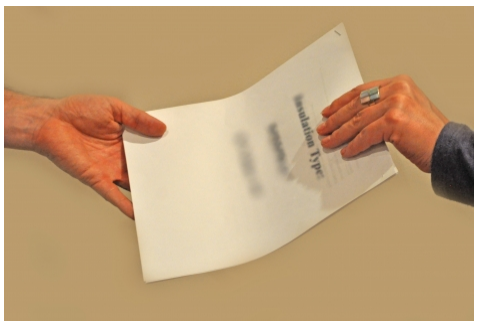
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.6 - Pier Construction Subfloor Insulation—Batt Installation with Rigid Barrier

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

4.1301.6a - Subfloor preparation

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

Specification(s):
Sealing between house and crawl space will be completed before insulating

Objective(s):
Ensure airtight envelope

Prevent leakage

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.6b - Installation

Desired Outcome:
Consistent, uniform thermal barrier 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

Before

Uninsulated floors above unconditioned spaces are an energy drain

After

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

Tools:

1. Utility knife
2. Drill

Materials:

1. Kraft-faced fiberglass batts to work order specifications
2. Rigid barrier -- drywall, plywood, XPS
3. Fasteners

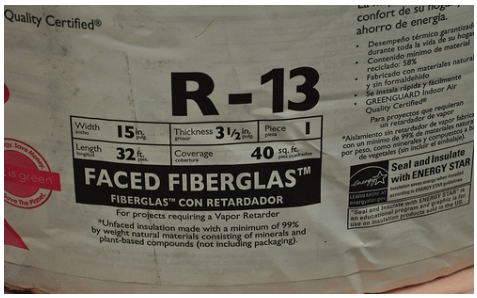
Measures

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



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

Install kraft-faced batts with paper against subfloor

Ensure batts are in full contact with subfloor and remain uncompressed

4.1301.6c - Secure batts

Desired Outcome:
Consistent, uniform thermal barrier 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

Batts should not hang away from subfloor

"Lightning rods" or twine should be used to maintain contact

Tools:

1. Utility knife
2. Drill
3. Staple gun

Materials:

1. Lightning rods
2. Twine
3. Fasteners

Batts should be in full contact with subfloor without being compressed

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

4.1301.6d - Rigid air barrier

Desired Outcome:
Consistent, uniform thermal barrier 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

Seams and penetrations will be sealed

Objective(s):
Protect insulation

Unfaced fiberglass batts can be attractive housing for pests

Rigid barrier allows for air sealing and protects batt insulation

Tools:

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

Materials:

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

Fasten rigid barrier, aligning seams with joists when possible

Seal all seams with caulk to prevent leakage

Pay particular attention to complex joints

Remember to seal along sills

4.1301.6e - Occupant education

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

Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area

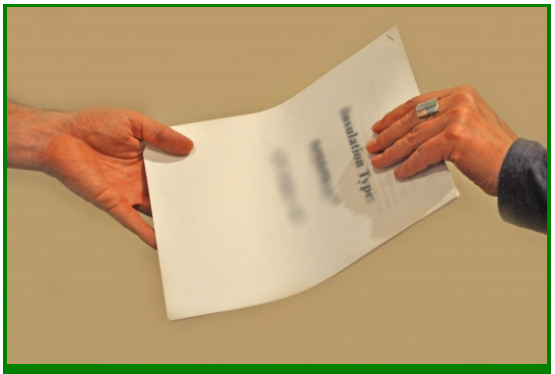
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

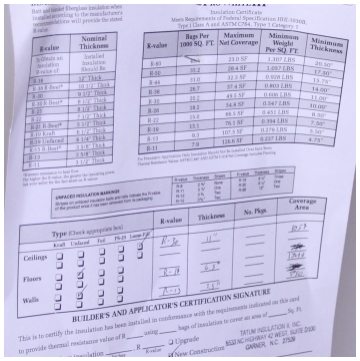
Comply with 16 CFR 460.17



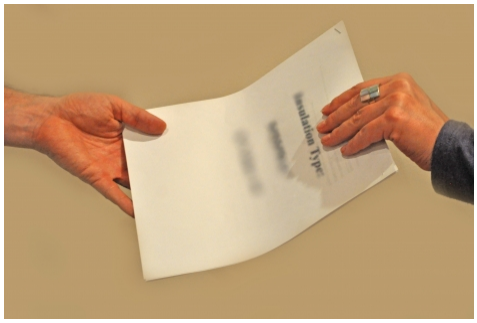
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.7 - Pier Construction Subfloor Insulation—Loose Fill with Rigid Barrier

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

4.1301.7a - Subfloor preparation

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

Specification(s):
Sealing between house and crawl space will be completed before insulating

Objective(s):
Prevent air leakage

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.7b - Rigid air barrier

Desired Outcome:
Consistent, uniform thermal barrier 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 while creating 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

Fasten rigid barrier, aligning seams with joists when possible

Seal all seams to prevent leakage

Pay particular attention to complex joints


Remember to caulk along sills

4.1301.7c - Installation

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

Specification(s):
Loose fill 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

Before

Once rigid barrier has been sealed, insulation can be blown in

After

After insulating, restore rigid barrier to prevent leakage

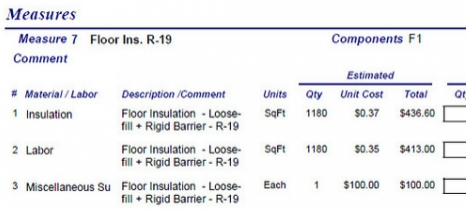
Tools:

1. Insulation machine
2. Caulk gun

Materials:

1. Loose fill insulation
2. Caulk

Always wear proper PPE when working with insulation



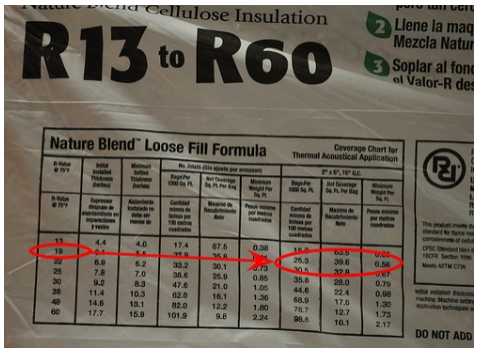
Measures

Measure 7 Floor Ins. R-19 *Components* F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Estimated Unit Cost	Estimated Total	Qt
1	Insulation	Floor Insulation - Loose-fill + Rigid Barrier - R-19	SqFt	1180	$0.37	$436.60	
2	Labor	Floor Insulation - Loose-fill + Rigid Barrier - R-19	SqFt	1180	$0.35	$413.00	
3	Miscellaneous Su	Floor Insulation - Loose-fill + Rigid Barrier - R-19	Each	1	$100.00	$100.00	

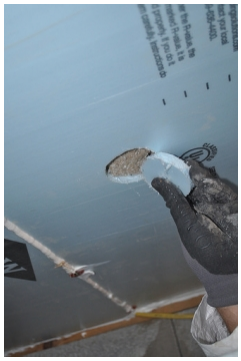
Purchase and install insulation to r-value specified on Work Order



Check manufacturer specs to ensure proper installation and density

Drill hole in rigid barrier slightly larger

Fill cavities formed by rigid barrier



Once cavities have been filled to

than insulation hose with loose fill insulation specified r-value, prepare plug

Seal rigid barrier to prevent leakage

4.1301.7d - Occupant education

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

Specification(s):
A dated receipt signed by the installer will be provided that includes:

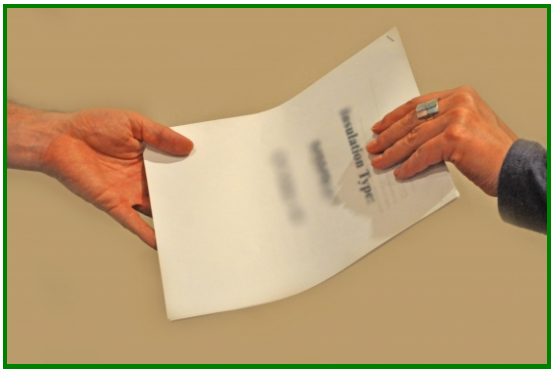
- Insulation type
- Coverage area
- R-value
- Installed thickness and minimum settled thickness
- Number of bags installed in accordance with manufacturer specifications

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

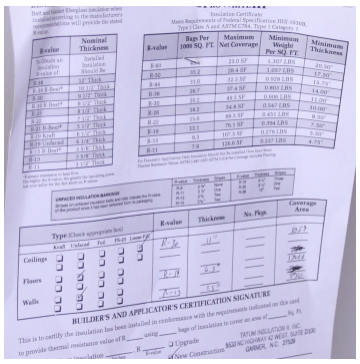
Comply with 16 CFR 460.17



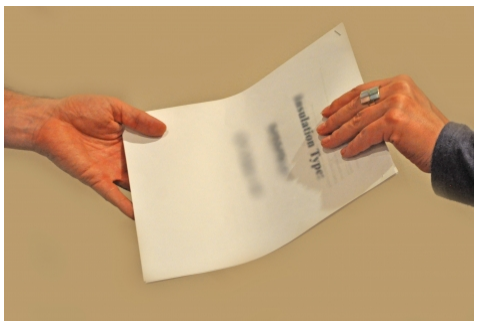
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1301.8 - Pier Construction Subfloor Installation—Dense Pack with Rigid Barrier

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

4.1301.8a - Subfloor preparation

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

Specification(s):
Sealing between house and crawl space will be completed before insulating

Objective(s):
Prevent air leakage

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.8b - Rigid air barrier

Desired Outcome:
Consistent, uniform thermal barrier 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 while creating 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

Fasten rigid barrier, aligning seams with joists when possible

Seal all seams with caulk to prevent leakage

Pay particular attention to complex seams

Remember to seal along sills

4.1301.8c - Installation

Desired Outcome:
Consistent, uniform thermal barrier 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

Before

Once rigid barrier has been sealed, insulation can be blown in

After

Rigid barrier should be sealed after insulating to maintain air barrier

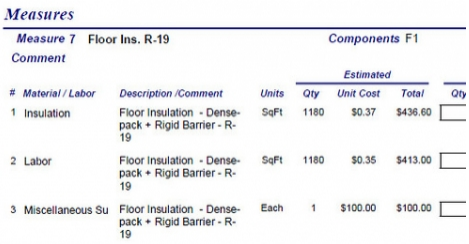
Tools:

1. Insulation machine
2. Caulk gun

Materials:

1. Dense packable insulation
2. Caulk

Make sure to wear proper PPE when working with insulation



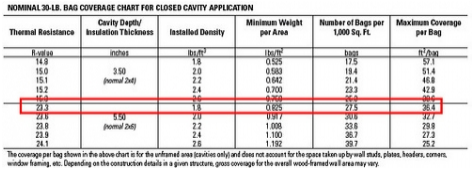
Measures

Measure 7 Floor Ins. R-19 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Estimated Qty	Unit Cost	Total	Qty
1	Insulation	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	$0.37	$436.60	
2	Labor	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	$0.35	$413.00	
3	Miscellaneous Su	Floor Insulation - Dense-pack + Rigid Barrier - R-19	Each	1	$100.00	$100.00	

Purchase and install insulation as per Work Order



NOMINAL 30-LB. BAG COVERAGE CHART FOR CLOSED CAVITY APPLICATION

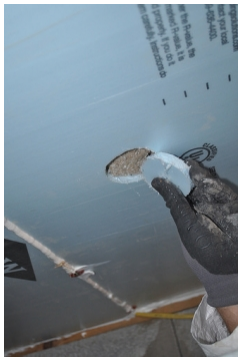
Thermal Resistance	Cavity Depth/ Insulation Thickness	Installed Density	Minimum Weight per Area	Number of Bags per 1,000 Sq. Ft.	Maximum Coverage per Bag
R-value	inches	lbs/ft³	lbs/ft²	bags	ft²/bag
14.9		1.8	0.525	17.5	57.1
15.0	3.50	2.0	0.583	19.4	51.4
15.1	(nominal 2x4)	2.2	0.642	21.4	46.8
15.2		2.4	0.700	23.3	42.9
15.3		2.5	0.729	24.3	41.1
22.3		1.8	0.625	27.5	36.4
22.6	5.50	2.0	0.917	30.6	32.7
23.0	(nominal 2x6)	2.2	1.008	33.6	29.8
23.9		2.4	1.100	36.7	27.3
24.1		2.6	1.192	39.7	25.2

The coverage per bag shown in the above chart is for the unframed area (cavities only) and does not account for the space taken up by wall studs, plates, headers, corners, window framing, etc. Depending on the construction details in a given structure, gross coverage for the overall wood-framed wall area may vary.

