Alaska Housing FINANCE CORPORATION

Alaska

Weatherization Assistance Program

Standard Work Specifications

Field Guide

Weatherization Works

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Introduction and Acknowledgements

This field guide is an effort in Alaska to create a usuable tool for implementing measures for DOE's Weatherization Assistance Program (WAP) following the guidelines of NREL's Standard Work Specifications (SWS) for Residential Homes.

Standard Work Specifications (SWS) defines the minimum requirements for DOE WAP to ensure that the work performed during energy upgrades in single-family, multifamily, and manufactured homes is effective, durable, and safe.

Thanks to Amanda Hatherly and staff of New Mexico Energy$mart Academy, Santa Fe Community College for providing original document.

Special thanks to the Opportunity Council's Building Performance Center for technical support and to the Energy Outwest membership in the development of the Alaska Field Guide.

Thanks to the staff of AHFC for their patience and direction and the support of RuralCAP and Interior Weatherization in the review process.

We also appreciate the support and understanding from DOE headquarters in regard to this project.

Final appreciation to the staff of Alaska Community Development Corp for all the work that went in to creating this guide.

This manual is a work in progress, every attempt has been made to stay current and utilize best practice in relation to the SWS and the intent of the WAP.

Co-edited in a collaboration by Dan Berube and Mimi Burbage
Anchorage, Alaska

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Appendix A

Combustion Safety Test Report
Daily In progress Combustion Report
Combustion Safety Technical Support Document

Appendix C

Diagnostic Test Report
Diagnostic Test Report Technical Support Document

Appendix F

Insulation Checklist – Wall
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Appendix G

Air Sealing Checklist – Wall
Air Sealing Checklist – Floor
Air Sealing Checklist – Attic
Air Sealing Checklist – Complete

2.0100.1f - Protective clothing

2.0100.1b - Hand protection

Protective Clothing and Hand Protection

Desired . utcome:
Work completed safely without injury or hazardous exposure

Specification: MSDSs and OSHA regulations will be consulted for protective clothing and equipment

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

Durable and wrist-protecting gloves will be worn that can withstand work activity

Objective(s): Protection from skin contact with contaminants and hands from hazards

Minimize spread of contaminants

Workers should be aware of work required and dress appropriately

Ensure workers have proper protective equipment for work environment

Safe

Wear appropriate hand protection

Wear protective gloves when handling contaminants

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 SDSs for respiratory protection requirements

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

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

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

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

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

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.

Avoid electrical workin wet areas.

Metal ladders will be avoided.

Take special precautions 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 wiring for hazards

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

Use fiberglass ladders in place of metal

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

Carbon Monoxide Monitoring

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 work will be discontinued if ambient CO level inside the home or work space exceeds 70 parts per million (ppm)

Objective(s):
Protect worker and occupant health

Personal Monitor

STOP WORK if Ambient CO levels are higher than 70 ppm

Carbon monoxide alarm

Install before work begins

Note: Alaska WAP requires that a Carbon Monoxide alarm is installed before wx work begins

Carbon Monoxide (CO) Detectors: Local agencies shall install a minimum of one carbon monoxide (CO) detector on every floor in every dwelling unit where detectors are not present or are inoperable. Replacement of operable CO detectors is not an allowable cost. CO detectors shall be installed in accordance with manufacturer's requirements. a. Detector standards: Detectors shall have:

(1) A 5-year warranty for residential models or 1-year warranty for commercial low-level models.

(2) An electrochemical sensor.

(3) A digital display that indicates CO levels in Parts Per Million (ppm).

(4) The capability to accurately detect and display low levels of carbon monoxide to 15 ppm.

(5) A label to verify testing and listing to the UL 2034 Standard

Low Level Commercial exception ACGIH and NIOSH Standards

Confined Space Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):

Access and egress points will be located before beginning work

Inspection will be conducted for frayed electrical wires

Use of toxic material will be reduced

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

Provide adequate access and egress points

Prevent electrical shock

Locate all access and egress points of confined spaces before entering

Perform visual inspection of confined spaces before beginning work

Check for electrical hazards

Check for toxic hazards

Note: Use Alaska WAP confined space protocol when entering confined spaces

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 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

Electrically Powered Tool Safety

Use PPE as required
Operate within design limitations
Do not use in wet or damp locations
Do not use around combustable materials
Work area should be well-lit
When not in use store in a dry location

Pneumatic Tools

Wear hearing protection
Keep body balanced
Keep body parts away from working end
Stay clear of whipping hoses
Only use accessories made for pneumatic tools

Ergonomic Safety

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification:
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

Objectives:
Prevent injuries from awkward postures, repetitive motions, and improper lifting

Unsafe

Workers will take precautions to protect themselves on the job site

Best Practice

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

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

Exterior lead containment elements

EPA recognized Lead Test Kit

Tools:

1. PPE
2. Containment tools
3. HEPA Vacuum
4. Lead safe engineering controls

Materials:

1. EPA approved Lead test kit
2. Containment materials: caution tape, signs, poly

Vermiculite

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.

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

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

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

Objective(s):
Protect workers from toxic exposure

Material identified as vermiculite may contain asbestos

Do not disturb vermiculite by vacuuming, dusting, or sweeping

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

Note: It is assumed Vermiculite is an Asbestos Containing Material (ACM) since sample testing protocols of a non homogeneous material are unable to "prove" absence of Asbestos in all the material present.

The Zonolite Vermiculite Insulation Trust has been established to assist homeowners with cost of removal of Zonolite insulation in attics, the Trust will also assit with cost of reinsulating attic. See link for additional information www.zonoliteatticinsulation.com/claim-form/

Mercury Disposal

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 workers and occupants from mercury exposure

Replace?

Mercury thermostats that are being replaced should be disposed of properly.

Unsafe

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

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

Contact: www.thermostat-recycle.org
www.earth911.org

for recycling options.

Asbestos

Desired Outcome:

Work completed safely without hazardous exposure of workers or occupants to asbestos

Specification(s):

Assess potential asbestos hazard; if unsure whether material contains asbestos, assume asbestos. 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) reaccess for possible deferral or work safe practice.

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)

2.0201.1b - Fuel leak detection

2.0103.1c - Raw fuel

Fuel Leak Detection

Specification:

Inspect and test for gas or oil leakage at connections of natural gas, propane piping, or oil systems.

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

Objective(s):

Detect fuel oil and gas leaks

Determine and report need for repair

Bubble solution will be used to detect pressurized gas leaks.

Visually inspect for bulk fuel oil leak

Test Procedure for natural gas or propane

1. Test all accessible gas lines from meter to appliances using a calibrated Gas leak detector
2. If Gas leak detector alarms, then use a leak detection fluid to verify leak

Action

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

Inspect exterior gas and oil lines for leaks and damage

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

Ventilation Client Education

Desired outcome

Ensure occupant is educated on the safe and efficient operation of the system

Deliver intended air exchange

Occupant will be educated on:

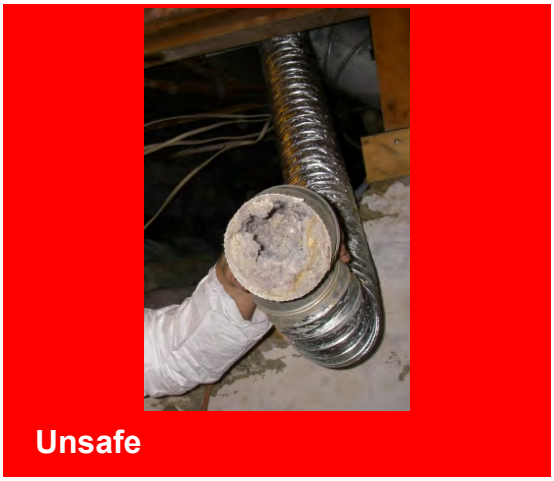
- ☐ Purpose of the ventilation system
- ☐ Proper operation, cleaning and use of controls
- ☐ Cost and benefit of system
- ☐ Manual shut off
- ☐ A label indicating the presence and purpose of the ventilation system will be included or a copy of the system operation guide will be given to client.

Dryer Client Education

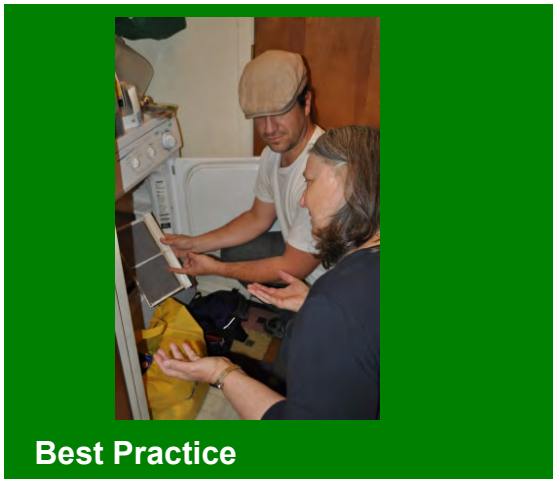
Desired Outcome:
Dryer air exhausted efficiently and safely

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)



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)

Occupant Education Forced Air Systems

Objective(s)

Ensure occupant .

- ☐ has a reasonable expectation of the equipment's capability
- ☐ can operate system controls
- ☐ can shut off equipment in emergencies
- ☐ does not block combustion air inlets

Educate occupants on:

- ☐ Basic operation of the equipment (e.g., design conditions, efficiency measures, differences from previous system or situation)
- ☐ Proper operation and programming of system controls to achieve temperature and humidity control
- ☐ Indoor and outdoor electrical disconnects and fuel shut-offs will be demonstrated
- ☐ Location of combustion air inlets will be identified
- ☐ Importance of not blocking inlets will be explained to occupant
- ☐ Importance of cleaning dust and debris from return grilles
- ☐ Proper placement of interior furnishings with respect to register
- ☐ Importance of leaving interior doors open as much as possible

Routine maintenance

- ☐ Proper filter selection and how to change the filter
- ☐ Importance of keeping outside unit clear of debris, vegetation, decks, and other blockage
- ☐ Importance and timing of routine professional maintenance
- ☐ Occupant will be provided with relevant manuals and warranties

Insulation Onsite Documentation

Specification:
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 specifications

This requirement applys whenever insulation is installed:

Reference 16 CFR 460.17:
The installer, must provide the customer or client documentation regarding the insulation installed.

Documentation will indicate the coverage area, thickness, and R-value of the insulation.

The insulation certification must be dated and signed by the installer.

Insulation certificate to be posted at entrance to attic or crawlspace and a copy shall be provided for project file.

To figure out the R-value of the insulation, use the data that the manufacturer gives you.

Information on insulation installed should be posted nearby

Combustion Safety Assessment

Specification:
Examine appliance for signs of damage, misuse, improper repairs, and lack of maintenance
Gather accurate information in regard to appliance safe operation

Emergency Take Action Problems:

- Ambient gas levels greater than 10% Lower Explosion Limit (LEL)
- Ambient CO levels exceed 70 ppm

If these conditions exist:

- Communicate clearly and immediately to the customer,
- The dwelling shall be evacuated,
- Appropriate personnel (e.g.: HVAC technician, utility, emergency services) shall be contacted.

Evidence of backdrafting

Heat exchanger inspection

Objective(s):

Ensure system does not have potentially hazardous problems

Ensure combustion appliance has adequate combustion and dilution air

Follow State of Alaska combustion safety testing protocols found in Appendix A

Combustion Appliance Venting

Specification(s):
Combustion venting systems will be inspected for:

damage
leaks
disconnections
inadequate slope
other safety
hazards.

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

For oil systems, the presense and operability of a draft regulator will verified and tested.

Desired Outcome: Combustion appliances properly vented

Determine if a draft regulator is working properly

Inspect vent systems for damage

Properly vented appliances make a house healthier and more efficient

Inspect vent systems for adequate slope

Inspect for missing draft diverter

Inspect vent systems for disconnected pipes

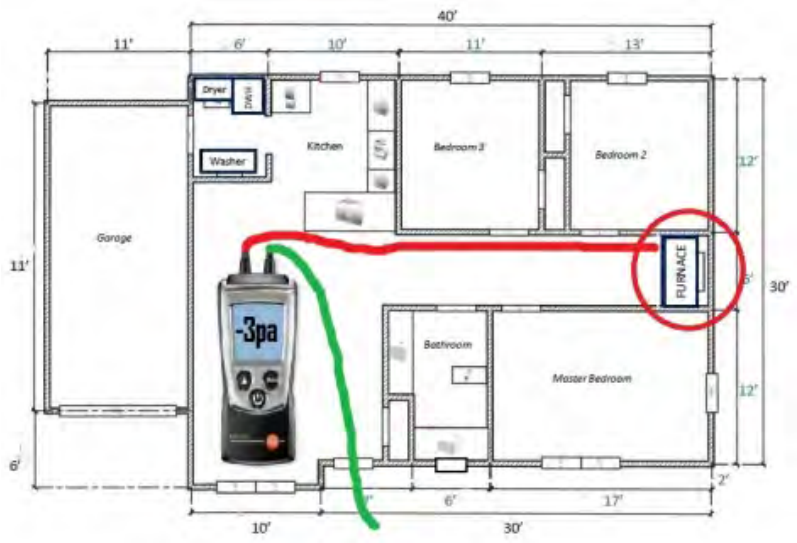
Follow Alaska WAP Combustion safety protocols See Appendix C and D

Combustion Safety-Daily Test Out

Desired Outcome:
Ensure proper drafting of all combustion appliances before leaving dwelling at end of day

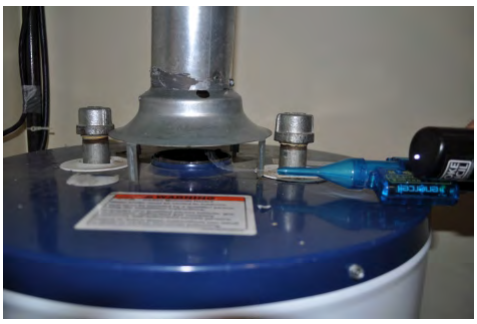
Specification:
At the conclusion of each work day in which envelope or duct sealing measures have been performed, depressurization and spillage testing will be performed

Objective:
Ensure work completed in dwelling has not adversely affected the operation of combustion appliances



Run depressurization test at the end of the work day

Complete spillage testing on all combustion appliances



Assure draft using a smoke pencil, mirror, or lighter,

Test for spillage on all sides of draft diverter

Alaska Variance-daily test out only necessary when work being performed could effect a combustion appliance.