Check manufacturer specifications to install properly

Drill hole in rigid barrier slightly larger

Blown in insulation to density and r-



Once cavity is filled, prepare plug to

than insulation hose value specified by work order reseal rigid barrier

Securely seal plug into rigid barrier to prevent leakage

4.1301.8d - Occupant education

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

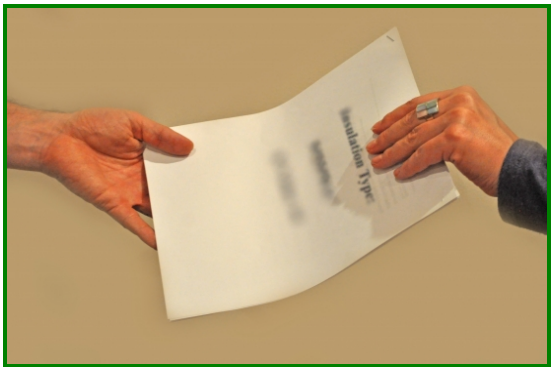
Specification(s):
A dated receipt signed by the installer will be provided that includes:

- Coverage area
- Thickness
- R-value

Objective(s):
Document job completion to contract specifications

Confirm amount of insulation installed

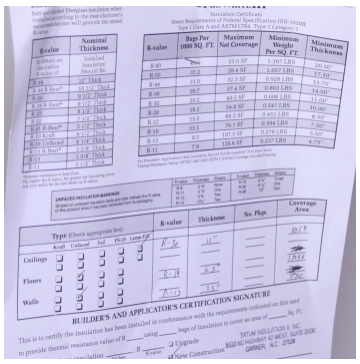
Comply with 16 CFR 460.17



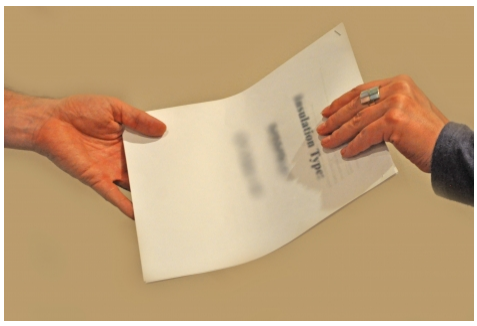
Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support



Documentation should include insulation material and r-value



Provide occupant with copies of all documentation

4.1402.2 - Basement Wall Insulation—No Groundwater Leakage

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

4.1402.2a - R-value

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
Regional IECC will be followed for required R-values

Objective(s):
Improve thermal performance of the basement and living space

	Continuous Rigid Insulation, Interior or Exterior	Interior Cavity Insulation
Zone 1	0	0
Zone 2	0	0
Zone 3	5	13
Zone 4, except marine	10	13
Zone 5 and marine 4	15	19
Zone 6-8	16	19

Best Practice

Find your regional zone and insulation application to determine r-value

4.1402.2b - Air barrier

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
A continuous air barrier will be installed on the warm side of the insulation

Objective(s):
Prevent condensation on the basement wall

Before

Basement shows no sign of ground water penetration, but needs insulation

After

Insulation and drywall create an air barrier

Tools:

1. Utility knife
2. Tape measure
3. Drill
4. Taping knife

Materials:

1. XPS insulation board
2. Kraft-faced fiberglass batts
3. Drywall
4. Spackle
5. Seam tape
6. Fasteners

XPS insulation board is a non-absorbent insulation option

The drywall still provides an air barrier to keep moisture build up on wall

OR Kraft-faced fiberglass batts can be used with paper toward living space

Both kraft-face and drywall create air barrier, but batts are absorbent

4.1402.2c - Vapor permeability

Desired Outcome:
Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):
When absorbent insulation materials are installed, assembly will remain vapor semi-impermeable to the interior in all climate zones except Zone 7

Objective(s):
Provide drying potential to the basement

4.1601.2 - Insulating Metal Ducts

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

4.1601.2a - Selection of duct insulation material

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

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

Hot humid and warm coastal regions will not bury ducts

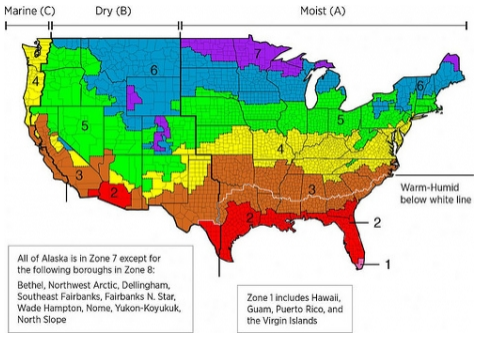
Objective(s):
Decrease heat loss and condensation problems

Uninsulated ducts in unconditioned spaces are an energy drain

Properly insulated ducts operate at much higher rates of efficiency

Ducts in unconditioned areas should have r-8 insulation with vapor barrier

OR ducts can be buried in loose fill in attic spaces in drier climates



Burying ducts is discouraged in warm coastal and hot humid regions

4.1601.2b - Duct sealing

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

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

Objective(s):
Minimize duct leakage

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

Sealed ductwork connections help prevent leakage

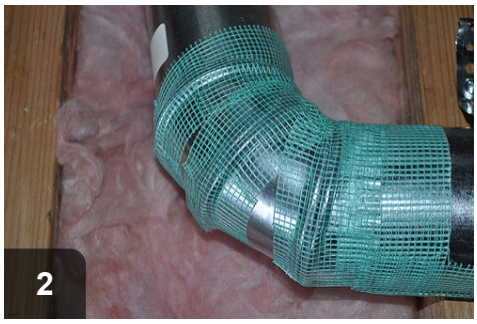
Tools:

1. Putty knife

Materials:

1. Mesh tape
2. Mastic

Prepare work area by assessing any safety concerns



Wrap joint with fiberglass mesh tape

Apply UL 181 mastic to seal joint

4.1601.2c - Attachment of duct insulation

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
Duct insulation will be secured to the duct system using metal wire or rot-proof nylon twine

Pattern of the wire or twine will be sufficient to securely hold the duct insulation tight to the duct

Objective(s):
Ensure a secure connection between the duct system and the duct insulation

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

4.1601.2d - Taping of the duct insulation

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
Using a tape approved by the manufacturer, all seams and connection of the duct insulation will be taped

No gaps will exist between pieces of duct insulation

Objective(s):
Prevent gaps in the vapor barrier of the insulation

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

5.3001.1 - Load Calculation and Equipment Selection

Desired Outcome:
Equipment sized properly and operates efficiently

5.3001.1a - Load calculation

Desired Outcome:
Equipment sized properly and operates efficiently

Specification(s):
Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J (Residential Load Calculation) and manufacturer specifications

Objective(s):
Properly size equipment for load

According to Louisiana WAP variances: WAP subgrantees may use the DOE-approved audit tool to determine system sizing for heating and cooling systems for site-built homes, such as NEAT.

5.3001.1b - Equipment selection

Desired Outcome:
Equipment sized properly and operates efficiently

Specification(s):
Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications

Objective(s):
Ensure equipment is able to heat, cool, and dehumidify the house

5.3001.1c - Air filtration

Desired Outcome:
Equipment sized properly and operates efficiently

Specification(s):

New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters

Objective(s):
Particle removal to protect equipment and help maintain indoor air quality

5.3003.1 - Data Plate Verification

Desired Outcome:
Data for commissioning and future service work is recorded

5.3003.1a - Data plate verification

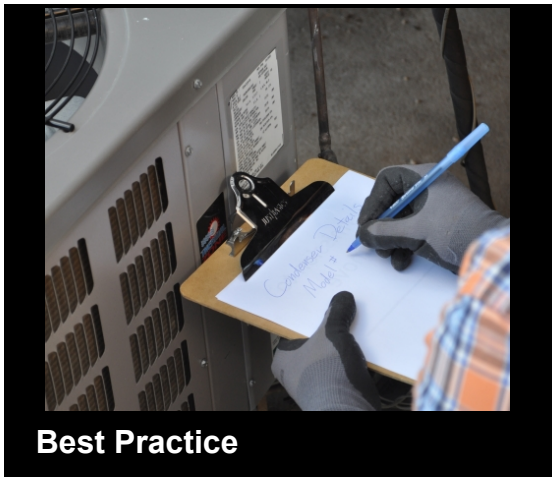
Desired Outcome:
Data for commissioning and future service work is recorded

Specification(s):
Equipment will be visually inspected

Information will be recorded from the equipment data plates indoors and outdoors where available

Objective(s):
Ensure technician has equipment data necessary for commissioning and future service work

Thoroughly inspect all heating and cooling equipment for safe operation and locate data plate to record information



Record model information about heating and cooling equipment to ensure proper maintenance

5.3003.2 - Combustion Analysis of Oil-Fired Appliances

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Note:
The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detailIf new installation or replacement is necessary, ANSI / ACCA 5 QI HVAC Quality Installation Specification will be followed

5.3003.2a - Oil system: filter

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Filter will be present, clean, and leak free

Objective(s):
Ensure oil filter is present and functional

Locate oil filter(s) on oil-fired water heaters and furnaces, and check for need of cleaning or replacement

If necessary, replace with appropriate filter and gasket

Tools:

1. Wrench

Materials:

1. Replacement oil filter
2. Gasket

Some systems have more than one filter. One filter is typically located close to fuel tank and may be outdoors.

Take note of filter model number for easy replacement

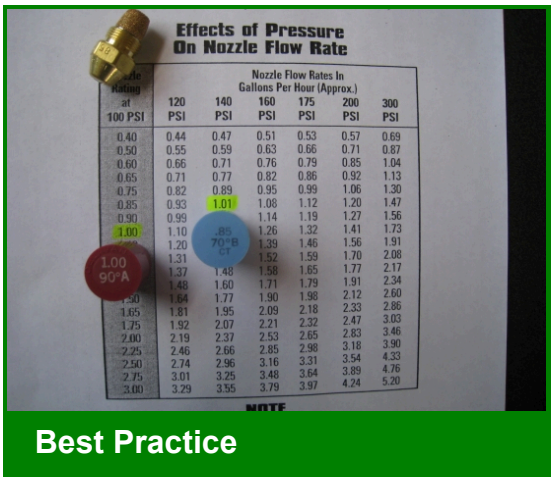
5.3003.2b - Nozzle

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Nozzle size, angle, and spray pattern will be correct for design input and within equipment firing rate of the heating system manufacturer. Position of nozzle and electrodes will be in accordance with manufacturer specifications

Objective(s):
Ensure equipment is outfitted with the correct nozzle per manufacturer guidelines

Locate nozzles on oil-fired water heaters and furnaces



Verify that nozzle size is appropriate for model by consulting flow chart

Tools:

1. Calipers
2. Nozzle Sizing Capacity Chart

5.3003.2c - Fuel pressure

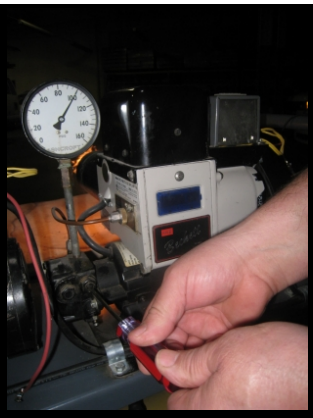
Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Measurement will be verified in accordance with manufacturer specifications

Objective(s):
Ensure correct oil pump pressure for nozzle installed and at OEM’s specified values per ACCA

Best Practice

Check oil-fired furnaces and water heaters for proper fuel pressure



In Progress

Verify that fuel pressure matches manufacturer's specifications

5.3003.2d - Place appliance in operation

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Heating equipment will be placed in operation in accordance with applicable standards and manufacturer specifications when available