Refer to: AK Daily In-Progress Combustion Safty Test Form in Appendix A

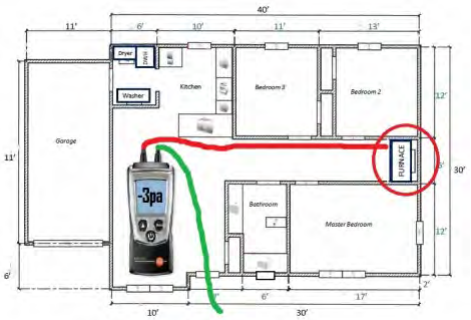
Dryer Combustion Safety

Desired Outcome:
Dryer air exhausted efficiently and safely

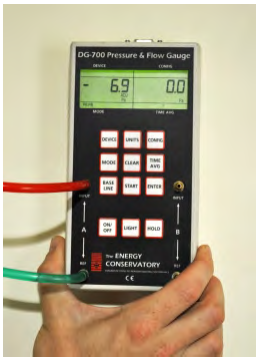
Specification(s):
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Objective(s):
Ensure safe operation of combustion appliances

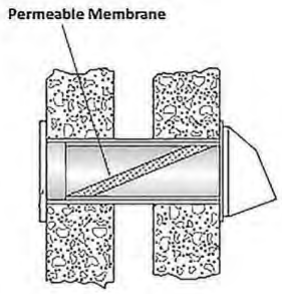
Ensure occupant health and safety



Run depressurization testing on house to ensure dryer 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

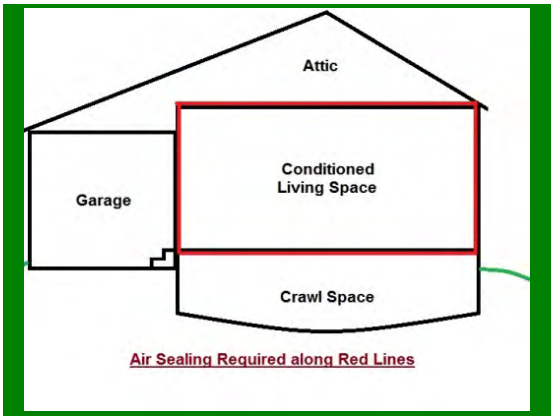
Exhaust Fans Depressurization

Desired Outcome:
Ensure safe operation of installed exhaust fans

Specifications:
Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics)

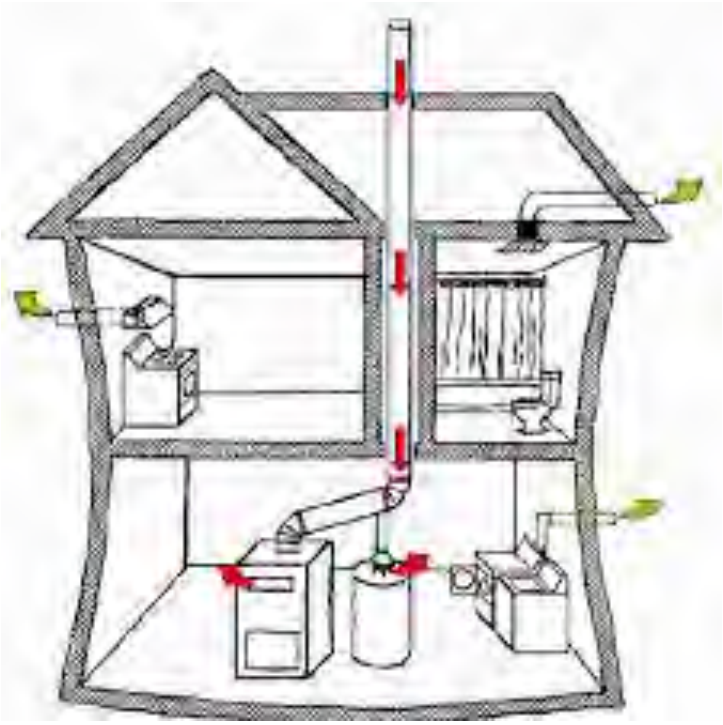
Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards

Objective(s):
Ensure occupant health and safety



Best Practice

The barrier between conditioned and unconditioned spaces should be airsealed as tight as practical



See also SWS 3.1501.1 Air Sealing Garage Penetrations.

Combustion Make-up . ir

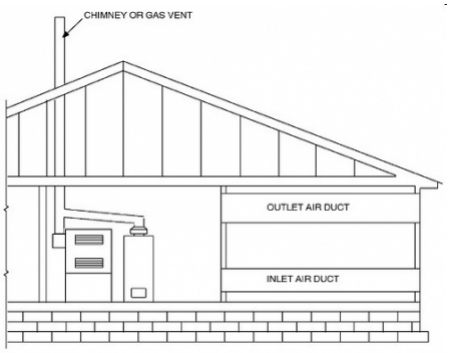
Desired . utcome:
Buildup of dangerous combustion byproducts in the living space prevented

Specification:
Where applicable, combustion air will be provided from the outside and installed in accordance with the 2012 IRC for the type of appliance installed

Objective(s):
Provide adequate combustion air for proper draft of combustion appliance

Note: Alaska variance approved, adding combustion air is required only if performance testing indicates combustion air is needed for proper operation of a combustion appliance.

When adding combustion air here are 2 options:



 # 1 one opening
min free area of 1 sq in per 3,000 Btu/h (734 mm2/kW) of total input rating

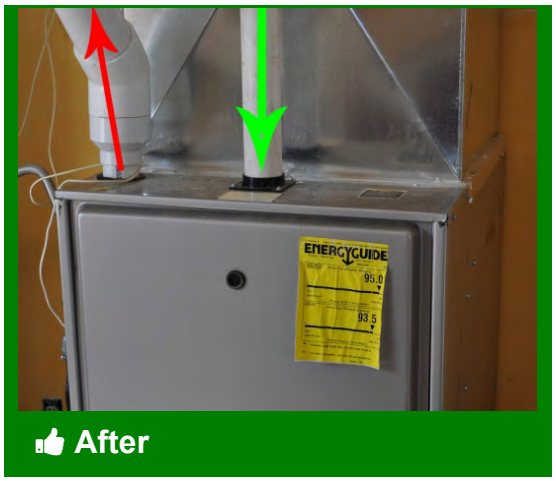
#2 2 openings high and low sidewall min free area of 1 sqin per 2,000 Btu/h (1100 mm2/kW) of total input rating

New Combustion Appliances

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

Direct vent space heaters are also an available replacement

2.0201.2d - Gas ovens
2.0201.2e - Gas range burners

Gas Oven Testing

Desired Outcome:
Ensure safe and clean burn of gas oven

Specification:
Gas ovens will be tested for CO using a combustion analyser with probe.

1. Check oven for stored items
2. Start oven at 350 degress
3. After 5 minutes turn oven to 500 degrees
4. Read CO as measured at outlet of oven

If the oven vent at steady state exceeds 225 ppm as measured then take these actions:

1. Require clean and tune of oven
2. If not installed, evaluate installation of vented range hood
3. Advise client of issue and document in file

Gas Burner Inspection

Specification:
Recommend clean and tune if the flame has any discoloration, flame impingement, or an irregular pattern or if burners are visibly dirty, corroded, or bent.

Before

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

After

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

Objective: Ensure clean burn and operation of gas range burners

Note: Check for improper jets installed, i.e. natural gas versus propane

Smoke Alarms

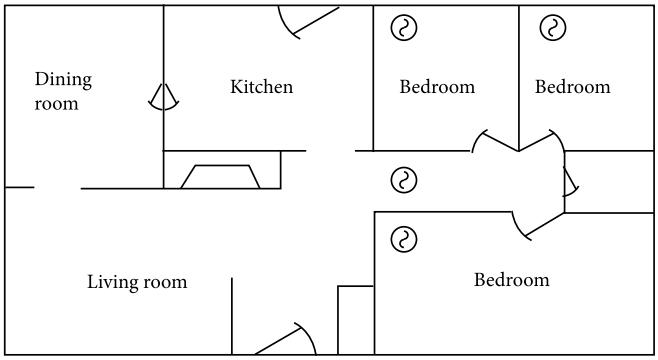
Specification:

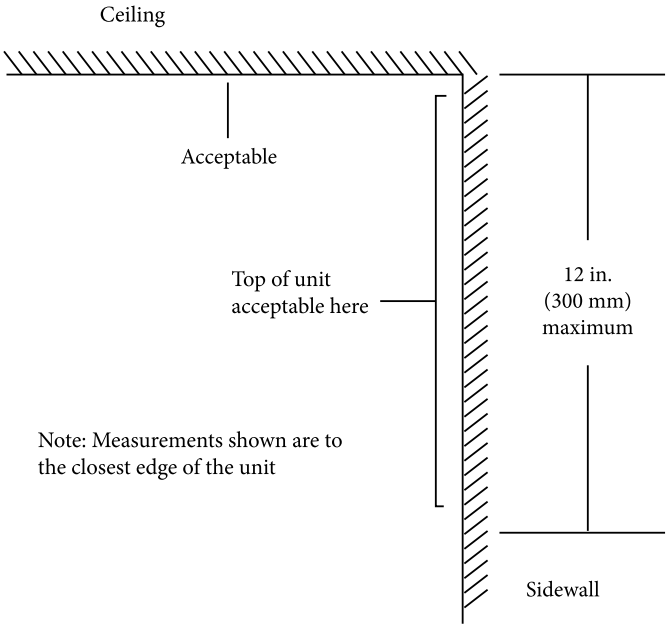
Battery operated alarms will be installed in accordance with the 2012 IRC, NFPA 72 and manufacturer specifications

Alarm Placement

Smoke alarms should be installed according to NFPA 72 and the manufacturer's instructions. Heat and smoke rise, so smoke alarms should be installed on the ceiling or high on a wall to detect the first traces of smoke.

If a room has a pitched (slanted) ceiling, mount the unit near the ceiling's highest point, 4 to 12 inches (10 to 30.5 centimeters) away from the wall. If the room has an A-frame ceiling, mount the unit at least 4 to 12 inches (10 to 30.5 centimeters) away from the peak.



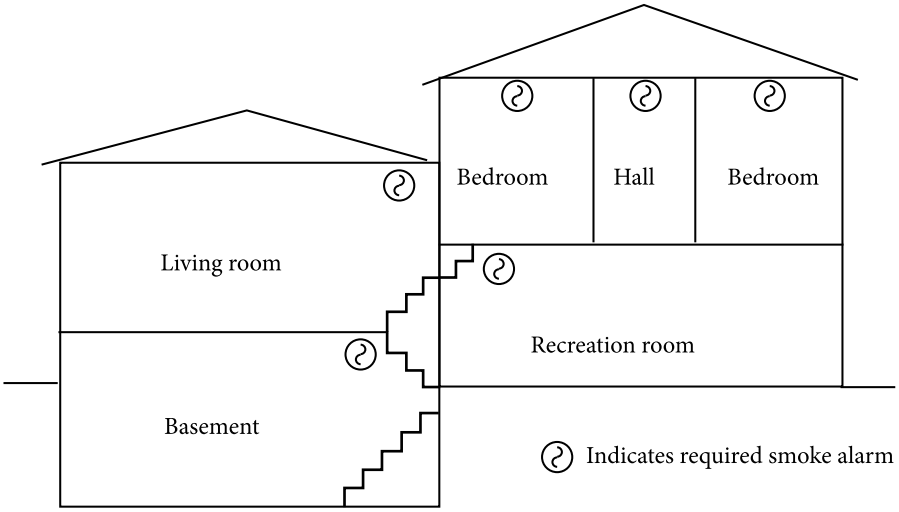


Wall-mounted smoke alarms should be installed so that the top of the alarm is not more than 12 inches (30.5 centimeters) from the ceiling.

Install basement smoke alarms close to the bottom of the stairs. Don't install an alarm at the top of basement stairs; dead air trapped near the closed door could prevent smoke from reaching the unit.

Some household environments can cause nuisance alarms or interfere with a smoke alarm's operation. Avoid placing alarms near a cooking appliance, a dusty area, a shower, or any area where the temperature drops below 40°F (4.5°C) or rises above 110°F (43°C).

Cooking fumes, steam, and automobile exhaust can result in nuisance alarms. Do not install alarms in bathrooms, kitchens, garages, attics, or unheated areas or near recessed ceiling areas, ceiling fans, furnaces, or furnace vents. Place alarms at least 3 feet (0.9 meter) horizontally from bathroom doors.



CO Detectors

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

Desired Outcome:
Properly installed CO alarms or monitors

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

Objective: Working CO Detector installed before work begins

Reference 2012 IRC R315: An approved CO alarm will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within which fuel-fired appliances are installed and in dwelling units that have attached garages. 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 17-1, full compliance with ASHRAE 62.2.2016 and NFPA 720 is required.

Labeling: Installer shall write the date installed or manufacturers recommended replacement date on the device label so it is visible without having to remove the device.