Objective(s):
Prepare equipment for combustion analysis tests

Verify oil-fired furnaces and water heaters are operating safely

5.3003.2e - Smoke Test

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Smoke test will be conducted before any combustion testing is completed

Smoke spot reading will be in accordance with burner manufacturer specifications

If smoke test is more than actionable levels, specify a clean and tune

Objective(s):
Determine whether equipment is operating within acceptable range according to smoke test and call for action if needed

Verify oil-fired furnaces and water heaters are operating safely

Best Practice

Smoke tests determine if oil-fired appliances burn cleanly by testing soot

Tools:

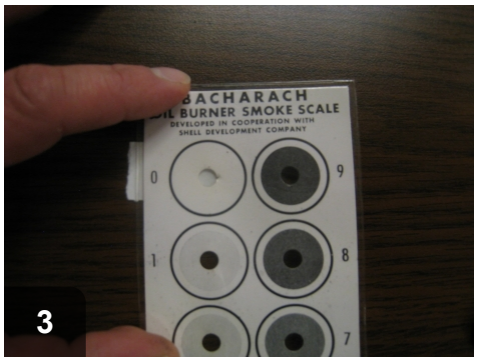
1. Smoke testing pump

Materials:

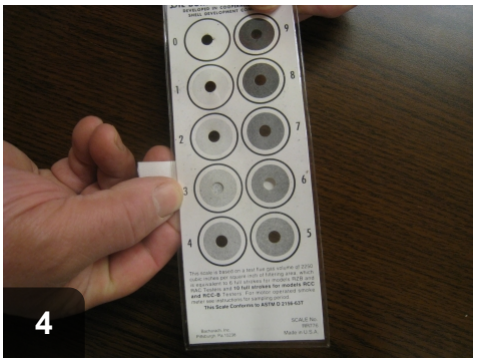
1. Filter paper

Place filter paper in testing pump and draw air through paper

Remove paper and verify draw was successful by checking for soot



Compare level of soot deposit against smoke chart. A rating of 0 is ideal



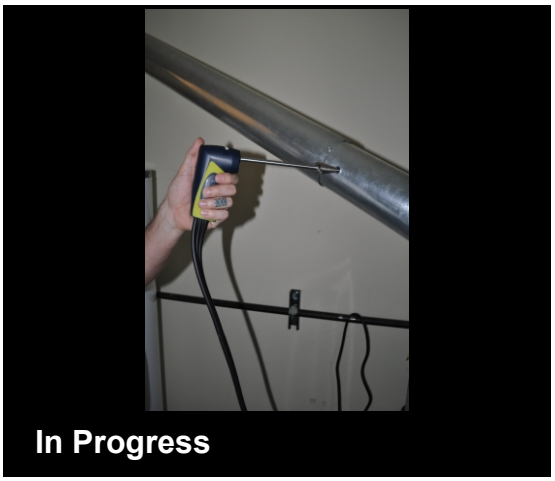
Appliances with ratings of 3 or higher should be cleaned and tuned

5.3003.2f - Steady state efficiency (SSE)

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Measurement will be verified in accordance with manufacturer specifications

Objective(s):
Determine whether steady state efficiency is within manufacturer range



In Progress

Test flue gases to determine steady state efficiency

After

Test 10-15min after firing, when appliance is at steady state. Reading should be within manufacturer's tolerances

Tools:

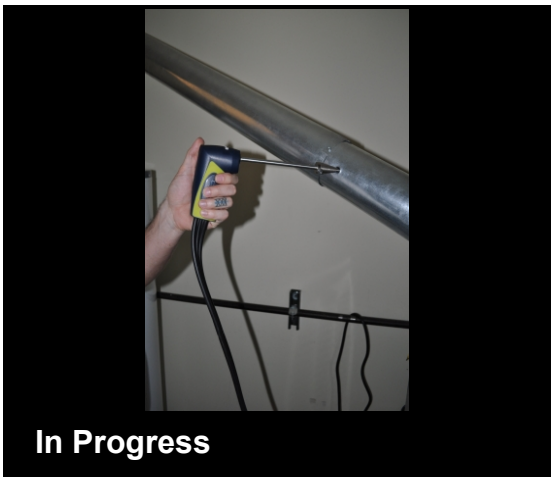
1. Combustion analyzer with probe
2. Drill

5.3003.2g - Net stack temperature

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Net stack temperature will be measured and verified in accordance with manufacturer specifications

Objective(s):
Determine whether net stack temperature is within manufacturer’s recommended range



In Progress

Verify oil-fired appliances are not burning hotter than manufacturer specs

After

T-stack minus T-air equals net stack temperature. Check against specs

Tools:

1. Combustion analyzer with probe
2. Drill

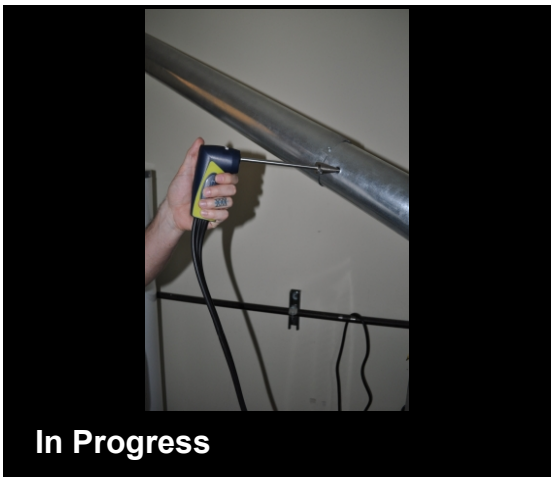
T=temperature. T-stack minus T-air = Delta T or Net Stack Temperature.

5.3003.2h - Carbon dioxide (CO2) and oxygen (O2)

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Measurement will be verified in accordance with manufacturer specifications

Objective(s):
Verify combustion performance of equipment is within manufacturer recommended range based on CO2 and O2 readings



In Progress

Verify oil-fired appliances are burning safely by testing CO2 and O2 levels

After

Levels should be within industry standards and match manufacturer specs

Tools:

1. Combustion analyzer with probe
2. Drill

15.4% should be the highest allowable level of CO2 produced by an oil-fired appliance.

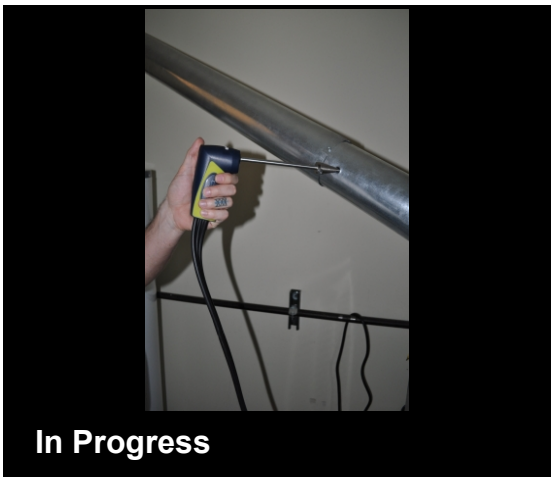
O2 levels in the atmosphere are at a constant 20.9%. O2 readings in appliances vary due to O2 density and the efficiency of the combustion process.

5.3003.2i - Excess combustion air

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Excess combustion air will be calculated and shown to be in accordance with manufacturer specifications

Objective(s):
Verify combustion performance of equipment is within manufacturer recommended range based on excess combustion air readings



Oil-fired appliances require an appropriate level of air mixed with the oil

The percentage of Excess Air (EA) should be within manufacturer specs

Tools:

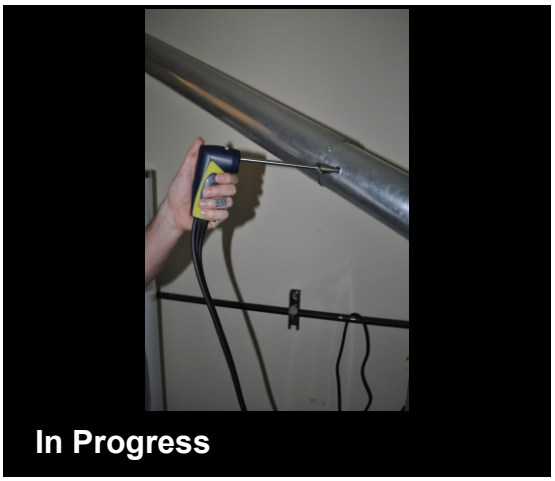
1. Combustion analyzer with probe
2. Drill

5.3003.2j - CO in flue gas

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
Measure CO and recommend actions to ensure that CO in the undiluted flue gas will be less than 400 ppm air-free

Objective(s):
Ensure CO in undiluted flue gas is less than 400 ppm air-free



Test oil-fired appliances for air-free CO in the flue gases to verify safe levels

Air-free CO, or CO(0), should be less than 400ppm

Tools:

1. Combustion analyzer with probe
2. Drill

5.3003.2k - Testing/inspection holes

Desired Outcome:
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable.

Specification(s):
All testing and inspection holes will be sealed with approved materials

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

Best Practice

Foil tape should be used to seal testing holes unless high temperature sealant is required by jurisdictional code

Materials:

1. Foil tape
2. High temperature sealant

Check jurisdictional code for approved method

5.3003.3 - Evaluating Air Flow

Desired Outcome:
Air flow is properly tested

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

5.3003.3a - Total air flow

Desired Outcome:
Air flow is properly tested

Specification(s):
Total system air flow will be measured by one of the following methods:

- Temperature rise
- Flow plate
- Fan depressurization device (e.g., Duct Blaster®, DucTester®)

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

5.3003.3b - External static pressure

Desired Outcome:
Air flow is properly tested

Specification(s):
External static pressure will be in accordance with manufacturer specifications

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

5.3003.3c - Pressure

Desired Outcome:
Air flow is properly tested

Specification(s):
Pressure drop across cooling coils will be in accordance with manufacturer specifications

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

According to Louisiana WAP variances: Cooling drop as measured between return and supply plenums will be used to determine if system airflow is within manufacturer's recommendations. Drilling holes in the supply plenum near the evaporator coil is discouraged strongly, as damage may be done to the coil.

5.3003.3d - Filter Inspection

Desired Outcome:
Air flow is properly tested

Specification(s):
Visual inspection to verify filter type is per manufacturer specifications, and is clean

Objective(s):
Ensure equipment:

- Operates as designed

- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

Louisiana WAP variances state: Cooling drop as measured between return and supply plenums will be used to determine if sstem airflow is within manufacturer's recommendations. Visual inspection of filter for fit and cleanliness is adequate to meet the specification.

5.3003.3e - Balancing room flow: new ductwork

Desired Outcome:
Air flow is properly tested

Specification(s):
Proper air flow delivery to each room will be ensured by one of the following:

Measuring air flow at each register

OR

Measuring heat rise, room pressures, and interviewing residents to ensure their comfort.

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

5.3003.3f - Supply and return temperature measurements

Desired Outcome:
Air flow is properly tested

Specification(s):
Supply and return wet bulb (wet bulb temperature is measured for cooling systems only) and dry bulb air temperatures will be recorded

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

Louisiana WAP variances state: Measurement of wet bulb temperature in cooling system is not necessary. Supply and return dry bulb air temperatures will be sufficient.

5.3003.3h - Temperature rise: gas and oil furnaces only

Desired Outcome:
Air flow is properly tested

Specification(s):
Temperature rise between the supply and return will be in accordance with manufacturer specifications

Objective(s):
Ensure equipment:

- Operates as designed
- Operates efficiently
- Provides comfort
- Operates safely
- Is durable

5.3003.8 - Evaporative Cooler Maintenance and Repairs

Desired Outcome:
Evaporative cooler evaluated and maintained as needed

5.3003.8a - Assessment and diagnosis

Desired Outcome:
Evaporative cooler evaluated and maintained as needed

Specification(s):
The following system elements will be assessed:

- Pump
- Pan
- Spider
- Float
- Damper
- Roof jack support
- Water line
- Water valve
- Electrical
- Pads
- Motor
- Fan

Elements will be repaired or replaced as needed in accordance with manufacturer instructions

Objective(s):
Ensure all components function properly

Assess wear and tear on various parts of evaporative cooler

In Progress

Pads have deposits and are shrunken from age. Replace

Pump needs to be cleaned of calcium deposits

Pan has calcium deposits as well but still holds water

Check spider, which distributes water to pads, for cracks and leaks

The float, attached to the water valve, shows no signs of cracking

The damper needs to be opened at the beginning of summer

The roof jack shows some signs of cracking and should be resealed

Water line is in tact and not leaking

Water valve has signs of deposits, but isn't leaking

Motor and electrical are in good working order

5.3003.8a - Assessment and diagnosis

Desired Outcome:
Evaporative cooler evaluated and maintained as needed

Specification(s):
The following system elements will be assessed:

- Pump
- Pan
- Spider
- Float
- Damper
- Roof jack support
- Water line
- Water valve
- Electrical
- Pads
- Motor
- Fan

Elements will be repaired or replaced as needed in accordance with manufacturer instructions

Objective(s):
Ensure all components function properly

5.3003.8b - Repair and maintenance

Desired Outcome:

Evaporative cooler evaluated and maintained as needed

Specification(s):
Calcium deposits will be removed

Pads will be replaced

Any additional repairs or replacements will be made as necessary in accordance with manufacturer's instructions

Objective(s):
Protect the potable water supply from cross-contamination

Ensure evaporative cooler functions properly

Old swamp cooler pad on left needs replacement due to calcium depositing

Pads have been replaced; calcium deposits have been removed. Ready to run

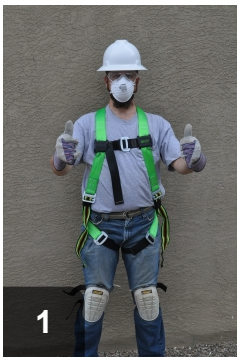
Tools:

1. Large vessel

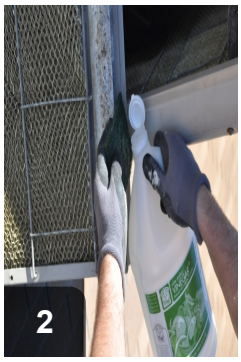
Materials:

1. Scrub pads
2. Distilled white vinegar

See also SWS 2.0100.1f and 2.0100.1l for Health & Safety measures.



When working on a roof, always be sure to wear a fall-protection harness and proper PPE



Use vinegar both as a soak and on scrub pads to remove calcium deposits

Scrub calcium deposits off all surfaces, including trickle trough

Exterior deposits should also be cleaned. Can you tell which part is clean?

Measure and cut, if necessary, new pads designed for use in swamp coolers

Reinstall new pads, held in place with metal bracketing

5.3003.8b - Repair and maintenance

Desired Outcome:
Evaporative cooler evaluated and maintained as needed

Specification(s):
Calcium deposits will be removed

Pads will be replaced

Any additional repairs or replacements will be made as necessary in accordance with manufacturer's instructions

Objective(s):
Protect the potable water supply from cross-contamination

Ensure evaporative cooler functions properly

5.3003.8c - Occupant education

Desired Outcome:
Evaporative cooler evaluated and maintained as needed

Specification(s):
A regular service schedule will be recommended to occupant

Issues regarding multiple systems running will be discussed with occupant

Objective(s):
Ensure the occupant understands basic operation and the importance of regular maintenance

Occupants with evaporative coolers should be alerted to proper maintenance

Communicate professionally with occupant to provide information and support

Standard Evaporative Cooler Maintenance
Spring (Start-Up)
Clean Pump
Clean Spider Nozzles and Drip Trough
Oil Blower and Motor Bearings - DO NOT Over Oil
Change Pads
Check Belt Condition and Tension (3/4" deflection @ 3lb. Force)
Check water bleed-off and clear any clogs
Remove damper/baffle (if present)
Plug in motor and pump
Turn-on/Reconnect Electricity
Mid-season Checks
Clean/Replace Pads - depends on water quality
Winter Shut Down
Turn-off/Disconnect Electricity
Drain Water (pan and all lines)
Unplug motor and pump
Insert damper/baffle (if equipped)
Cover unit

Review properly and timely evaporative cooler maintenance

Explain evaporative and refrigerative cooling should not be run together

5.3003.8c - Occupant education

Desired Outcome:
Evaporative cooler evaluated and maintained as needed

Specification(s):
A regular service schedule will be recommended to occupant

Issues regarding multiple systems running will be discussed with occupant

Objective(s):
Ensure the occupant understands basic operation and the importance of regular maintenance

5.3003.10 - Condensate Drainage of Heating and Air Conditioning Equipment

Desired Outcome:
Equipment and condensate drain operate as designed

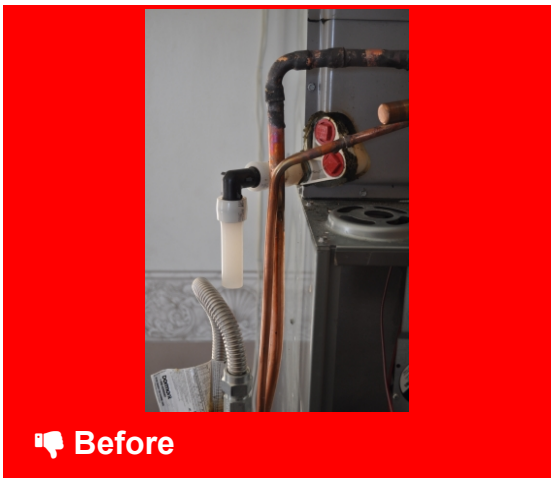
Note:
The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail.

5.3003.10a - Connection

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
Connections in condensate drain system will be watertight

Objective(s):
Ensure condensate drain connections do not leak



HVAC equipment needs condensate drainage to prevent water damage

Drainage pipes should be sealed to be water-tight

Tools:

1. Hacksaw
2. Crimper

Materials:

1. Pex piping and angles
2. PVC piping and angles
3. Purple primer
4. PVC cement

5.3003.10b - Insulation

Desired Outcome:
Equipment and condensate drain operate as designed

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

Objective(s):
Ensure condensate drain connections do not leak

Before

Once drainage pipes cross into unconditioned space, they can freeze

After

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

Tools:

1. Tape measure
2. Utility knife

Materials:

1. 1" thick pipe insulation
2. Zip ties

5.3003.10c - Overflow protection: upflow

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
Secondary drain pan and float switch will be installed when overflow could damage finished surfaces

OR

Float switch in the primary condensate drain for upflow systems will be installed when overflow

could damage finished surfaces

Objective(s):
Ensure condensate drain connections do not leak

A float switch should be installed to prevent overflow and damage

5.3003.10d - Pumps

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
Condensate drain pumps will be installed when condensate cannot be drained by gravity

Power source for pump will be installed

Operation and drainage of pump will be verified

Objective(s):
Ensure condensate drain connections do not leak

HVAC equipment that drains upward through a roof cannot drain naturally

For non-gravity draining systems, a pump is necessary

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

5.3003.10e - Vents and traps

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
Vents and traps will be installed on condensate drainlines

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

Objective(s):
Ensure condensate drain operates as designed

Ensure condensate drain does not leak air

5.3003.10f - Drain pan

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
Condensate from all cooling coils or evaporators shall be conveyed from the drain pan outlet to an approved place of disposal

Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than 1/8 unit vertical in 12 units horizontal (1% slope)

Condensate shall not discharge into a street, alley, or other areas where it would cause a nuisance

Objective(s):
Prevent water damage from drain system malfunction

5.3003.10g - Float switch

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
All secondary drain pans will have a float switch and be drained away through a drainline

Objective(s):
Prevent water overflowing the pan and draining onto the ceiling below

Float switches should be installed in drainage pans to prevent overflow

5.3003.10h - Termination

Desired Outcome:
Equipment and condensate drain operate as designed

Specification(s):
Condensate drain will be terminated in accordance with local codes

Objective(s):
Ensure condensate does not leak to the house

Ensure condensate drain does not freeze

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

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14a - Gas Pressure

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
Measurement will be verified by a certified professional in accordance with fuel type and manufacturer specifications

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

5.3003.14b - Place appliance in operation

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
Heating equipment will be placed in operation in accordance with applicable NFPA standards and manufacturer specifications when available

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

Best Practice

Only place appliances in operation that are installed to manufacturer specification and have passed combustion testing

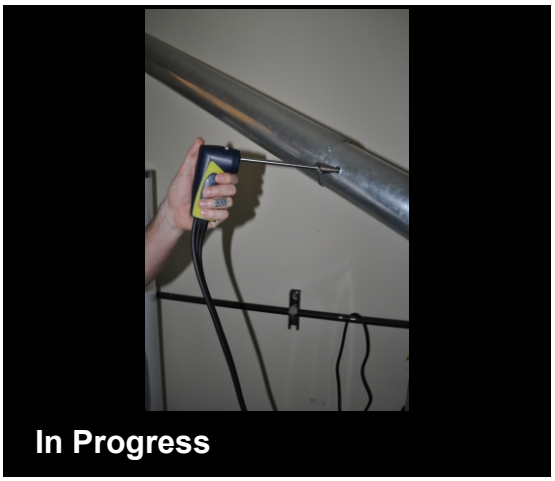
5.3003.14c - Carbon dioxide (CO2)and oxygen (O2)

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
Measurement will be verified in accordance with industry manuals (e.g., Testo, Bacharach)

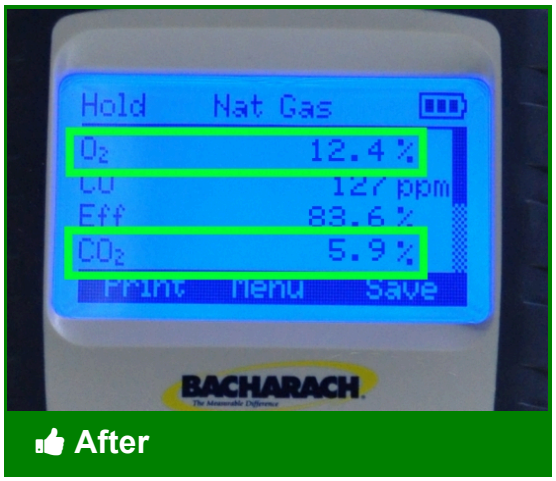
Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable



In Progress

Verify gas-fired appliances are burning safely by testing CO2 and O2 levels



After

Levels should be within industry standards and match manufacturer specs

Tools:

1. Combustion analyzer with probe
2. Drill

O2 levels in the atmosphere are at a constant 20.9%. O2 readings in appliances vary due to O2 density and the efficiency of the combustion process.

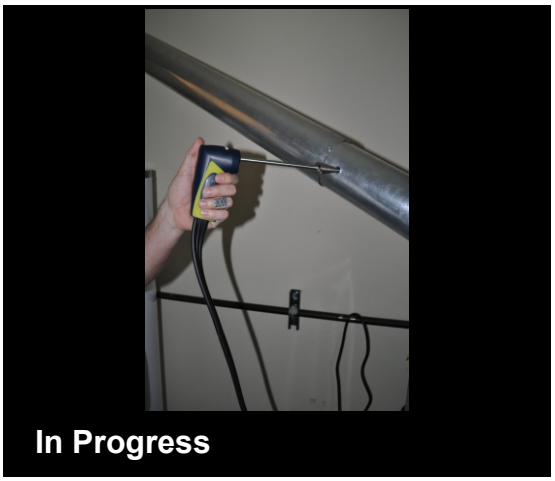
5.3003.14d - Carbon monoxide (CO) in flue gas

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

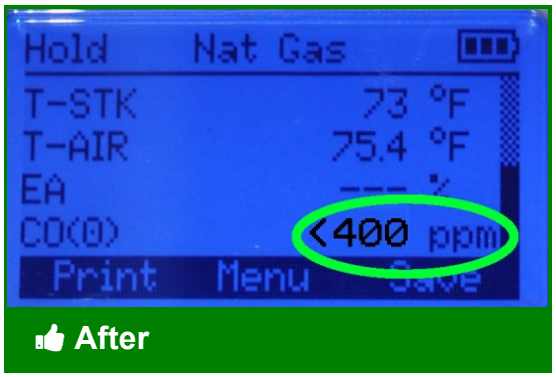
Specification(s):
CO in the undiluted flue gas will be less than 400 ppm air-free

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable



Test undiluted flue gasses for carbon monoxide levels



Air-free CO, or CO(0), should be less than 400ppm

Tools:

1. Combustion analyzer with probe
2. Drill

5.3003.14e - Testing/inspection holes

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
All testing and inspection holes will be sealed with manufacturer approved materials

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

Best Practice

Foil tape should be used to seal testing holes unless high temperature sealant is required by jurisdictional code

Materials:

1. Foil tape
2. High temperature sealant

Check jurisdictional code for approved method of sealing

6.6002.1 - Ducts

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

6.6002.1a - Duct design and configuration

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
Ventilation ducts will be as short, straight, and smooth as possible

Ventilation ducts will not be smaller than the connections to which they are attached

Objective(s):
Effectively move the required volume of air

Duct work for exhaust fans should be short, smooth, and not pinch down

Duct is the same size as the outlet and makes shortest run possible

Tools:

1. Metal snips
2. Drill

Materials:

1. Metal duct piping
2. Fasteners

See also ASHRAE 62.2-2016.