Carbon Monoxide (CO) Detectors: Local agencies shall install a minimum of one carbon monoxide (CO) detector on every floor in every dwelling unit where detectors are not present or are inoperable. Replacement of operable CO detectors is not an allowable cost. CO detectors shall be installed in accordance with manufacturer's requirements.

Detectors shall have:

(1) A 5-year warranty for residential models or 1-year warranty for commercial low-level models.

(2) An electrochemical sensor.

(3) A digital display that indicates CO levels in Parts Per Million (ppm).

(4) The capability to accurately detect and display low levels of carbon monoxide to 15 ppm.

(5) A label to verify testing and listing to the UL 2034 Standard.

Exception: CO Detectors need not be UL listed if a low level detector is desired. To comply with this exception, these commercial low-level detectors must meet or exceed all of the following:

(a) (1) through (4) above.

(b) ACGIH and NIOSH Standards.

Knob and Tube Detection

Desired Outcome:
Live unsafe wiring identified and brought up 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 & Tube wiring in an attic.

First determine whether K&T wiring is active using an AC voltage detector.If the K&T wiring is active, a licensed electrician must inspect the wiring and document the findings. .

Tools:

1. AC Voltage Detector

Alaska Variance allows knob and tube (K&T) wiring to be covered with insulation, but first requires a licensed electrician to inspect and certify in writing the knob and tube wiring system is safe for insulation contact.

Remember, K&T wiring can be beneath the floor and in wall cavities too.

3.1001.1 Penetrations and Chases

Air Sealing Attics

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

Specifications:
Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

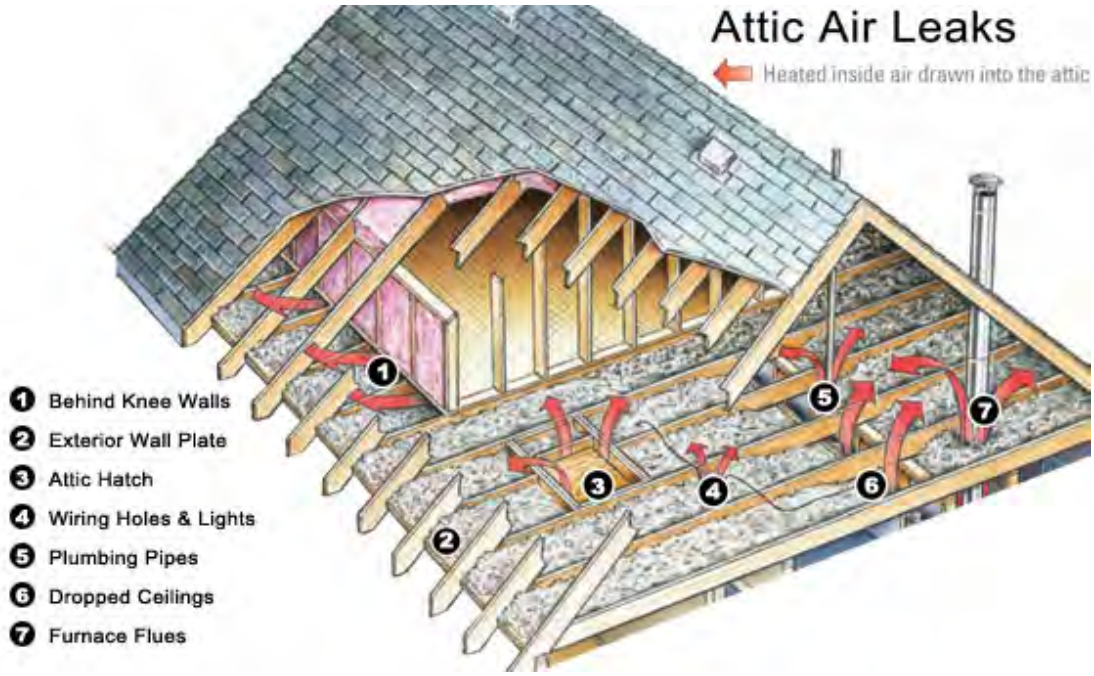
Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction.

Objective(s):

Select appropriate sealant for a durable, long lasting airseal.

Should be able to pass smoke test or 50 pascal pressure difference with less than 1 pascal leakage.

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



High Temperature Caulk Application

3.1001.1d - High temperature application

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

Reference local codes and manufacturers specifications

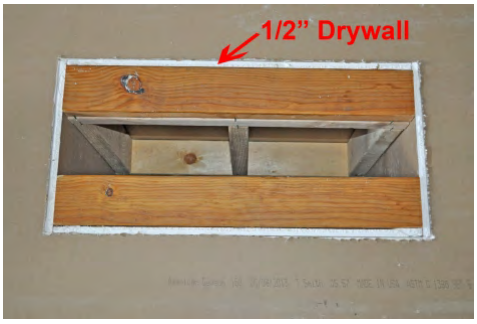
Air Seal Chase

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

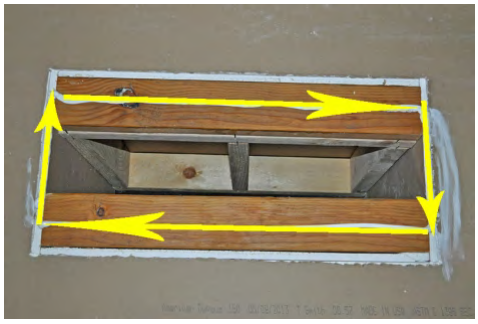
Specification(s):
Entire opening will be spanned with rigid material, if span exceeds 24" support use appropriate material

Material will be cut to fit and fastened as required

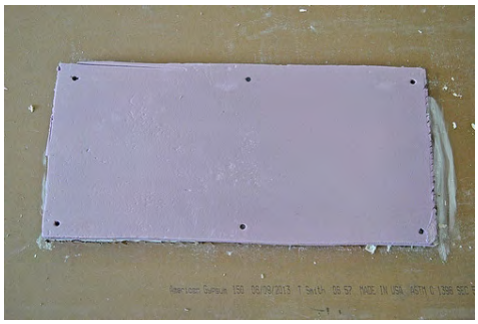
Objective(s):
Reduce opening to what can be sealed with sealant



Clear area of debris and insulation in preparation for work



Apply sealant all the way around opening



Fasten rigid material appropriately, such as with screws

Sealing Chase That Does Not Meet Flame and Smoke Spread

Specification:
Material will be used that can be exposed to the interior of the house and meet the flame and smoke spread indexes as required in 2012 IRC R302.9

Objective(s):
Prevent a fire hazard

Paneled drop soffits typically are more combustible than plain drywall

When sealing on attic side use 5/8 inch drywall, fasteners and sealant

Sealing Methods for Attic Penetrations

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

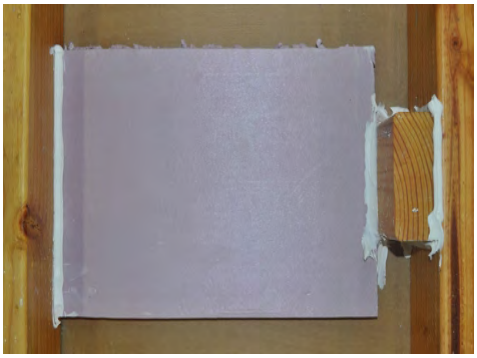
Objective(s): Prevent air leakage from wall cavity to attic

Wall cavities are open to attic

Verifytest for no visible air movement

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

Option 2: Bridge cavities with spray foam



Option 3:Cap with XPS or drywall, seal exposed gaps

Sealing Dropped Ceiling

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 bore sealed with rigid material from bottom of dropped ceiling to top-plate or

Wall below openings will be dense packed or

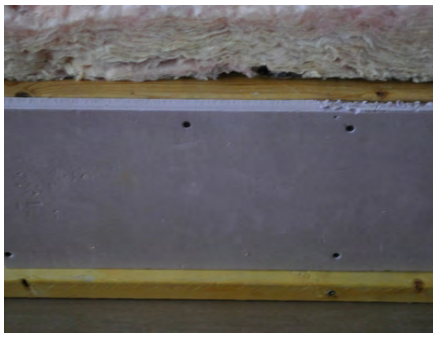
Wall below openings will be bridged and sealed with SPF

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

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

Prepare work area by removing existing insulation and debris

Option 1, 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 to verify no air leakage

Dropped Ceiling and Soffit Above Closets and Tubs

Desired Outcome: Continuous, airtight barrier between 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.

Any of these methods could be used:

Options

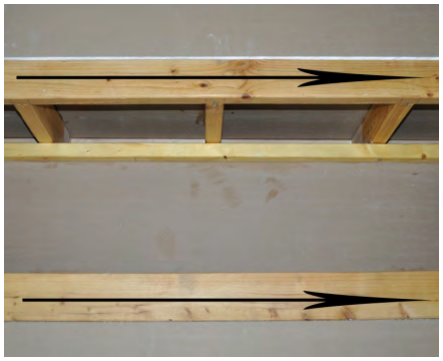
*Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate

*Wall below openings will be dense packed

*Wall below openings will be bridged and sealed with SPF

Objective:

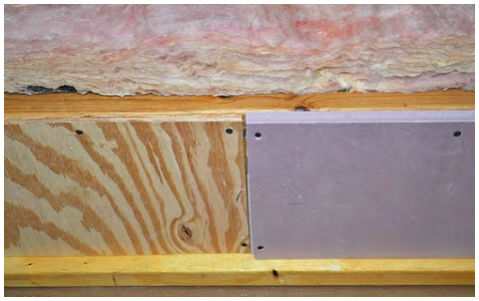
Prevent air leakage from dropped ceiling to attic
Seals able to withstand 50 pascals of pressure difference



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

Sealing Dropped Soffit

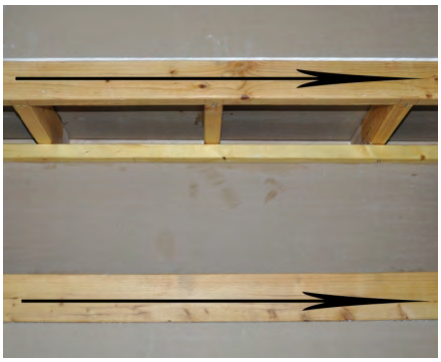
Desired Outcome:
Provide continuous air barrier across soffit openings to prevent air leakage and moisture movement between the attic and conditioned space

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

Bring Soffit Inside (seal at top)

Specification:
Entire opening will be spanned with rigid material in line with the ceiling level
Material will be cut to fit and fastened as required for supprt and sealing

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



Apply sealant along top plates

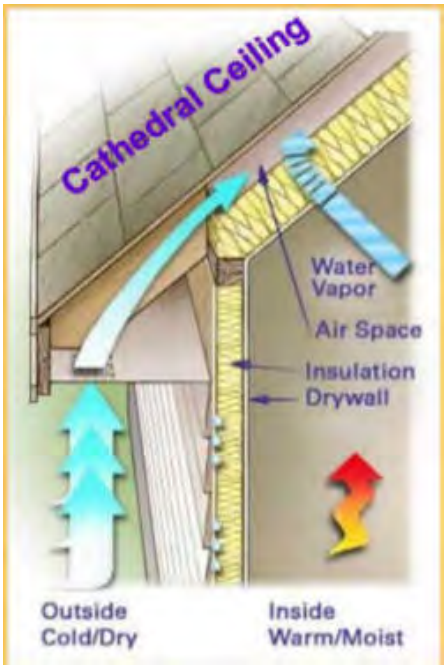
Cap soffit with rigid material, such as drywall, cut to size

Leave Soffit Outside (seal at stud bays)

A sealed rigid barrier will be installed at all transitions

Span each stud bay with rigid material at level of soffit

Sealing Tongue and Groove Ceilings



Desired Outcome:
Tongue and groove ceilings 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 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

Ensure ceiling remains aesthetically pleasing

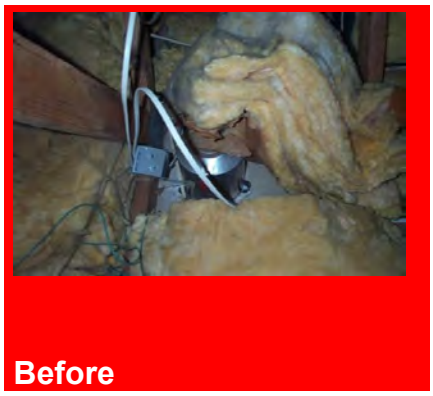
Sealing Recessed Can Lights

Desired Outcome:

Ensure safety from fire and prevent air leakage,
. easure less than one pascal using a pressure pan
with Blowerdoor at 50pa

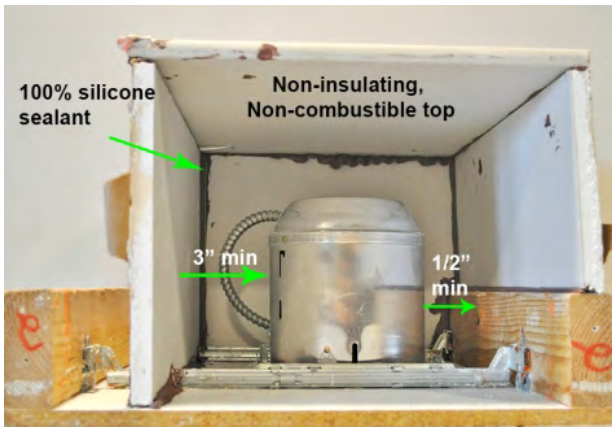
Use one of these methods:

1. Replace with airtight, IC rated recessed fixture
2. Replace with surface mounted fixture and opening sealed.
3. Air sealing measures as approved by the authority having jurisdiction.
4. A fire-rated airtight closure
   (i.e., equivalent to 5/8 fire code gypsum wallboard)



Non-IC rated recessed light

Airtight IC rated recessed light



Sealed box around non-IC light

Recessed can adapter

Sealed box should meet smoke and flame spread

3" clearance between enclosure and fixture.
Enclosure height must be above surrounding insulation.
Enclosure lid may not exceed R value of .5.