6.6002.1b - Duct insulation

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes

Objective(s):
Prevent condensation from forming or collecting inside of the ductwork

Uninsulated ducts in unconditioned spaces are an energy drain

R-8 insulation with a vapor barrier should be securely wrapped around ducts

Tools:

1. Utility knife
2. Metal snips

Materials:

1. R-8 insulation with vapor barrier
2. Nylon twine
3. Wire
4. UL-181 duct tape

See also ASHRAE 62.2-2016. Check local codes to see if R-8 is accepted level of insulation.

6.6002.1c - Duct support

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

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" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart

Objective(s):
Effectively move the required volume of air

Preserve the integrity of the duct system

Eliminate falling and sagging

Before

Ducts should not be allowed to droop or sag to maximize efficiency

After

Supports should be evenly spaced to allow for minimal distance of run

Tools:

1. Drill
2. Metal snips
3. Utility knife

Materials:

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

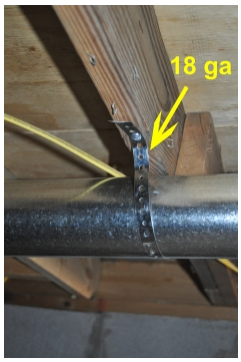
See also ASHRAE 62.2-2016.

BAD: Make sure supports DO NOT compress insulation or duct

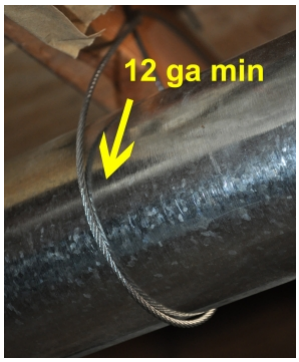
Flex ducts should have support straps at least every 4 feet

Support straps should be at least 1 1/2 inches wide

Metal ducts should be supported at 10 feet or less with wire or metal strap



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



Metal wire should be at least 12 gauge and galvinized

6.6002.1d - Duct connections

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws

Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic- plus-embedded-fabric systems, or tapes

Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool

PVC-to-PVC materials will be fastened with approved PVC cement

Other specialized duct fittings will be fastened in accordance with manufacturer specifications

In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Objective(s):
Effectively move the required volume of air

Preserve the integrity of the duct system

Fan duct is disconnected and venting into the attic space.

Fan has been vented with sealed, insulated duct material.

Tools:

1. Drill
2. Tie band tensioner
3. Brush

Materials:

1. Tie bands
2. Insulated flex duct
3. Mastic
4. PVC primer
5. PVC cement

Apply mastic to the connection fitting

Snug duct liner onto connection fitting

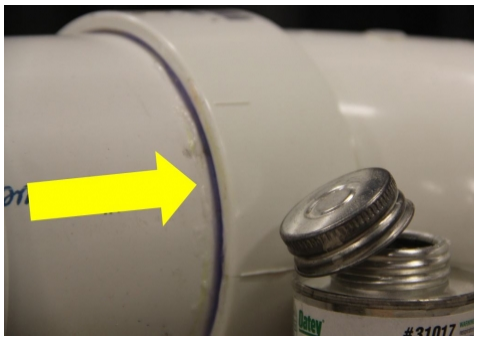
Use tie band and tensioner to secure liner to connection fitting

Apply mastic to fan connection

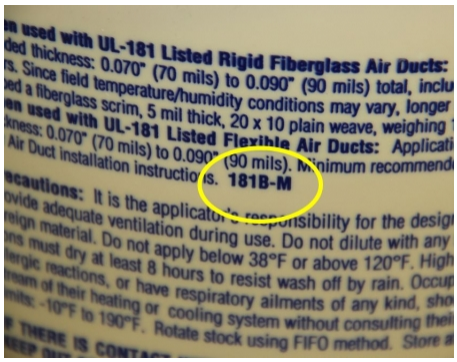
Using mechanical fasteners, secure connection fitting to fan connection

Snug insulation to fan housing and strap into place

Round metal-to-metal connections require fiberglass mesh tape and 3 mechanical fasteners minimum



PVC-to-PVC connections should use PVC primer and cement



Sealants should be UL181-M or UL181B-M listed

6.6002.1e - Duct materials

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
Flexible materials will be UL 181 listed or Air Diffusion Council approved

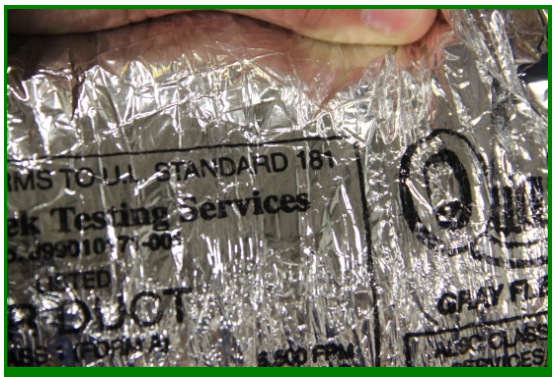
The metal gauge of rigid kitchen fan ducting shall meet code requirements or the approval of the authority having jurisdiction.

Objective(s):
Effectively move the required volume of air

Preserve the integrity of the duct system

Bad Practice

Existing duct is installed incorrectly and is not UL listed



Best Practice

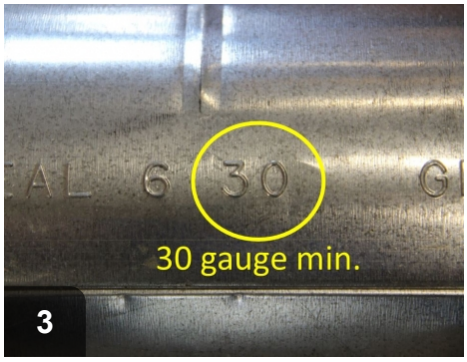
This flexible duct conforms to UL 181

Materials:

1. All materials should be UL 181 Listed
2. 30-gauge minimum Rigid Duct

Look for the Air Diffusion Council seal.

Flex installed should meet or exceed UL181.



When rigid duct is being used, its wall thickness should be 30 gauge minimum.

6.6002.2 - Terminations

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

6.6002.2a - Hole in building shell

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
A hole no greater than a 1/4" greater than the fitting will be cut to accommodate termination fitting

Objective(s):
Allow for ease of weatherproofing

Before

Exhaust fans need exterior ventilation, often through roofs and walls

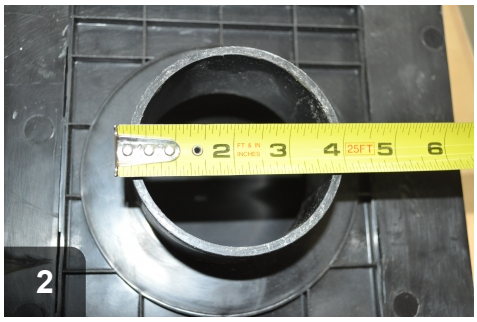
After

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

Tools:

1. Hole saw
2. Drill
3. Tape measure

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

6.6002.2b - Termination fitting

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
A termination fitting with an integrated collar will be used

Collar will be at least the same diameter as the exhaust fan outlet; if collar is larger than exhaust fan outlet, a rigid metal transition will be used

Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable

Objective(s):
Effectively move the required volume of air to the outside

Preserve integrity of the building envelope

Ensure durable installation

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

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

6.6002.2c - Duct to termination connection

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
Duct will be connected and sealed to termination fitting as follows:

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally

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

Fasteners will not inhibit damper operation

Objective(s):
Effectively move the required volume of air to the outside

Preserve integrity of the building envelope

Ensure durable installation

Before

Termination is not mechanically fastened, or sealed appropriately.

After

Termination fitting is secure, and duct is sealed to termination.

Tools:

1. wire cutter
2. chip brush
3. zip tie tension tool
4. utility knife

Materials:

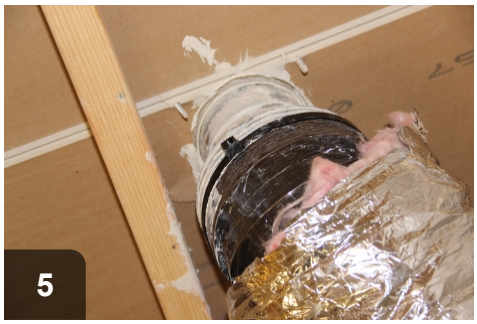
1. insulated flex duct with liner
2. UL 181 sealant
3. zip tie straps
4. PVC primer
5. PVC cement

With other end of the duct connected to the fan, cut duct to desired length.

Apply mastic to termination fitting.

Fit duct liner on to termination fitting.

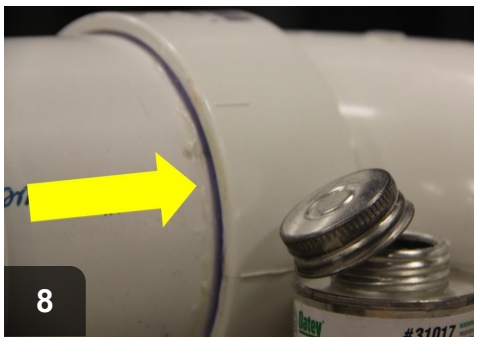
With duct liner in place, use the zip tie tension tool to secure the liner to the fitting.



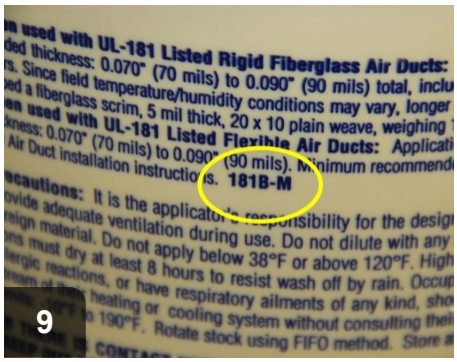
With liner secured and zip tie trimmed, you are ready to pull the insulation to cover the fitting.

Ensure termination damper functions as intended.

Round metal-to-metal connections require fiberglass mesh tape and 3 mechanical fasteners minimum.



PVC-to-PVC connections should use PVC primer and cement.



Sealants should be UL181-M or UL181B-M listed.

6.6002.2d - Weatherproof installation

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Exterior termination fitting will be flashed or weather sealed

Water will be directed away from penetration

Installation will not inhibit damper operation

Manufacturer specifications will be followed

Objective(s):

Preserve integrity of the building envelope

Ensure a weather tight and durable termination installation

Ensure unrestricted air flow

Before

Holes for termination fitting need to be sealed to weatherproof

After

Termination installation should follow shingling to deter water penetration

Tools:

1. Hole saw
2. Caulk gun
3. Drill

Materials:

1. Fasteners
2. Caulk

Termination fitting is installed to repel water and sealed

6.6002.2e - Pest exclusion

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

6.6002.2f - Termination location

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
Terminations will be ducted to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors.