Fireplace Chimney and Combustion Vents

Desired Outcome:

Combustible materials kept away from combustion sources

Specification(s):

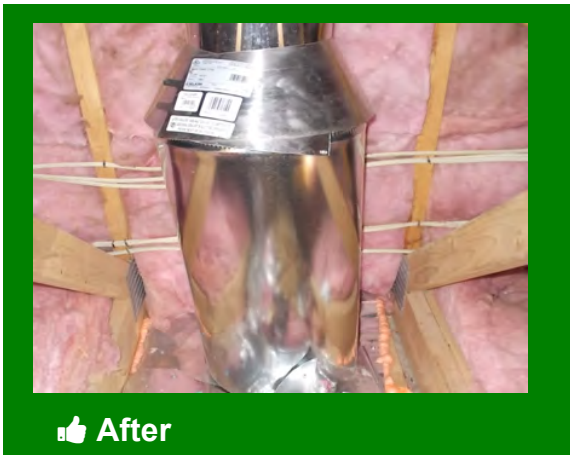
Holes, penetrations, and bypasses will be sealed

Dams will be fixed in places that maintain required clearance

Alaska requires dam to be covered to prevent insulation from entering

Ensure insulation dams maintain clearance

Does not meet clearance requirements



Properly installed insulation dam prior to insulating

1. Construct and install a rigid dam, ensure proper clearance per manufacturer spec between the dam material and chimney.
2. Air seal chimney penetration prior to damming combustion flue or chimney..
3. Fasten damming to substrate or framing to prevent it from moving.
4. Extend dam higher than the top of the insulation to be installed.
5. Fiberglass batt may be used for damming in areas where installation of rigid daming is not feasible, maintain 3" clearance.
6. Ensure the dam material does not bend, move, or sag.

Masonary Chimney Insulation Dam

Air leak around masonry chimney, needs to be air sealed.

Rigid, non-combustible material should be used to construct seals and dams on chimneys

Only construct dam after sealing has been completed properly.

Damming is held in place with mechanical fasteners and maintains 3" clearance from chimney.

Eave Baffling

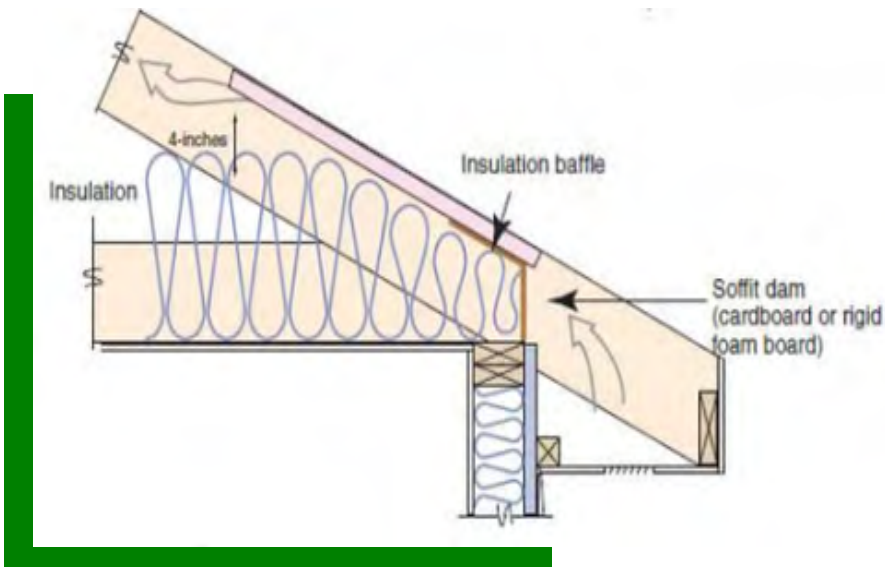
Desired Outcome:
Attic ventilation meets code requirements and insulation is protected from wind washing

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

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

Insulation should not block vented eaves



Baffles shall have min 1" air space &
prevent insulation from falling into eave

Baffle shall extend vertically a minimum of 4" above the final level of the insulation.
Mechanical fasteners shall permanently affix baffle in place.

Knee Wall Airsealing

Desired outcome:
Airtight cavity and properly insulated knee wall

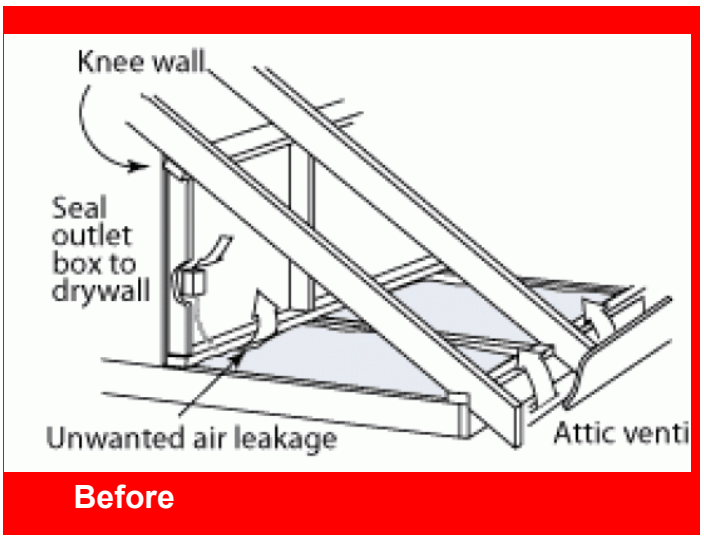
Specification(s):
All knee walls will have a top and bottom plate or blockers installed using a rigid material

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

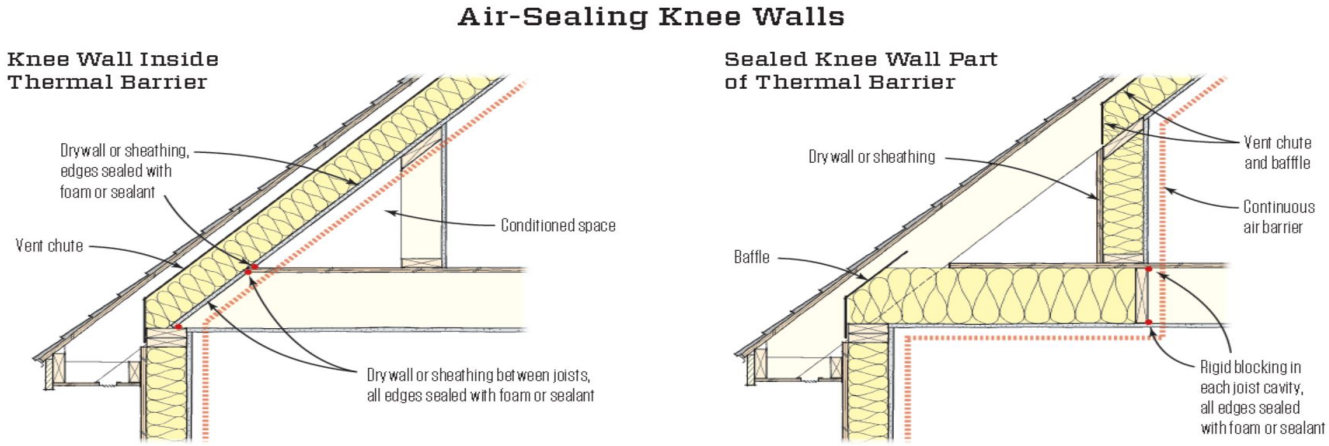
Objective(s):
Eliminate bending, sagging, or movement that may result in air leakage

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

Create an air barrier



Unsealed joist cavity below knee wall



Knee Wall Prep (Example)

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 sealed to surrounding joist and framing

Knee Wall Batt 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

Where existing insulation is improperly installed, fix it

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

Batts should fill entire volume of knee wall stud bays

Note: Alaska standard, If knee wall area is used for storage fiberglass shall be covered with insulweb, weather resistant barrier (WRB) or FSK to prevent human contact with fiberglass.

Attic Prep-Cavity Access Checklist

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

- [ ] 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
- [ ] 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

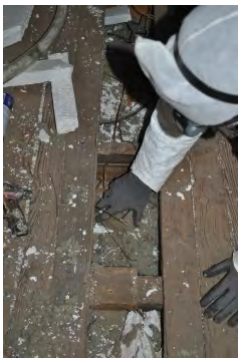
Attic Prep-Cavity Access

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

Attic Floor Insulation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
All insulation will be installed to the depth indicated on the manufacturer coverage chart for desired R-value

Objective(s):
Reduce heating and air conditioning costs

Improve comfort

Minimize noise

Insufficient level of insulation allows heat loss and wasted energy.

Attic floor blown with loose fill, achieving R-value of program requirements.

Tools:

1. Insulation machine
2. Rake or stick to level insulation as needed

Materials:

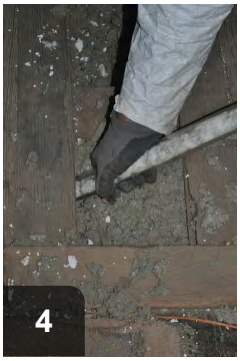
1. Loose fill insulation
2. paper rulers to mark insulation depth
3. Insulation manufacturer's coverage chart

Attic Blowin Installation (cont)

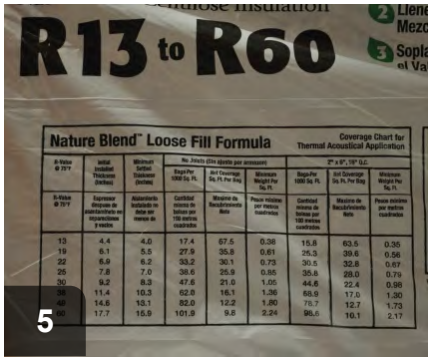
Adjust machine settings for loose fill: open gate for high material flow, allow enough air pressure to avoid clogging.

Use depth markers to ensure insulation has reached prescribed R-value

PPE for attic includes N-95 respirator or greater, gloves, and coveralls.



Where flooring cannot be removed, verify insulation is meeting R-value goal



Use the manufacturer's coverage chart to ensure R-value and post the chart with the insulation certificate

Pulldown Stairs

Desired Outcome:
Pull-down attic stair properly sealed and insulated

Specification(s):
Hatches will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

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

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

Objective(s):
Achieve uniform R-value

Prevent loose insulation from entering the living area

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

Insulated pull-down stairs cover installed to prevent air leakage

Attic Access Door

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.

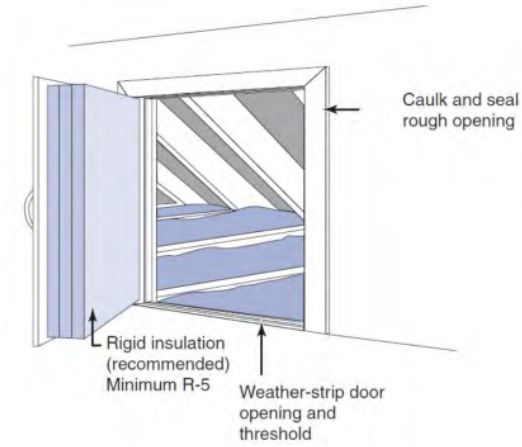
Attic hatches rough opening will be surrounded with a structurally durable protective baffle that is higher than the level of the surrounding attic floor insulation.

Objective(s):
Attempt to 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

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



Alternate installation for vertical access panel to attic

Materials:

1. Baffle or damming around horizontal access: 1/2" plywood or OSB.
2. Fiberglass batt or rigid foam to achieve R-value on hatch.
3. Strapping to attach fiberglass batt to access hatch.
4. Adhesive or fasteners to attach rigid foam to access hatch.

When a rigid dam is not practical or possible due to hatch location (less than 24 inches clearance from top of damming to bottom of roof truss or rafter), fiberglass batts may be used to prevent loose insulation from falling into conditioned space when hatch is opened.

Ensure ceiling hatch is tight fitting and if necessary weatherstripped or caulked to prevent air leakage between conditioned space and attic.

Crawlspace 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

Clear away trash, wood debris and overgrowth. Remove anything that could puncture the ground cover.

Ground Vapor Retarder

Desired Outcome:

Installed durable, effective ground moisture barrier with long-lasting access and minimizes ground vapor

Specification(s):

A ground moisture barrier that covers 100% of the exposed crawl space floor will be installed
A ground moisture barrier with a rating of no more than 0.1 perm will be used

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

- All seams shall overlap a minimum of 12 inches.
- A durable sealant, compatible with the air barrier and ground moisture barrier, will be used.
- Poly shall not be in direct contact with wood posts or framing.
- Where necessary, poly shall be fastened in place using landscape staples, spikes with washers or ballast to prevent shifting caused by routine access or other factors such as sloping grade or wind.

Alaska Variance allows less than 100% ground cover when areas are inaccessible.