Terminations will be installed:

- A minimum of 3' away from any property line
- A minimum of 3' away from operable opening to houses
- A minimum of 10' away from mechanical intake
- As required by authority having jurisdiction

Objective(s):
Prevent exhaust from reentering house

Exhaust vent has been improperly mounted too close to mechanical vent

Exhaust vent was properly mounted over 3ft from door, window, and deed line

Tools:

1. Measuring tape
2. Hole saw
3. Drill

6.6002.2g - Kitchen exhaust

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
Galvanized steel, stainless steel, or copper will be used for termination fitting for kitchen exhaust

Objective(s):
Prevent a fire hazard

Before

Kitchen exhaust vents should not be made from highly combustible materials

After

This roof-mounted kitchen exhaust fan is galvanized steel--heat resistant

6.6003.3 - Through the Wall

Desired Outcome:
Through the wall fans installed to specification

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

6.6003.3a - Hole in building shell

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly

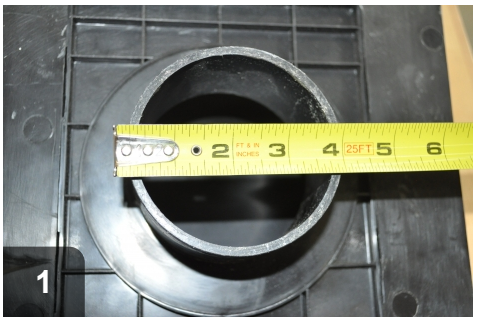
Objective(s):
Allow for ease of weatherproofing

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



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 - Wiring

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes

Objective(s):
Prevent an electrical hazard

Before

Incorrect: disconnected ground, no wire nuts on splices, no clamp on wires passing through junction box

After

Fan junction box with cover installed

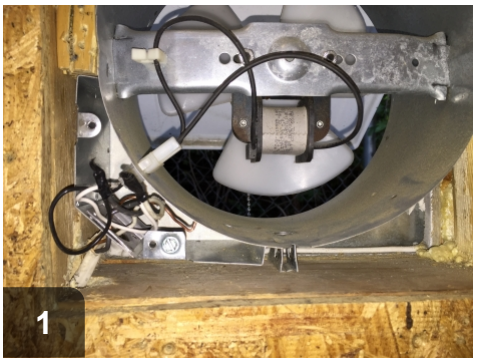
Tools:

1. Wire strippers
2. Utility knife or cable ripper
3. Screwdriver
4. Non-contact voltage tester
5. Lineman's pliers

Materials:

1. Ground wire crimp sleeves
2. Non-metallic sheathed wire (Type NM-B) e.g., Romex ®
3. Plastic junction box and cover plate
4. Wire nuts
5. Cable staples
6. Clamp-type cable connectors

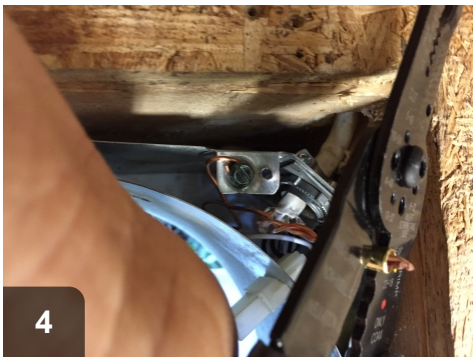
Follow manufacturer's specifications and applicable codes when wiring newly installed equipment.



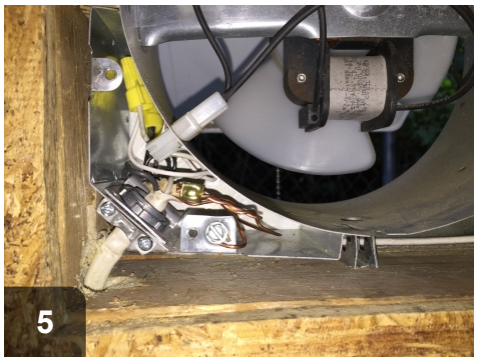
Inspect for: proper ground, wire nuts on splices, clamps on wiring where it enters junction box, cover installed on box

Install clamp on wiring into junction box

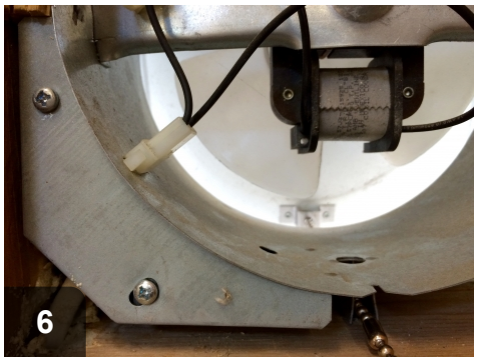
Install wire nuts on splices



Use crimp sleeves to connect ground wires



Tuck wiring into place



Reinstall cover on junction box

6.6003.3c - Fan mounting

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Fan outlet will be oriented toward the final termination location

Fan will be oriented so the equivalent length of the duct run is as short as possible

Fan will be mounted securely according to manufacturer specifications

Objective(s):
Install mounting fan securely

Ensure fan housing does not shake, rattle, or hum when operating

Improperly aligned fan

Fan is mounted securely with the termination outlet lined up.

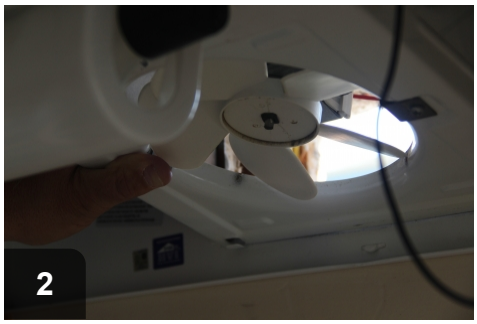
Tools:

1. drill
2. drill bits

Materials:

1. fasteners

Fan is not properly supported, resulting in a improper alignment with the termination location.



Line the fan up so the outlet lines up with the termination.

Install the fan using factory mounting holes, ensuring a tight fit and quiet operation.

6.6003.3d - Weatherproof installation

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Exterior termination fitting will be flashed or weather sealed

Water will be directed away from penetration

Termination fitting 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 installation

Ensure unrestricted air flow

Best Practice

Apply sealant behind termination cap, taking care to apply sealant to all edges.

Best Practice

Termination is sealed and securely attached to the wall.

Tools:

1. caulk gun
2. drill
3. drill bits
4. reciprocating saw
5. drywall saw or utility knife

Materials:

1. weatherproof termination kit with pest screen
2. caulk or equivalent sealant
3. mechanical fasteners

Clean existing sealant to ensure proper adhesion to the surface.

Once area around the termination opening is cleaned, apply sealant to all four sides of the opening.

Install screws through the sealant, which will tighten the fitting and squeeze out excess sealant.

Wipe away excess sealant for a clean look.

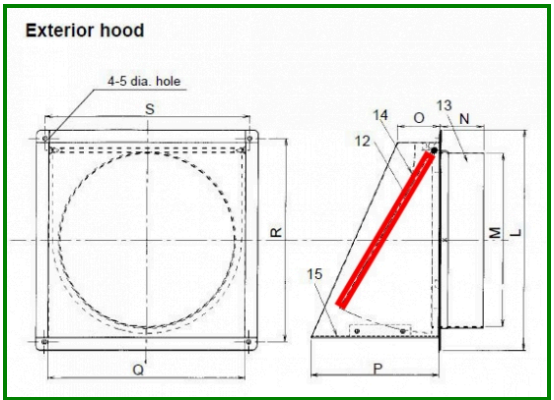
Ensure damper swings open freely, and closes with a tight fit.

6.6003.3e - Backdraft damper

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):
Prevent reverse air flow when the fan is off



Best Practice

Damper should be installed to maintain exterior air barrier

6.6003.3f - Fan housing seal

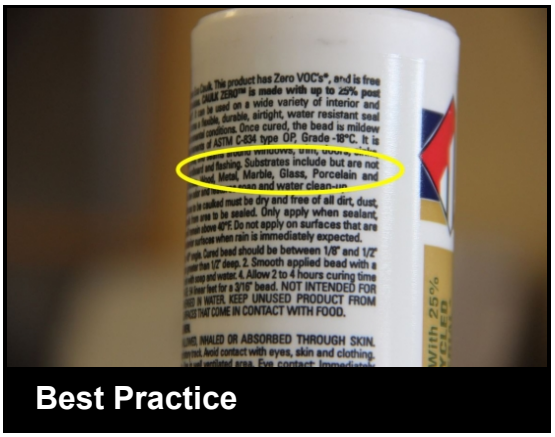
Desired Outcome:
Through the wall fans installed to specification

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

Sealants will be continuous and meet fire barrier specifications

Objective(s):
Prevent air leakage through fan housing

Ensure a permanent seal to the building air barrier



Sealant should be waterproof and adhere to the desired surfaces.

Seal unused holes in the fan housing.

Tools:

1. caulk gun

Materials:

1. weatherproof, code approved caulk

6.6003.3g - Fan to interior surface seal

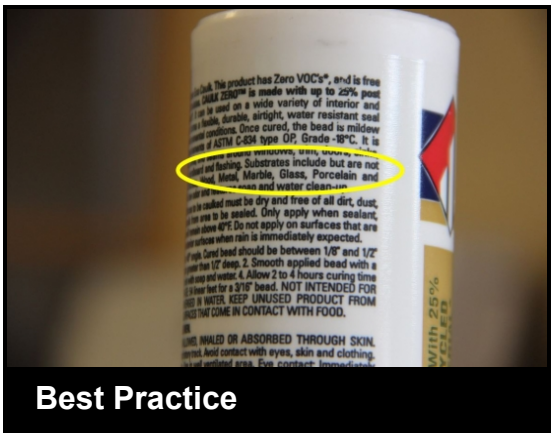
Desired Outcome:
Through the wall fans installed to specification

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

Sealants will be continuous and meet fire barrier specifications

Objective(s):
Prevent air leakage around intake housing

Prevent a fire hazard



Sealant should be waterproof and adhere to desired surfaces.

Sealant should be applied to the fan housing where it comes in contact with the exterior wall.

Tools:

1. caulk gun

Materials:

1. code approved caulk

6.6003.3h - Insulation

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
All components outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local code

Exception: If system operates continuously, fan housing need not be insulated

Objective(s):
Preserve integrity of the duct system

6.6003.3i - Air flow

Desired Outcome:
Through the wall fans installed to specification

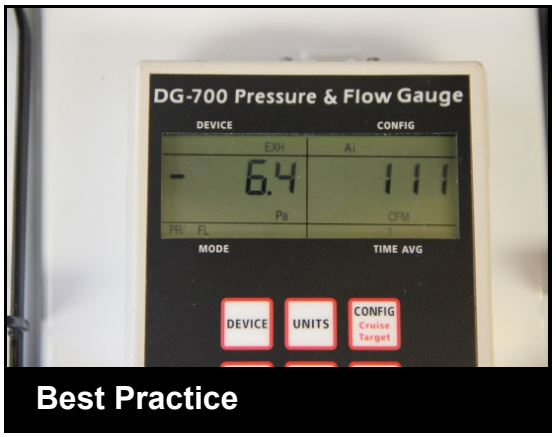
Specification(s):
Air flows in CFM will be measured and adjusted to meet the design requirements

Objective(s):

Exhaust sufficient air from desired locations to outside

Best Practice

Using a digital manometer, exhaust flow meter and fabricated cover, measure the fan flow.



Best Practice

Air flow should be within acceptable limits for the location of the fan.

Tools:

1. exhaust fan flow meter
2. manometer

Materials:

1. a fabricated cover for fans larger than the flow meter

The exhaust fan flow meter won't fit most range hoods. A fabricated cover is needed.

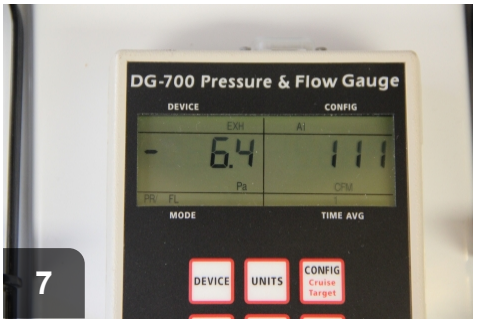
A fabricated cover can be used so long as the opening is smaller than the meter itself and larger than the E1 opening.

Attach a pressure hose to the exhaust fan flow meter.

Attach a the hose to a T connection on channels A & B with the manometer set to measure exhaust fan flow.

With manometer properly set up, prepare to test air flow

Fans must pull the required CFM according to ASHRAE.



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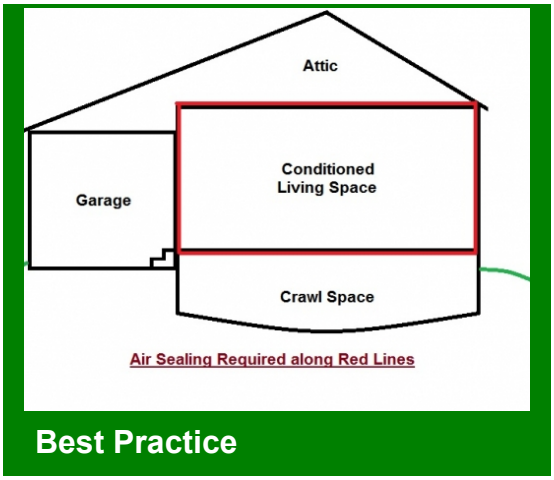
WIth the manometer Mode set to PR/FL, Device set to EXH, and Config set to E1, this fan pulls 111 CFM.

6.6003.3j - Preventing air leakage caused by exhaust fans

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics)

Objective(s):
Ensure occupant health and safety



The barrier between conditioned and unconditioned spaces should be sealed

See also SWS 3.1501.1 Air Sealing Garage Penetrations.

6.6003.3k - Combustion safety

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

Objective(s):
Ensure safe operation of combustion appliances

Before

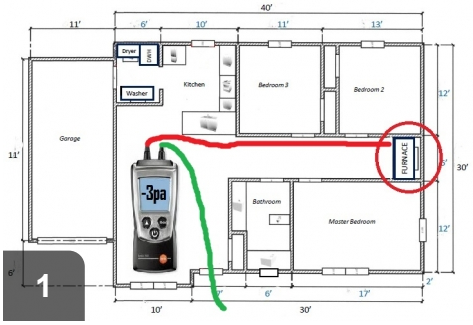
Installing new ventilation can cause imbalances within the house

After

Test that depressurization limit is not being exceeded by new ventilation

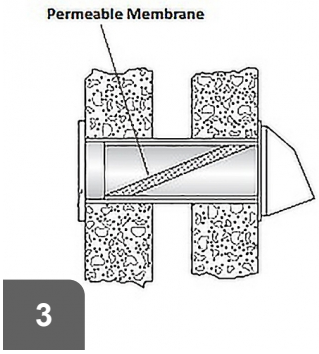
Tools:

1. Manometer



Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions

If depressurization limit is exceeded, mitigate to eliminate safety risk



Mitigate safety risk with make-up air or other pressure relief

After mitigation, verify that depressurization limits are not being exceeded

6.6005.1 - Clothes Dryer

Desired Outcome:
Dryer air exhausted efficiently and safely

6.6005.1a - Clothes dryer ducting

Desired Outcome:
Dryer air exhausted efficiently and safely

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

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

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

Plastic venting material will not be used

Uninsulated clothes dryer duct will not pass through unconditioned spaces such as attics and crawl spaces, except where allowed by the authority having jurisdiction

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

6.6005.1a - Clothes dryer ducting

Effectively move air from clothes dryer to outside

Before

Dryer is vented outside, but with the incorrect material.

After

Dryer is vented outdoors, with correct material. Run is as short and straight as possible ensuring maximum flow.

Tools:

1. metal trimmers
2. drill

Materials:

1. metal flex duct
2. dryer vent kit
3. hose clamps

Louisiana WAP variances state: Uninsulated clothes dryer ducting may pass through unconditioned spaces since climactic conditions prevent condensation the above requirement is meant to avoid

Disconnect existing vent pipe from termination. If hose clamp is installed, save for reuse.

Disconnect existing vent pipe from dryer.

Attach approved vent material to termination vent. Termination vent may need to be trimmed.

Trim metal vent to ensure the run is as short and straight as possible.

Connect vent pipe to dryer.

Dryer vents to outdoors, and exhaust damper is functional.

For vent runs >35 feet, a booster fan is required.

Duct runs outside of conditioned space must be properly supported.

6.6005.1b - Termination fitting

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
Termination fitting manufactured for use with dryers will be installed

A backdraft damper will be included, as described in termination fitting detail

Objective(s):
Preserve integrity of building envelope

Effectively move air from clothes dryer to outside

Termination fittings for dryers should have backdraft dampers

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)

6.6005.1c - Make-up air

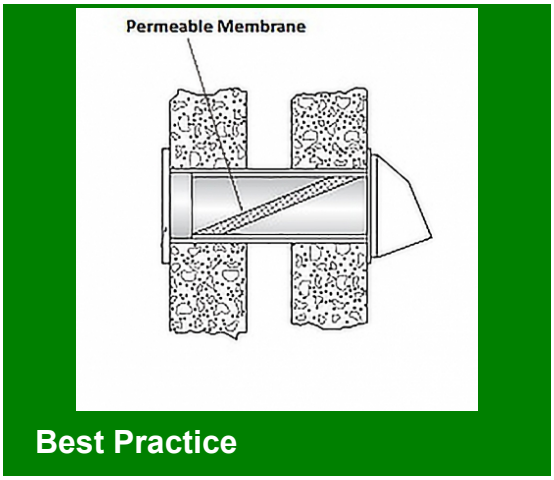
Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
If natural draft combustion appliances are present and if worst-case CAZ and/or other performance based testing is conducted and indicates a need for make-up air, make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

If natural draft combustion appliances are present and if no performance based testing is conducted, make-up air will be provided prescriptively in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

Objective(s):
Preserve integrity of building envelope

Effectively move air from clothes dryer to outside



A passive inlet vent can provide make-up air for dryer exhaust

Tools:

1. Drill
2. Hole saw
3. Caulk gun

Materials:

1. Caulk sealant
2. Fasteners

6.6005.1d - Combustion safety

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Objective(s):
Ensure safe operation of combustion appliances

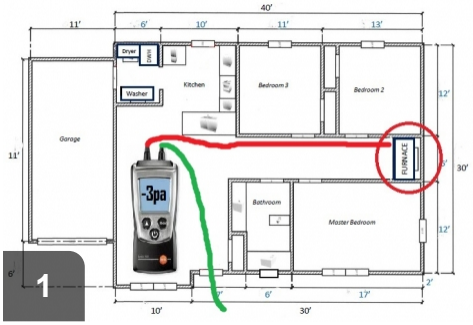
Ensure occupant health and safety

Appliance exhaust, such as that for a dryer, can cause depressurization

Test to verify combustion appliances are within depressurization limits

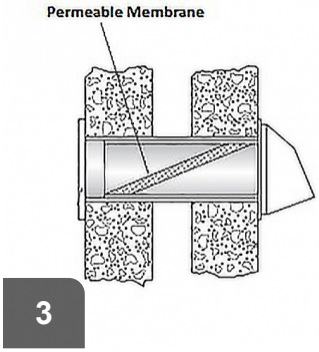
Tools:

1. Manometer



Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions

If depressurization limit is exceeded, mitigate to eliminate safety risk



Install make-up air, such as a passive inlet vent, or other pressure relief

After mitigation, verify that depressurization limit is not being exceeded

6.6005.1e - Occupant education

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):
Occupant will be instructed to keep lint filter and termination fitting clean

Occupant will be instructed to keep dryer booster fan clean, if present

Occupant will be instructed on clothes dryer operation safety including information on items that must not be placed in the clothes dryer (items with any oil or other flammable liquid on it, foam, rubber, plastic or other heat-sensitive fabric, glass fiber materials)

Objective(s):
Effectively move air from clothes dryer to outside

Neglect of clothes dryer maintenance can cause fire hazards

Occupants should be taught to clean lint filters and termination fittings


In homes with booster fans, occupant should know location and how to clean


Occupants should be taught never to put flammable articles in dryer (in this case, oily rags)

6.6005.2 - Kitchen Range

Desired Outcome:
Kitchen range fan installed to specification

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

6.6005.2a - Wiring

Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
Wiring will be installed in accordance with local regulations or the IRC in the absence of such regulations or where those regulations are not as stringent as the IRC

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

6.6005.2b - Fan venting

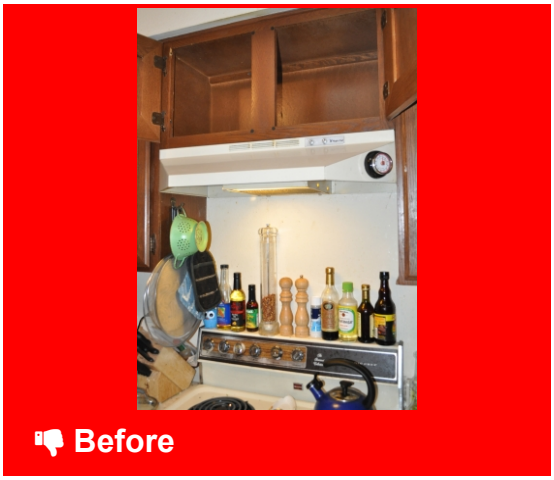
Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
Kitchen range fans will be vented to the outdoors

Recirculating fans will not be used as a ventilating device

Objective(s):
Remove cooking contaminants from the house

Preserve integrity of building envelope



Recirculating fans over ranges do not actually remove contaminants

Daylight visible through dampered kitchen exhaust proves venting access

6.6005.2c - Fan ducting

Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
Kitchen range fans will be ducted to the outdoors

As short a run as practical of smooth wall metal duct will be used, following manufacturer specifications

Ducting will be connected and sealed as follows:

- Metal-to-metal will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
- For down-draft exhaust systems, PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Objective(s):
Preserve integrity of building envelope

Effectively move air from range to outside

Exhaust duct should be smooth-walled and in as short a run as possible

Daylight visible through dampered kitchen exhaust proves outside access

Tools:

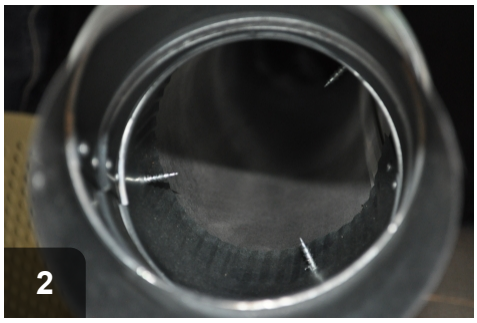
1. Drill
2. Putty knife
3. Tape measure
4. Metal snips
5. Saw

Materials:

1. Round metal ducting
2. Mastic
3. Fiberglass mesh tape
4. Fasteners

See also 6.6002.1d. Note: Only smooth-wall metal duct will be used, except for down-draft exhaust systems where PVC is acceptable as well. Flex duct is NOT acceptable for kitchen fan exhaust application.