Crawlspace Signage

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

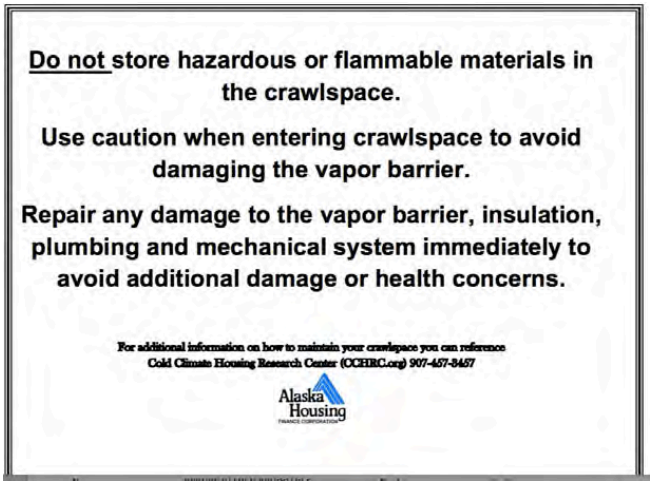
Educate anyone entering the crawl space

Provide occupants with a way to contact the installer

Note: SWS 2.0701.2a-c requires a sign (min.8.5"x11") at entrance of crawlspace that states:

1) Ground cover, air barrier and insulation if disturbed shall be repaired and maintained.

2) Hazardous or flammable materials or liquids shall not be stored in crawlspace.



Sample

Crawlspace Airsealing

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

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

Before

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

After

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

Note: If there is evidence of pests entering vented crawlspace these same techniques can be used to exlude pests

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

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

Floor Airsealing

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

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

open tub chase

Seal large tub chase using rigid foam then caulk or foam edges

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials.

Underfloor-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

Batt must be in contact with subfloor without voids, gaps or being compressed

Twine fastened across bays in a zig-zag pattern

FLOOR SUPPORT MATRIX

Floor Type	Support Material	Material requirements	Maximum Spacing	Acceptable patterns	Minimum fastener type	Minimum fastener depth
Joist up to 24"	Lath	3/8X1.5"	20"O.C.	Across floor joists	Corrosion resistant 3/8"crown 18AWG	5/8"
Joist up to 24"	Twine	150 LBS. polyester, polypropylene or nylon	12" O.C.	Shoelace/Zigzag (must be stapled at each joist	Corrosion resistant 3/8"crown 18AWG	5/8"
Post &Beam over 32" O.C.	Lath	3/8X1.5"	20" O.C.	Across floor beams up to 54". If over 54" need center support	Corrosion resistant 3/8"crown 18AWG	5/8"
Post &Beam over 32" O.C	Twine	150 LBS. polyester, polypropylene or nylon	12"	Shoelace up to 54" across. If over 54" need center support	Corrosion resistant 3/8"crown 18AWG	5/8"

Required twine or lath support for floor insulation, tiger teeth prohibited

Floor Netting-Install

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

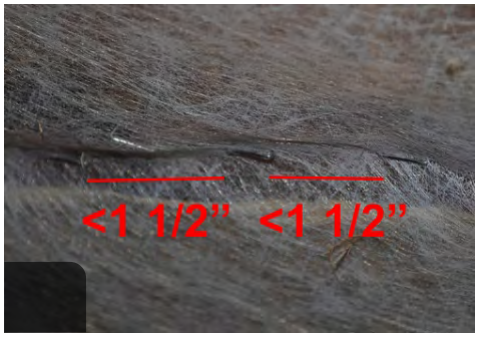
Netting or fabric will meet local fire codes

Objective(s):
Secure insulation

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

Dense Pack Floors above Garage

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

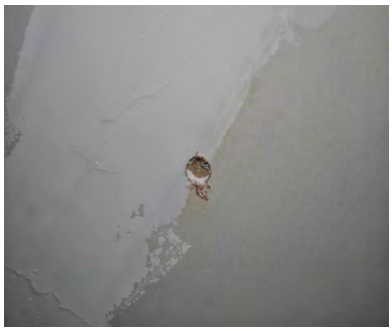
Specification(s): Each cavity will be 100% filled to consistent density:

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

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

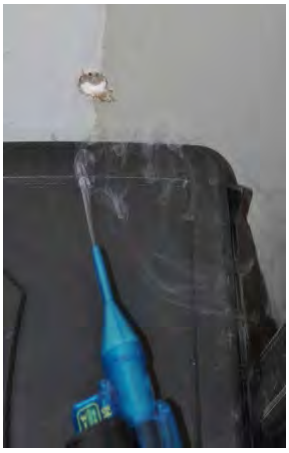
Blow insulation into cavities to density appropriate for chosen material

Close cavities with access panel cut out at the beginning



Cut small test hole to verify density

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



Chemical smoke at 50pa indicates insulation is at appropriate density

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

Underfloor Rigidboard- 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

Once rigid barrier is sealed, insulation can be blown in

Dense Pack Floor System with Rigid Barrier- Installation

Install rigid material that will withstand minimum 3.5 lb/cubic ft pressure using proper fasteners and techniques

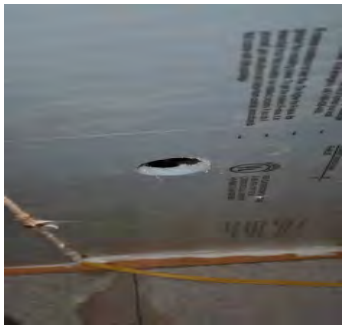
Drill hole slightly larger than nozzle into rigid barrier with hole saw

Dense pack insulation into floor cavities to specified r-value from Work Order

Check manufacturer specifications for r-value before filling

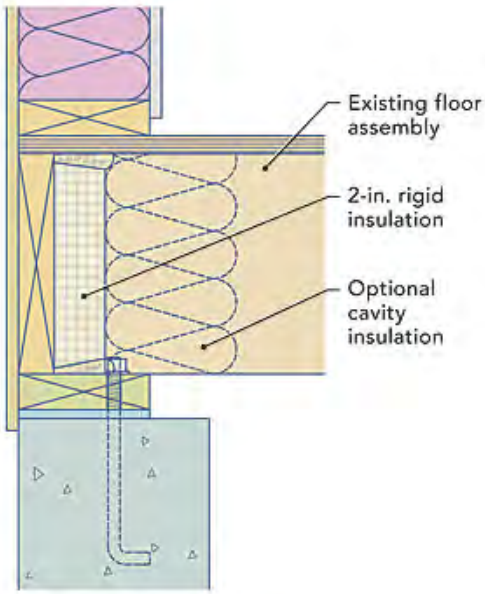
When filled to specified density and r-value, fill access hole

Onsite insulaltion certificate



Band/Rim Joists – Insulation

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



Section

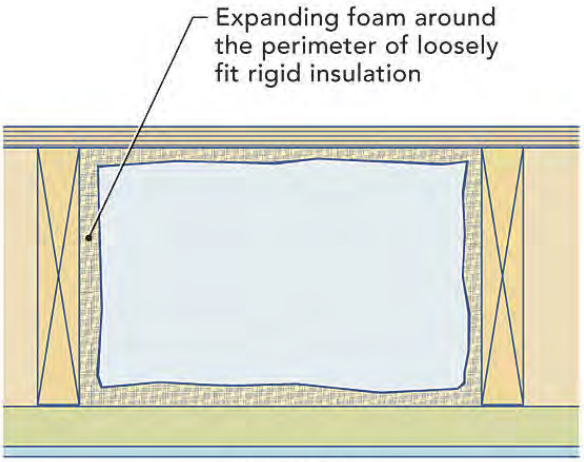
Specification(s):

A foam-based insulation will be installed so as to create a continuous thermal and pressure boundary or vinyl faced fiberglass batt insulation, installed tightly to the wood and sealed at all edges.

If rigid insulation is used, all edges will be sealed and the insulation will be installed tightly to the wood to prevent the movement of moisture throughout the assembly.

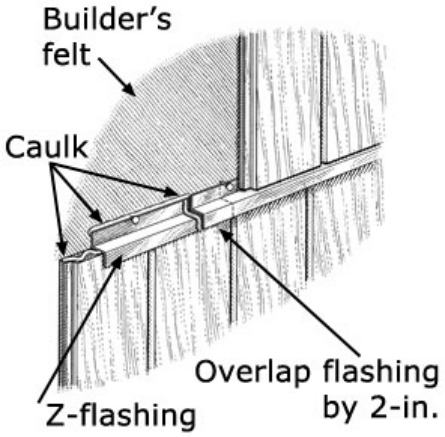
Insulation will be installed in accordance with local/national code requirements and/or manufacturer's instructions regarding flame spread.

Objective(s): Insulate and seal band/rim joist



Elevation

Skirting

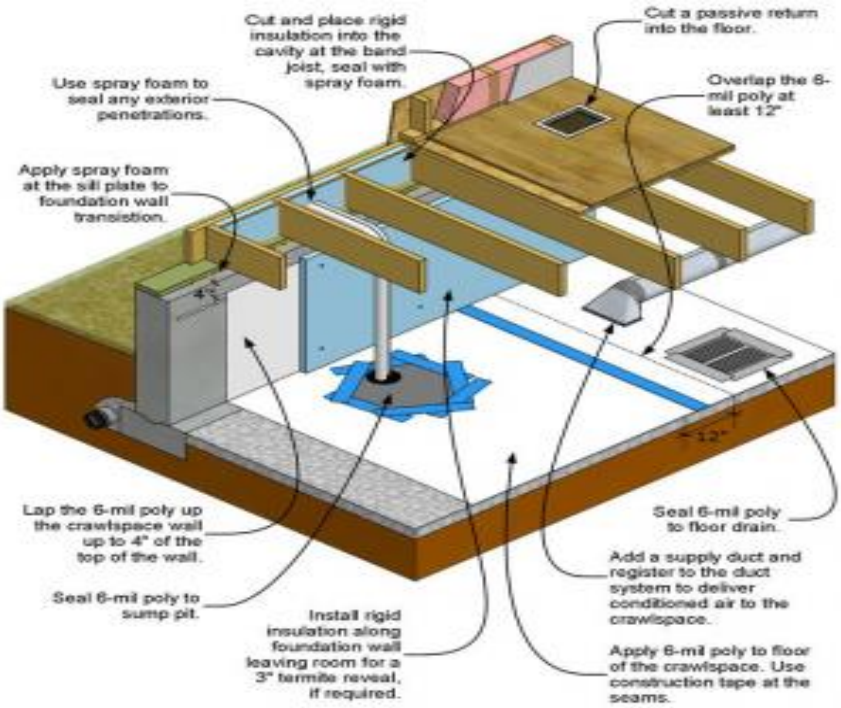


Desired Outcome:
Protective skirting effectively installed to retard damage from natural causes such as wind, water, and pests

Specification(s):
Any materials making contact with the ground will be rated for ground contact.
Any wood exposed to the elements should be weatherproof.
Use z-metal or apropriate flashing to prevent water intrusion at top of flashing and corners.

Skirting will be continuous around the perimeter and enclose the entire floor area below the conditioned living space

Objective(s):
Minimize pests, wind, water, and freezing of pipes under house

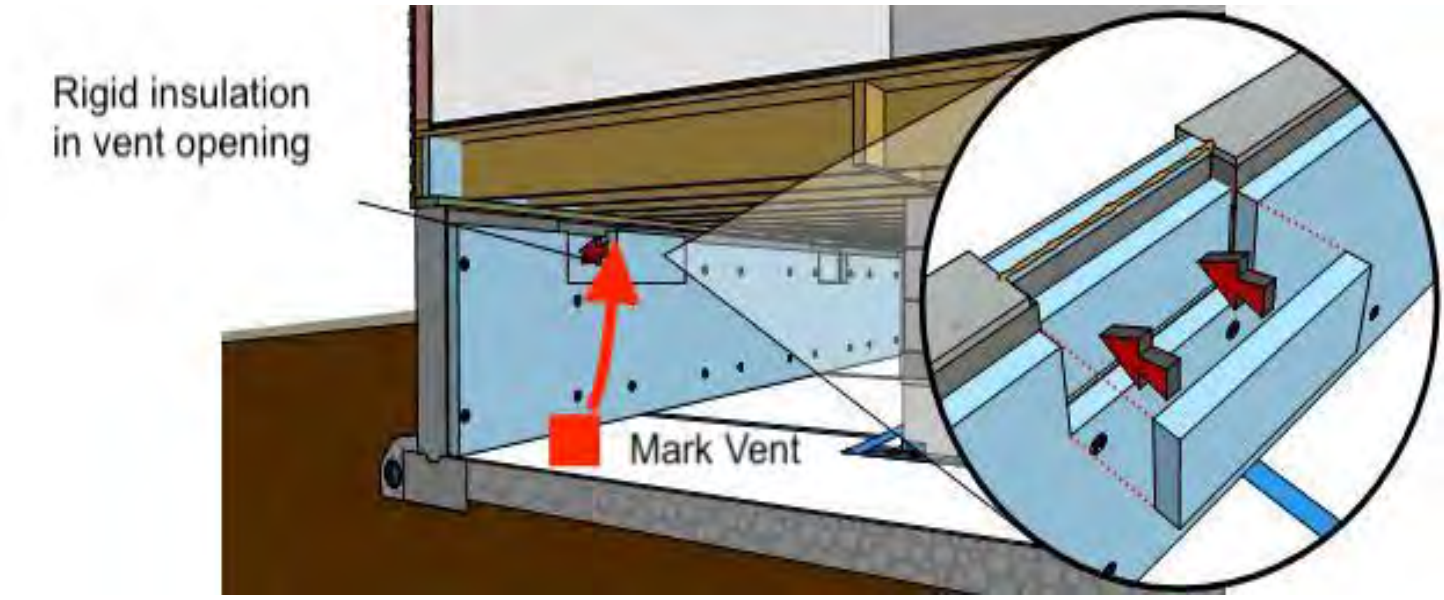


Crawlspace Vent Closure

Desired Outcome:
Prevent unconditioned outside air and moisture from entering through the existing vent into the crawl space blocked

Specification(s):
Vent opening can be sealed with removable plug marked from inside with survey tape.

Objective(s):
Reduce air infitration and moisture penetration



Exterior Wall 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, 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, the number of bags installed will be confirmed and will match the number required on the coverage chart.

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

Objective(s):
Eliminate voids and settling

Minimize framing cavity air flows

Tools:

1. insulation blowing machine
2. pressure gauge
3. blower door
4. chemical smoke dispenser
5. drill
6. tape measure
7. ladder

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

Exterior Wall Dense Pack

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.

Check for air leakage reduction after dense-pack insulation using a blower door at -50 Pascals and smoke

Garage to House Penetrations

Desired Outcome:
Openings from garage sealed to prevent air leakage and pollutant entry

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

Seal penetrations to minimize risks and air leakage from garage to house

Garage to House Door

Desired Outcome:
Prevent air leakage and pollutant entry through door between garage and house

Specification(s):
Weather stripping, door sweep, and threshold will be installed to stop air leakage
Also a spring hinge to insure door closure

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

Garage 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 into living space

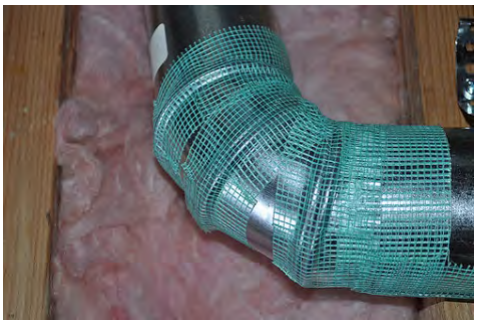
Unsealed joints and connections need to be sealed to prevent health risks.

Sealed ductwork connections help prevent leakage.

Materials:

1. Mesh tape
2. Mastic

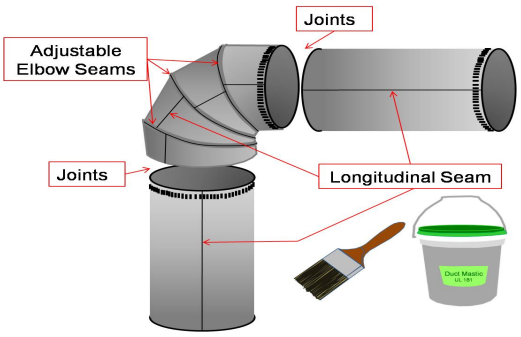
Prepare work area by assessing any safety concerns.



Wrap joint with fiberglass mesh tape.

Apply UL 181 mastic to seal joint.

Duct Sealing



Sealing Small, Medium & Large Holes

Specification
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:
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

After gaining access to the leakage site, choose the appropriate sealing technique from below. Each of these step-by-step groupings illustrate a specific sealing technique based on the hole size.

There are 3 sets to choose from:

Duct Sealing Small Holes (1/4" or less)

Seams, cracks, joints, holes and penetrations that are 1/4-inch or less and more than 10 feet from air handler.

Seal with mastic.

Sealing Medium Holes

STEP 1: Seams, cracks, joints, holes and penetrations that are 1/4-inch to 3/4-inch.

STEP 2: Install temporary tape over seams, cracks, joints, holes and penetrations.

STEP 3: Apply a base coat of mastic to completely cover and extend beyond tape.

STEP 4: Apply fiberglass mesh tape to completely cover and extend beyond mastic.

STEP 5: Apply a second coat of mastic atop fiberglass mesh tape to completely cover and extend beyond tape.

Notes:
Temporary tape can be a variety of different types of tape. It is used to prevent mastic from falling into the hole and should only be used if also using mesh tape for reinforcement.

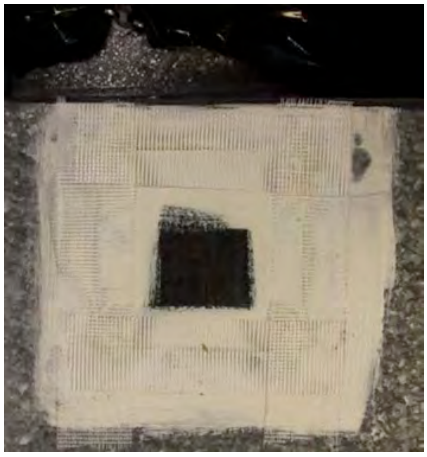
Sealing Large Holes

STEP 1: Seams, cracks, joints, holes and penetrations that are larger than 3/4-inch.

STEP 2: Install rigid duct support material that is at least 1 inch larger than the hole.

STEP 3: Apply a base coat of mastic to completely cover and extend beyond support material.

STEP 4: Apply fiberglass mesh tape to completely cover and extend beyond mastic.



STEP 5: Apply a second coat of mastic atop fiberglass mesh tape to completely cover and extend beyond tape.

Duct Sealing Large Holes in Plenum

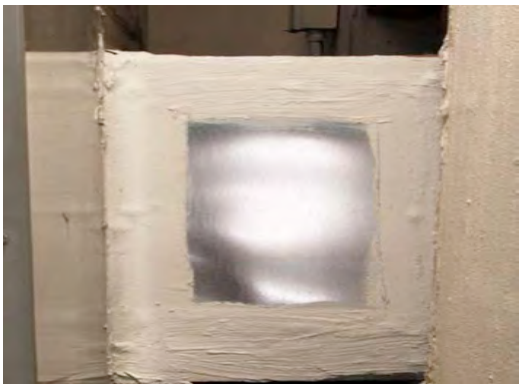
STEP 1: Seams, cracks, joints, holes and penetrations that are larger than 3/4-inch.

STEP 2: Install rigid duct support material that is at least 1 inch larger than the hole.

STEP 3: Apply a base coat of mastic to completely cover and extend beyond support material.

STEP 4: Apply fiberglass mesh tape to completely cover and extend beyond mastic.

STEP 5: Apply a second coat of mastic atop fiberglass mesh tape to completely cover and extend beyond tape..



Sealing Large Holes in Duct Board

STEP 1: Seams, cracks, joints, holes and penetrations that are larger than 3/4-inch.

STEP 2: Install rigid duct support material that is at least 1 inch larger than the hole.

STEP 3: Apply a base coat of mastic to completely cover and extend beyond support material.

STEP 4: Apply fiberglass mesh tape to completely cover and extend beyond mastic.

STEP 5: Apply a second coat of mastic atop

Duct Sealing Return Platform Plenum

STEP 1: Seams, cracks, joints, holes and penetrations that are larger than 3/4-inch.

STEP 2: Install rigid duct support material that is at least 1 inch larger than the hole.

STEP 3: Apply a base coat of mastic to completely cover and extend beyond support material.

STEP 4: Apply fiberglass mesh tape to completely cover and extend beyond mastic.

STEP 5: Apply a second coat of mastic atop fiberglass mesh tape to completely cover and extend beyond tape.

3.1601.3a - Support (applies to all duct types)
3.1601.4 Support for Horizontal, Suspended Ducts

Duct Support

Desired Outcome:
Ducts and plenums properly supported

Specification(s):
Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 ½" wide material

Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction

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

Objective(s):
Eliminate falling and sagging

Before

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

After

Properly supported ducts minimize heat loss and and maximize air flow

Support for Horizontal, Suspended Ducts

Flexible and duct board ducts and plenums will be supported where feasible in accordance with flex duct manufacturer specifications and local codes

Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping)

Metal ducts will be supported by metal strapping, rods, or other materials, where feasible

Duct Support (applies to all duct types)

BAD: Make sure supports DO NOT compress insulation or duct

Flex ducts should have supports no less than every 4 feet

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

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

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

Metal wire should be at least 12 gauge and galvanized

Sealing Flex Duct to Plenum

Peel back outer layer of insulation, seal plenum with mastic using appropriate sealing technique based on hole size

Install nylon tie band around inner liner using a tie band tensioning tool.

Seal inner liner with mastic. Choose the appropriate sealing technique based on hole size.

Replace outer liner and insulation.

Install nylon tie band around outer liner using a tie band tensioning tool.

Duct Boot Sealing

Desired Outcome:
Ducts and plenums sealed to prevent leakage

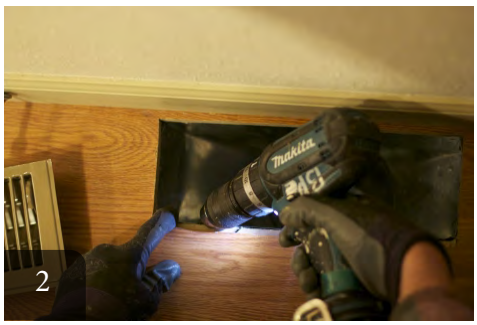
Specification(s):
All gaps between boot and interior surface that defines conditioned space will be air sealed

Gypsum edge will be wetted before applying water-based sealant

Sealants will be continuous and be in accordance with 2012 IRC R302.9

Objective(s): Prevent air leakage and a fire hazard

Remove grill to expose duct boot and gaps

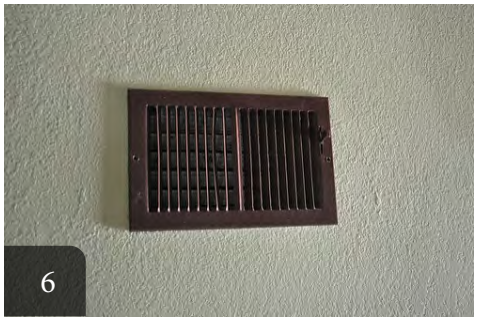


Use fasteners to close gaps before applying mastic

Wet the edges of the drywall to ensure a good bond

Cut mesh or UL 181 Aluminum Butyl tape to fit around duct boot and cover gaps

Apply mastic over tape to create heat resistant, durable bond, allow to dry



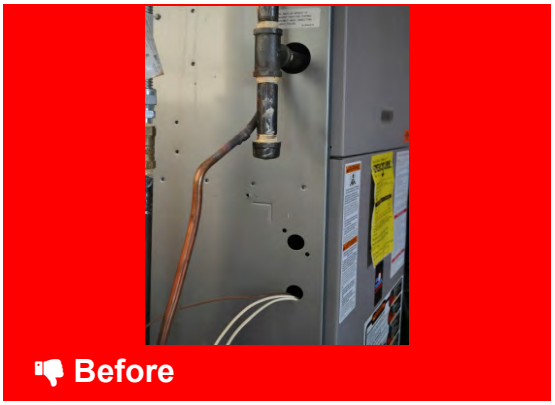
Once mastic is set, grill can be replaced and mastic should not show

Sealing 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

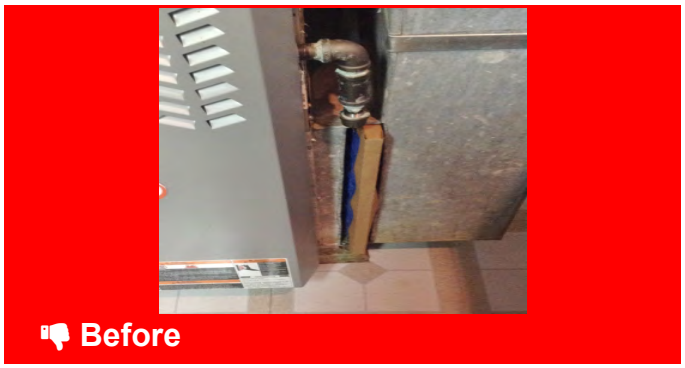
Sealing Filter Slot

3.1602.4d - Filter slot

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
A pre-manufactured or site manufactured durable filter slot cover will be installed

Objective(s):
Reduce air leakage while maintaining accessibility



Uncovered filter slots are a point of leakage

Filter slots should be covered

Duct Insulation

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.

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 can be buried in loose fill insulation in attic spaces.

Duct Sealing Before Insulating

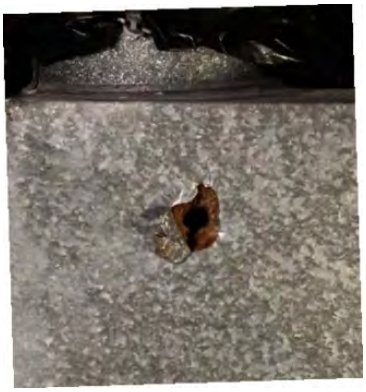
Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

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

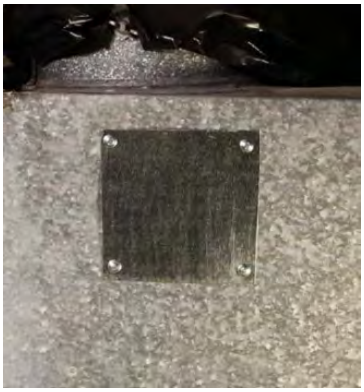
Objective(s):
Minimize duct leakage

Prepare work area by assessing any safety concerns

Apply UL 181 mastic to seal joint



Large hole greater than 3/4" in ductwork.



Install rigid duct support material that .. at least 1 inch larger than the hole.

Apply mastic to the seams of the patch.