Duct run should be as smooth and short as possible



Duct should be fastened securely with three evenly-spaced screws

Then joints should be secured with fiberglass tape

Finally, joint should be secured with UL-181 mastic

6.6005.2d - Termination fitting

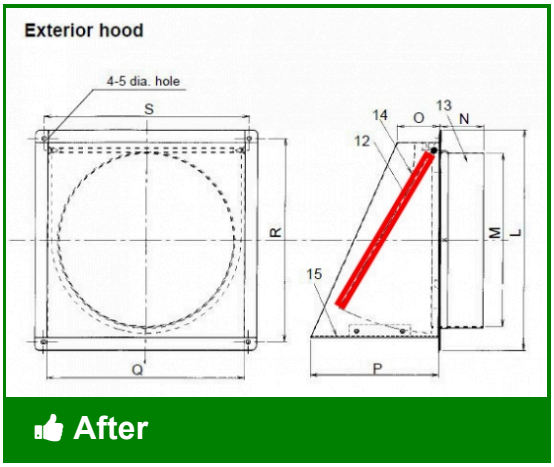
Desired Outcome:
Kitchen range fan installed to specification

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

Backdraft damper on roof mounted exhaust fan

An interior backdraft damper can also be installed for good measure

6.6005.2e - Make-up air

Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
If natural draft combustion appliances are present and if worst-case CAZ and/or other performance based testing is conducted and indicates a need for make-up air, make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

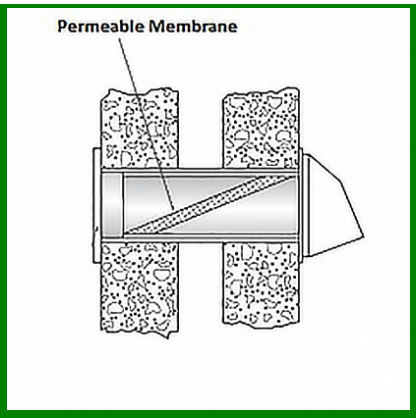
If natural draft combustion appliances are present and if no performance based testing is conducted, make-up air will be provided prescriptively in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

Objective(s):
Ensure safe operation of combustion appliances

Ensure occupant health and safety

Before

If kitchen exhaust is venting at more than 200 cfm, provide make-up air



After

A passive inlet vent can provide make-up air for kitchen exhaust

Tools:

1. Drill
2. Hole saw
3. Caulk gun

Materials:

1. Caulk sealant
2. Fasteners

6.6005.2f - Combustion safety

Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Objective(s):
Ensure safe operation of combustion appliances

Ensure occupant health and safety

Before

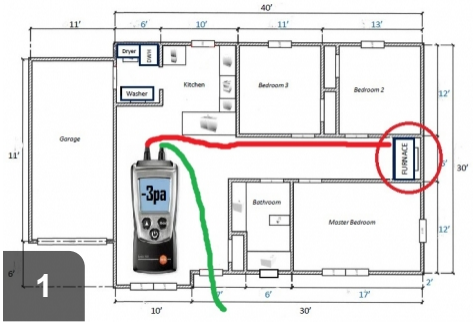
Kitchen exhaust fans can cause combustion appliances to depressurize

After

Test that combustion appliances are operating within depressurization limit

Tools:

1. Manometer

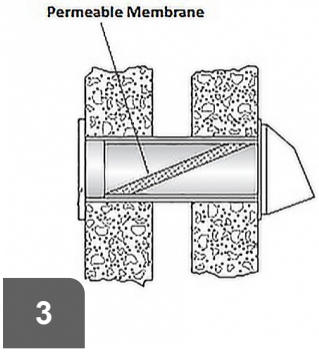


1

Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions

2

If appliances exceed depressuization limit, mitigate to reduce risk



3

Install a source of make-up air, such as a passive inlet vent

4

After mitigation, verify that depressurization limits are not being exceeded

6.6005.2g - Occupant education

Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
Occupant will be instructed to keep grease filters and termination fitting clean

Objective(s):
Effectively move air from kitchen range to outdoors

6.6201.2 - Primary Ventilation Air Flow between Rooms

Desired Outcome:
Air circulates freely between rooms

6.6201.2a - Balancing pressure

Desired Outcome:
Air circulates freely between rooms

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

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

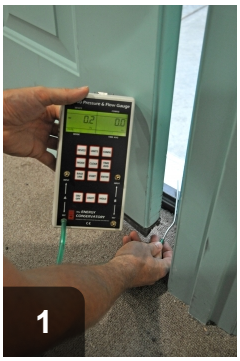
Objective(s):
Ensure free flow of air between rooms

Preserve integrity of the building envelope

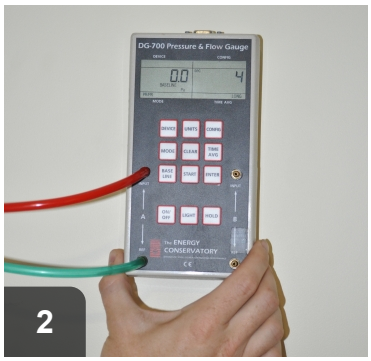
If reading is >+/-3pa, interior ventilation needs to be installed

Passive door vents and individual room returns are two possibilities

6.6201.2a - Balancing pressure

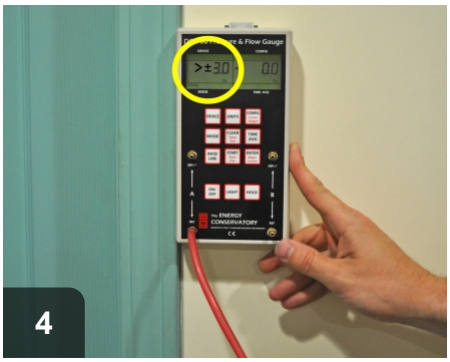


With interior doors open, put reference hose to exterior



Take baseline reading

Turn on exhaust fans and close interior doors



With hose under door, check pressure again. Readings >+/-3pa indicate a need for interior ventilation

7.8102.2 - Storage-Type Appliance

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

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

7.8102.2a - Hazardous material removal

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

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

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

Occupant will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation)

Objective(s):
Remediate health hazards using EPA-certified contractors

7.8102.2b - Equipment removal

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

Specification(s):
Accepted industry procedures and practices will be followed to:

- Remove old water heater and associated components in accordance with IRC or authority having jurisdiction

- Seal any unused chimney openings and penetrations in accordance with IRC or authority having jurisdiction
- Remove unused oil tank, lines, valves, and associated equipment in accordance with IRC or authority having jurisdiction

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

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

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

7.8102.2c - New equipment installation

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

Specification(s):
New water heater and associated components will be installed to accepted industry standards, in accordance with the IRC and manufacturer specifications

The system will be installed to be freeze resistant

Any existing water leaks will be repaired before installation begins

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

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

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

7.8102.2d - Emergency drain pan

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

Specification(s):
An emergency drain pan and drain line shall be installed in accordance with the IRC

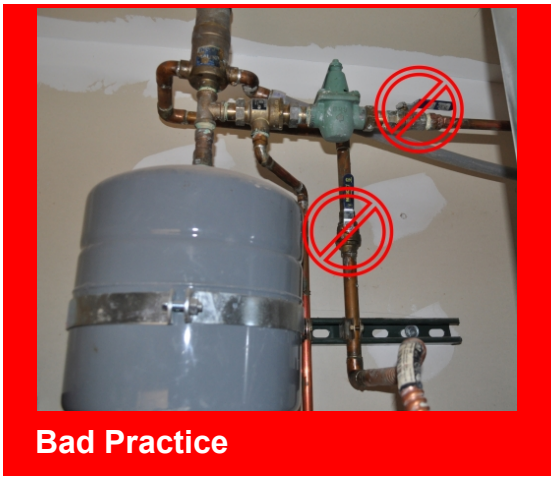
Objective(s):
Collect and safely dispose of water escaping from the storage tank

7.8102.2e - Expansion tank

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

Specification(s):
Expansion tanks will be installed where required and in accordance with the AHJ

Objective(s):
Protect the storage tank from expansion



Need to eliminate the valves between the storage tank and expansion tank

GOOD: Expansion tank is installed on both cold sides

Appropriate licensing for installer required.

7.8102.2f - Temperature and pressure relief valve

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

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

Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

Objective(s):
Discharge excessive energy (pressure or temperature) from storage tank to safe location

Water heaters should be not capped off at t&p valve

T&P discharge should be piped to a safe and observable location

Tools:

1. Pipe wrench
2. Hacksaw

Materials:

1. PVC
2. Plumber's epoxy

Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage -- the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

GOOD: T&P discharge should be piped within 6" of the floor or to outdoors

BAD: T&P discharge should flow with gravity and be observable

BAD: T&P discharge should not be piped into drainage system

7.8102.2g - Dielectric unions

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

Specification(s):
Dielectric unions will be installed in accordance with the IRC, authority having jurisdiction, and according to manufacturer specifications

Objective(s):
Break the stray voltage electrical circuit through the storage tank

7.8102.2h - Backflow prevention

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

Specification(s):
Backflow prevention will be installed in accordance with manufacturer specifications and all applicable codes

Objective(s):
Protect water supply from contamination

7.8102.2i - Thermal efficiency

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

Specification(s):
If additional tank insulation is installed, it will be rated a minimum of R-11 and will be installed to manufacturer specifications

If additional insulation is installed, it will be installed based on fuel type, making sure not to obstruct draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates

The first 6' of inlet and outlet piping will be insulated in accordance with manufacturer specifications

Combustible pipe insulation must maintain a minimum clearance of 6" from gas water heater draft hood and/or single wall metal pipe. Clearance from vent such as "B" vent should be maintained per vent manufacturer's specifications

Heat traps will be installed on the inlet and outlet piping where not provided by manufacturer

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

Ensure insulation does not make contact with flue gas venting

7.8102.2j - Fuel supply

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

Specification(s):
Electric or fossil fuel supply components will be installed to accepted industry standards as per NFPA 31 and 54, or NFPA 70 National Electric Code (NEC) for electric components, or authority having jurisdiction

Objective(s):
Provide sufficient fuel to the water heater, burner, or element

7.8102.2k - Discharge temperature

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

Specification(s):
Discharge temperature will be set not to exceed 120° or as prescribed by local code

Objective(s):
Ensure safe hot water supply temperature to fixtures

Water heaters producing water over 120 degrees raise heating costs

Water heaters should produce water under 120 degrees to prevent scalding

Tools:

1. Thermometer

Test temperature of hot water at faucets in house

Hot water temperatures should not exceed 120 degrees Fahrenheit

Adjust water heater settings and insulate as needed

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

7.8102.2l - Commissioning of system

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

Specification(s):
The following will be checked once the system has been filled and purged:

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

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

Objective(s):
Ensure safe system function

Keep cost of ownership as low as possible

7.8102.2m - Occupant safety

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

ownership

Specification(s):
Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction

Occupant will be provided information regarding the health effects and risk of high CO concentrations as well as a list of monitors that can provide more detail regarding CO levels

Objective(s):
Ensure occupant life safety; CO alarms are designed to detect levels at which occupants might become unable to evacuate

7.8102.2n - Occupant education

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

Specification(s):
Completed work will be reviewed

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

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

Objective(s):
Ensure occupant is informed of the safe, efficient operation and maintenance of the system

7.8103.1 - Storage-Type Appliance

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

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

7.8103.1a - Health and safety

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

Specification(s):
Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single Family Housing or other equivalent practice

Electrical components will be verified to comply with NEC (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire)

Objective(s):
Identify potential health and safety issues

Before

Complete combustion safety testing to ensure healthy, safe work environment

After

When completed work, retest to verify home is still healthy and safe

Tools:

1. Personal CO monitor
2. Combustion analyzer with probe
3. Manometer
4. Smoke pencil

Materials:

1. CO alarm
2. Fasteners

See also SWS 2.0201.1a-2.0203.4d for all Combustion Safety details and SWS 2.0100.1d for General Electrical Safety.

7.8103.1c - Thermal efficiency

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

Specification(s):
Water heater storage tanks shall have a minimum R-value of R-24, 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 IRC or local requirements, whichever is greater

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

Ensure insulation does not make contact with flue gas venting

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

Best Practice

Install water heater blanket with minimum value of R-11, unless SIR to add insulation is less than 1.0

Tools:

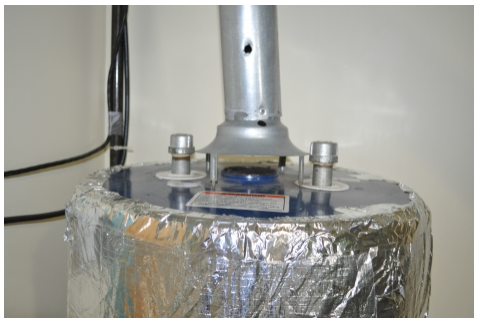
1. Utility knife

Materials:

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

Louisiana variance states: "Install water heater storage tank insulation blanket minimum value of R-11, unless the SIR to add insulation is less than 1.0, or the manufacturer of the water heater forbids installation of additional insulation."

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 - Temperature and pressure relief valve

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

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

Temperature and pressure relief valve discharge tube will be installed in accordance with IRC

Objective(s):
Discharge excessive energy (pressure or temperature) from storage tank to safe location

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.

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