Reference SWS 3.1602.1 Air Sealing Duct System

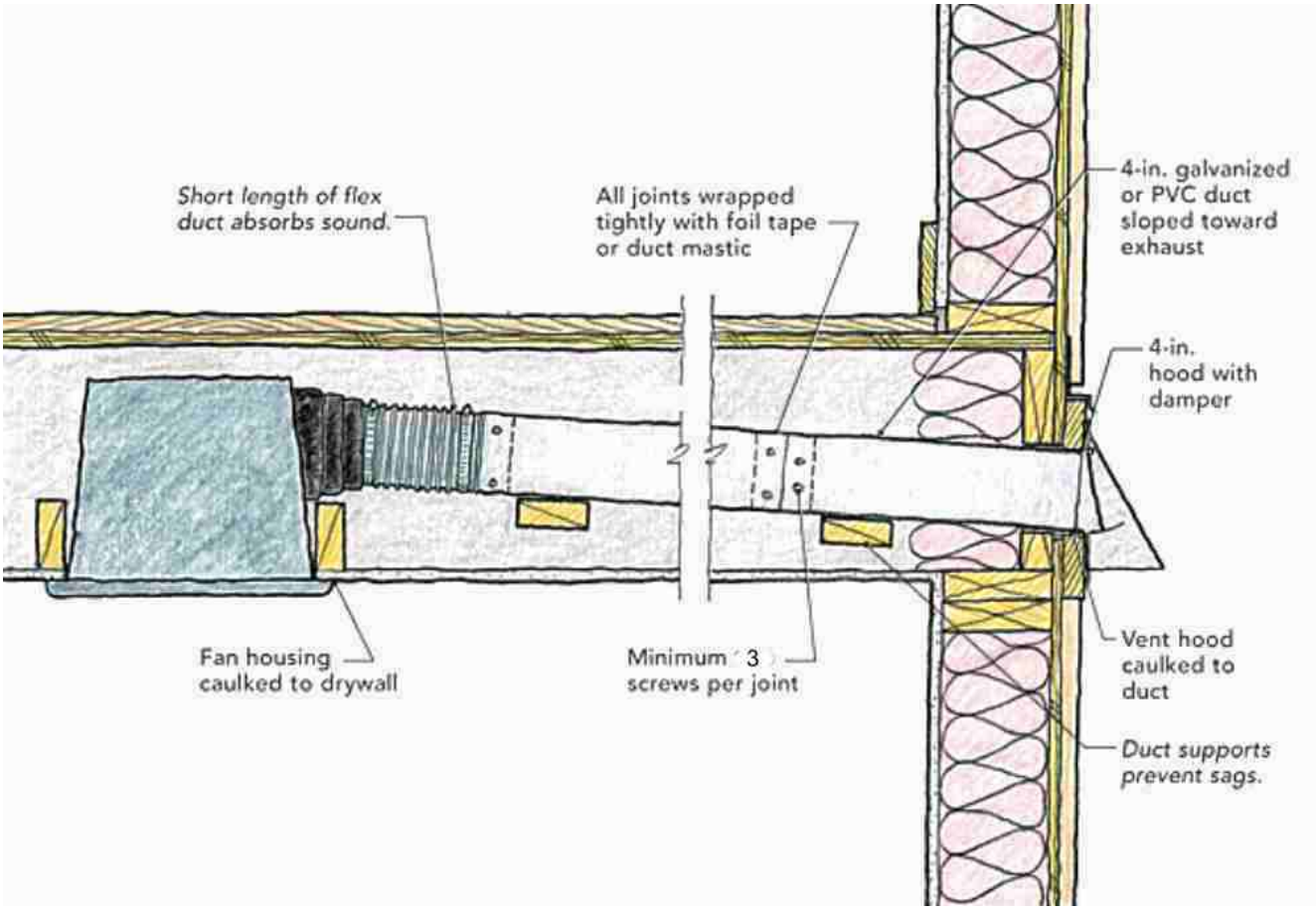
Exhaust Fan Duct Design

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification:
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



6.6002.1a - Duct design and configuration

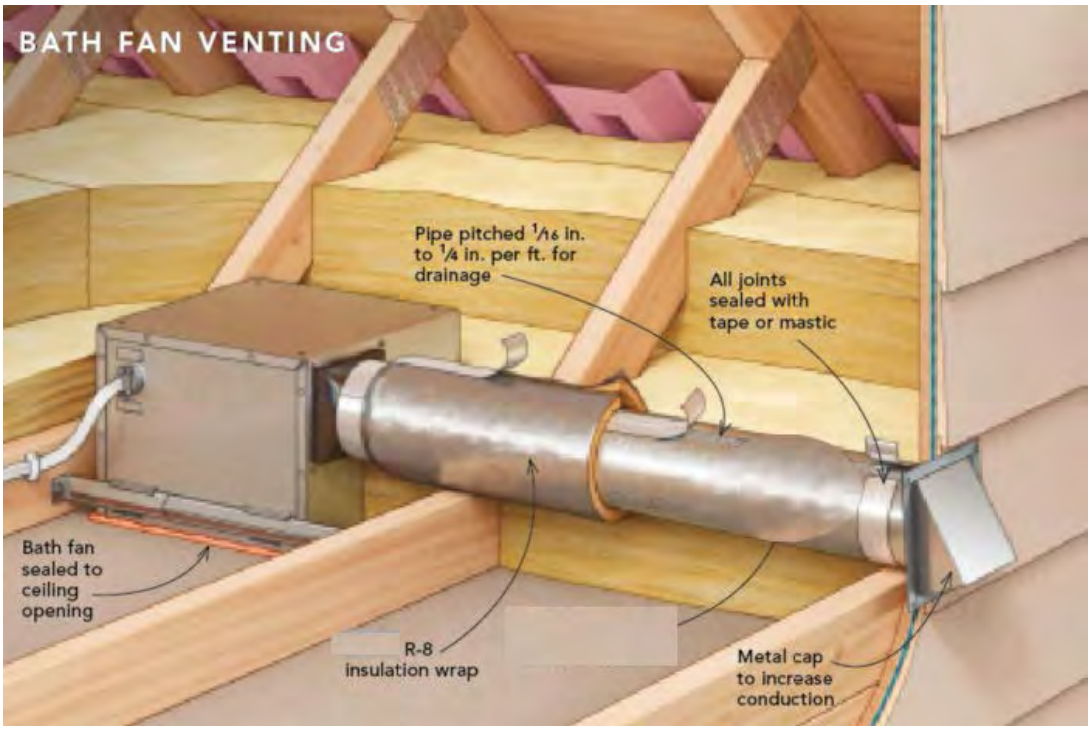
6.6002.1b - Duct insulation

Exhaust Fan Design and 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
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):
Prevent condensation from forming or collecting inside of the ductwork
Effectively move the required volume of air



Exhaust fan venting insulation does not require a vapor barrier.
Alaska recommends fans be ducted through gable end when practical

Note:flex-duct shall not exceed 6' feet in length.

6.6002.2d weatherproof

Exhaust Termination

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

6.6002.2g - Kitchen exhaust

6.6003.3e - Backdraft damper

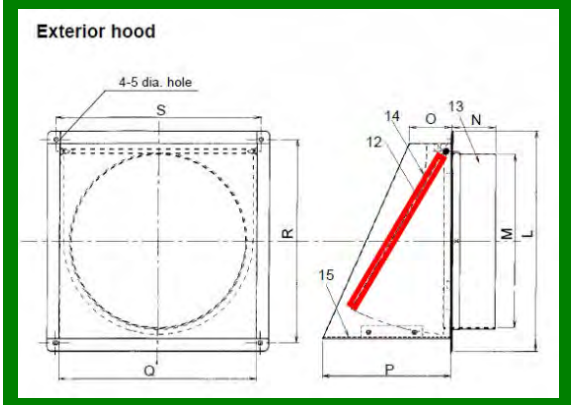
6.6003.3a - Hole in building shell

Kitchen Exhaust Termination

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
A backdraft damper will be installed between the outlet side of the fan and the exterior
A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly

Objective(s):
Prevent a fire hazard
Prevent reverse air flow when the fan is off



Best Practice
Damper should be installed to maintain exterior air barrier

3 1/4 x 9 through wall termination

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

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: Effectively move air from clothes dryer to outside with no damage to building components

Dryer vent transition piece: panduit straps, metal collar at wall, foam air sealing

Clothes Dryer Ducting (cont)

Supported and Insulated dryer vent through unconditioned space. Venting slopes downward toward termination.

Best Practice

Termination fittings for dryers should have backdraft dampers

In addition Clothes dryer venting installed shall comply with the following:

a. Vent shall terminate in a non-screened vent cap with a damper. The exhaust vent shall terminate not less than 3 feet in any direction from openings into the building.

b. Have a smooth interior finish and shall be constructed of metal a minimum 0.016 inch (0.4 mm) thick. The exhaust vent size shall be 4 inches (102 mm) nominal in diameter.

c. The insert end of the venting shall extend into the adjoining venting or fitting in the direction of airflow.

d. Not exceed 35 feet in length from dryer location to outlet terminal.
The maximum length shall be reduced two and one-half (2.5) feet for every 45 degree elbow and five (5) feet for each 90 degree elbow.

e. Both vertical and horizontal runs shall be supported using nylon, plastic, or metal strapping with a minimum width of ½ inch.

f.Support strapping or hangers shall be installed within one (1) foot of a joint or connection and a maximum of every four (4) feet thereafter.

g. Horizontal runs shall be sloped downward toward the vent discharge.

h. Dryer vents located in unconditioned space shall be insulated to a minimum R- 8.

Dryer transition piece:

The dryer transition piece is the venting component between the dryer and the point at which it goes through the wall, floor, or ceiling and leaves the vicinity of the dryer. This venting shall be listed and labeled in accordance with UL 2158A. The transition piece shall not exceed eight feet in length and be long enough to allow for moving the dryer away from the wall, but not allow excess bending and kinking that can trap lint and water in the venting. The flexible transition piece shall not pass through a wall, floor, or ceiling. The transition piece shall connect to a smooth metal vent or a metal collar where it penetrates the ceiling, wall, or floor.

Kitchen Range Hood Venting

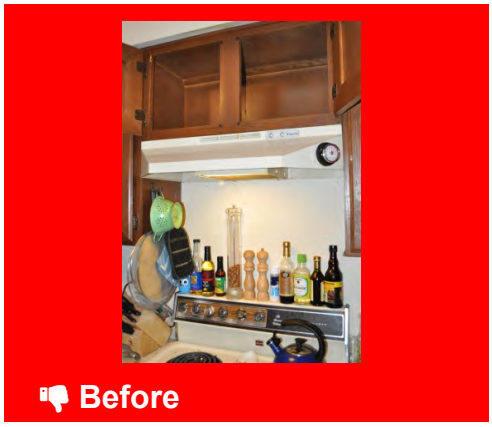
Desired Outcome: Kitchen range fan installed to specification

Specification(s):
Kitchen range fans will be vented to the outdoors

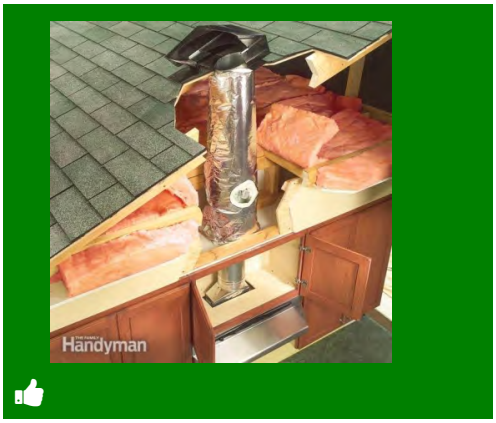
Recirculating fans will not be used as a ventilating device

Objective(s):
Remove cooking contaminants from the house

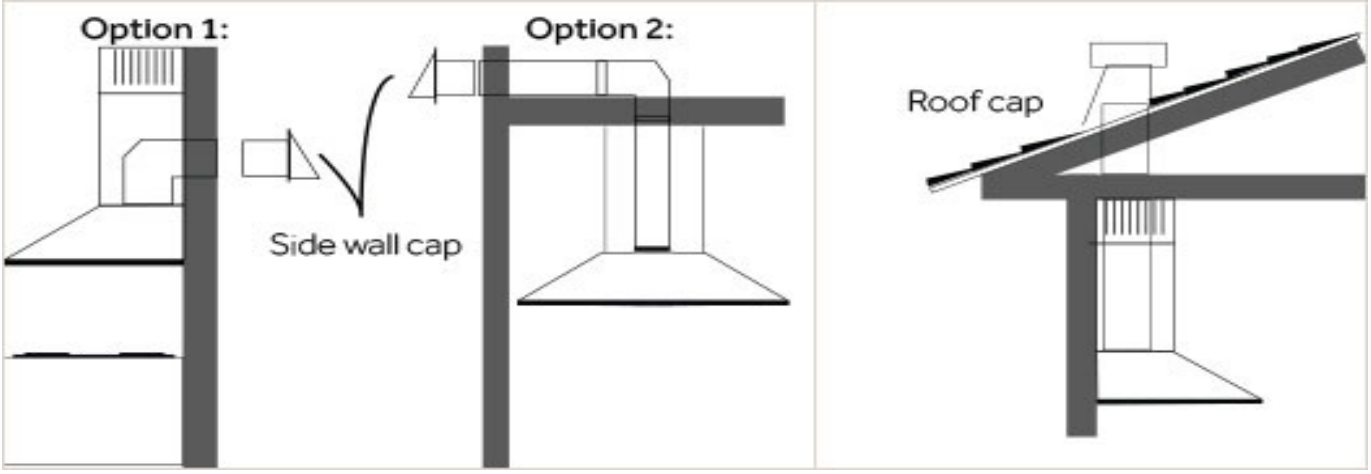
Preserve integrity of building envelope



Recirculating fans over ranges do not actually remove contaminants.



Kitchen exhaust vented to the outside and insulated when passing through unconditioned space.



Kitchen range checklist:

- ☐ Vent range fans outdoors.
- ☐ A short a run as practical of smooth wall metal .
- ☐ Ducting securely fastened and sealed with welds, gaskets, mastics or metal tapes
- ☐ Exhaust venting passing through unconditioned space will be insulated to a minimum R-8 and secured with twine or wire.

DHW 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

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

DWH Insulation

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

Specification(s):
If additional tank insulation is installed, it will be rated a minimum of R-11 and will be installed to manufacturer specifications

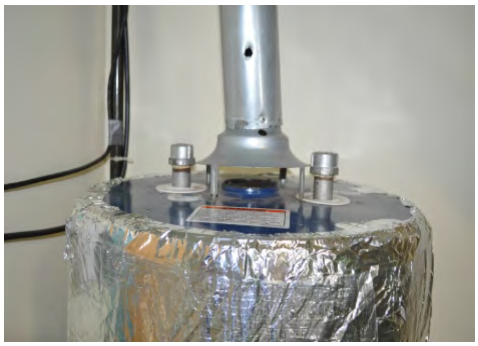
Added insulation will not obstruct the unit's draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates

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

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

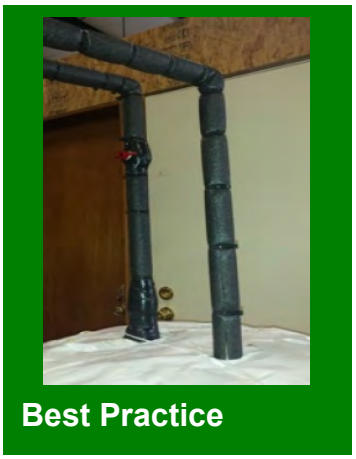
Ensure insulation has 6" clearance from flue gas venting

Data plate should still be accessible after wrapping

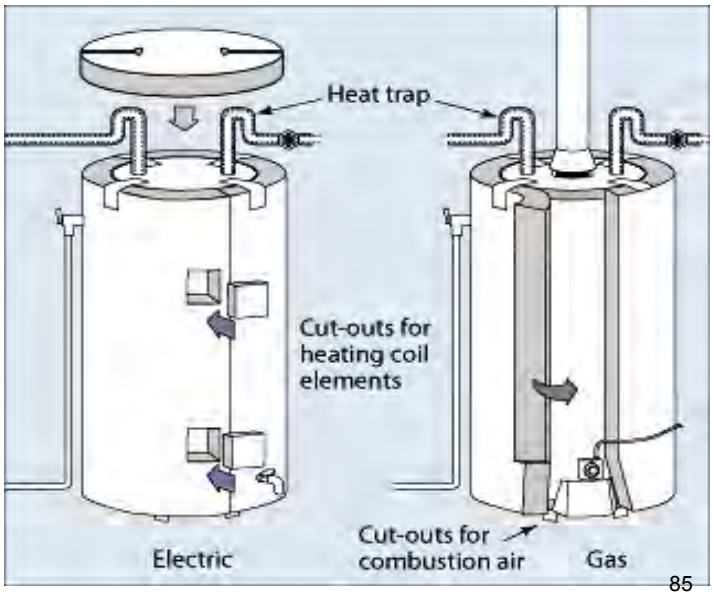


Blanket does not obstruct draft diverter or plumbing pipes and elements

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



1st 6 feet of hot and cold water pipes attached to electric water heater insulated with R-3 foam pipe wrap



DWH 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 P2803 of the 2012 IRC and according to manufacturer specifications

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

Objective(s):
Discharge excessive energy (pressure or temperature) from storage tank to safe location

GOOD: T&P discharge should be piped within 6" of the floor or to outdoors

Check local jurisdictional codes. reference 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.

Air Seal Waterheater Closet

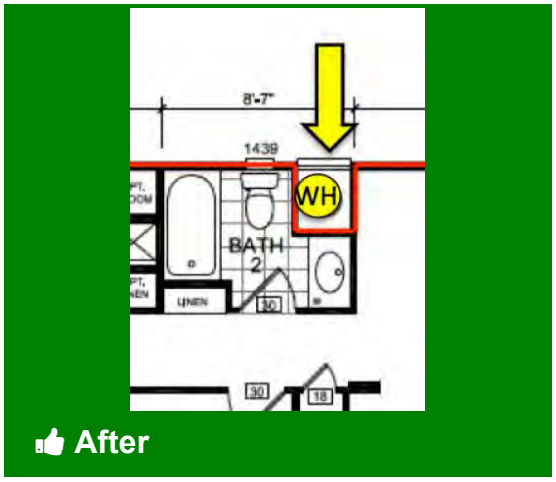
Desired Outcome:
Isolate combustion water heater closet from conditioned space

Specification(s):
When the water heater closet contains a heater that is not sealed combustion or power vented, the closet will be isolated/separated from the rest of the home through air sealing with fire-rated materials, if feasible

Avoiding frozen pipes must be considered without creating an additional utility burden (e.g., heat tape)

Objective(s):
Prevent combustion gases from entering living area and minimize extension of interior pressures caused by exhaust fan, dryers, and interior door closure into the water heater closet

Water heaters that are open combustion must be isolated from the conditioned space by air sealing the closet.



Air sealing the water heater closet has established the pressure boundary around the water heater, isolating it.

Tools:

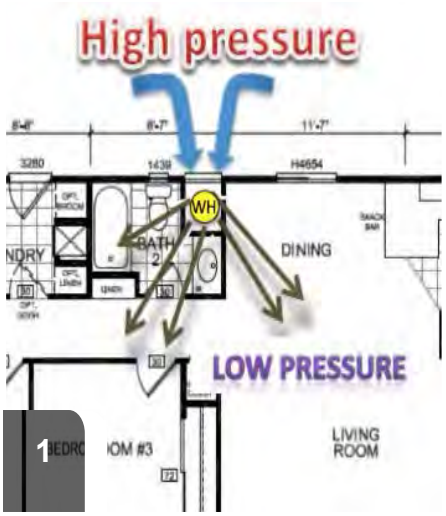
1. Caulk gun
2. Single-component foam gun
3. Manometer, hoses, pressure probes

Materials:

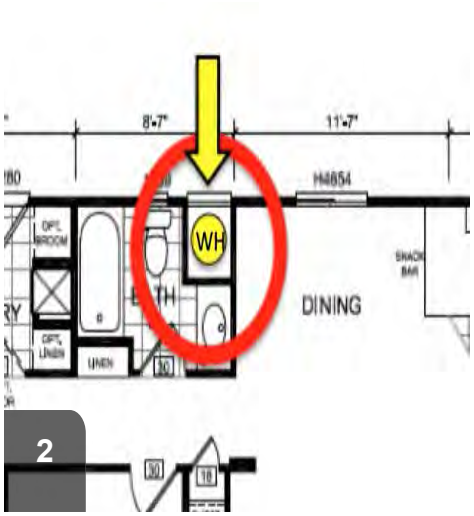
1. Caulk/ foam sealant
2. Water line insulation

If combustion make-up air is needed for proper combustion apliance operation upon completion of isloting the water heater, refer to Specification 2.0201.2a - Outside combustion make-up air.

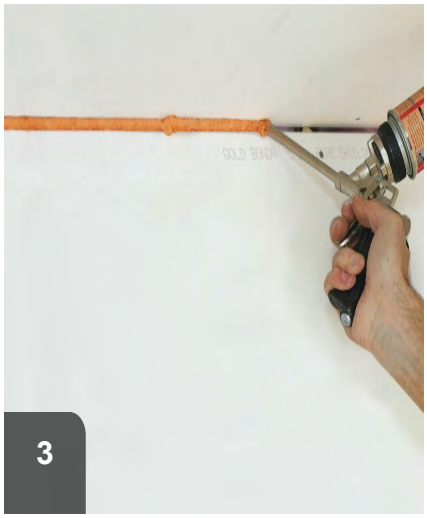
Air Seal Waterheater Closet (cont)



Before the water heater closet is isolated, combustion gases can be pulled into the living space.



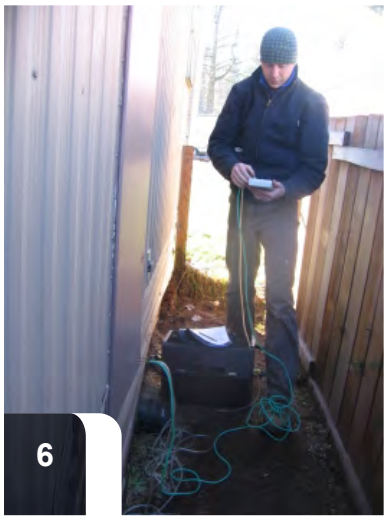
Locate the combustion water heater, determine the materials needed to air seal the closet.



Air seal the water heater closet to eliminate all air pathways from the closet into the living space.

After air sealing the closet, the water heater is isolated from the rest of the house.

Use pressure diagnostics and Alaska combustion safety testing to confirm the appliance operates safely.



Due to limited space in water heater closets, perform pressure diagnostics and combustion safety tests from outside.

4.1003.8a - Attic, ceiling, and roof verification

4.1003.10a - Attic, ceiling, and roof verification

Attic Insulation Installation Precheck

Desired Outcome:

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

Specification Checklist:

- [ ] All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads
- [ ] A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place.
- [ ] All ventilation systems will maintain a continuous connection and terminate to the outdoors
- [ ] All broken mushroom vents will be replaced or removed and sealed
- [ ] All plumbing stacks will be terminated to the outdoors
- [ ] Non-IC rated light fixtures will be replaced with air-tight IC-rated fixtures or air-tight damming will be installed around existing Non IC-rated fixture when access allows
- [ ] If replacing, recessed lights will be labeled as having an air leakage rate no more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential.
- [ ] All obvious ceiling penetrations will be sealed.
- [ ] The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials
- [ ] All roof, attic, and ceiling assemblies will be structurally sound; loose ceiling panels will be secured
- [ ] Temporary ceiling bracing will be recommended during the insulation installation process
- [ ] Dishing and pooling issues that allow standing water will be addressed
- [ ] All known roof water leaks will be repaired before insulation installation

Objective(s):

Ensure occupant and worker safety

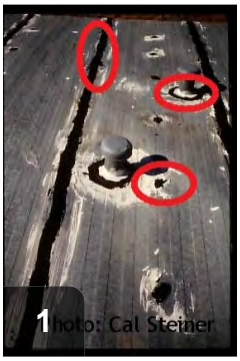
Verify attic space is ready to insulate

Ensure structural integrity of the roof and ceiling assembly

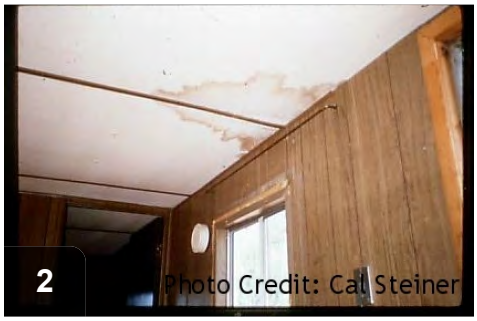
Prevent intrusion of bulk moisture

Prevent damage during the insulation installation process

Mobile Home Roof Cavity Insulation Precheck (cont)



Inspect roof for evidence of water pooling, leaks, or damage. Verify proper vent terminations

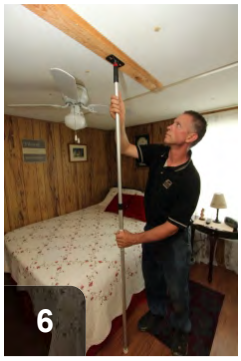


Inspect ceiling for weakness, leaks, clearance to combustibles, loose panels, and penetrations

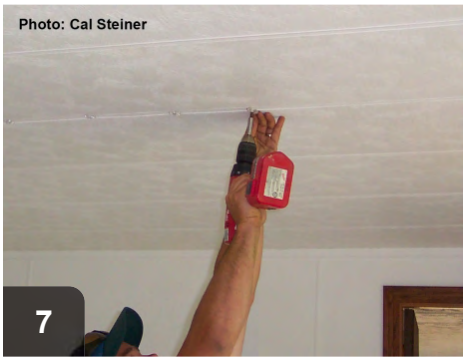
Verify presence of rain caps on all vents

Inspect all patches and repairs, and correct deficiencies if necessary

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



Use temporary supports to avoid ceiling collapse during insulation install



Add fasteners wherever needed to firmly attach ceiling to the trusses

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

After opening the roof edge, verify proper clearance to combustibles and inspect vent connections

Mobile Home Roof Attic Cavity Access

Ensure a safe work environment by setting up scaffolding. Work in manageable sections

Remove fasteners from the J-channel

Cut through putty tape and pry J-channel away from roof seam

Work in manageable sections to minimize roof damage. One section of J-channel is a long enough area

Remove staples as necessary to lift roof and inspect underneath

Place blocks to lift roof and enable inspection of roof cavity for obstructions and other concerns

Work in small sections to minimize flexing of roof and risk of wind damage

Once visual inspection has shown roof cavity to be viable, begin blowing insulation

Mobile Home Attic Fiberglass Blown Insulation Installation

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

Specification Checklist:

- [ ] Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot
- [ ] Using fill tube, 100% of each cavity will be filled to a consistent density
- [ ] Fill tube will be inserted within 6" of the end of each attic cavity
- [ ] Insulation will be installed into the void of the attic cavity:
  - If existing insulation is roof-mounted, insulation will be blown below
  - If existing insulation is ceiling-mounted, insulation will be blown above
  - If existing insulation is mounted at both locations, insulation will be blown in between
- [ ] Avoid overfilling of roof edges and above attic trusses
- [ ] Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84

Objective(s):

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

Avoid clogging of the cavity and the fill tube

Prevent damage to the ceiling

Allow roof to be returned to original position

Fire safety will be maintained

In Progress

In Progress

Mobile Home Roof Reattachment

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

Specification Checklist:

- [ ] If existing J channel is damaged, it will be replaced.
- [ ] Existing sealant will be removed from the roof edge and J channel.
- [ ] At a minimum, new sealant will be reinstalled at the original location.
- [ ] Roof and J channel will be fastened to the original location with new screws.
- [ ] All seams, edges, and penetrations will be sealed as necessary.

Objective(s):
Prepare roof edge and J channel for reattachment

Reattach roof edge and J channel without leaks

If J-channel is salvageable, clean thoroughly before applying putty tape

Apply putty tape to new or reused J-channel to seal roof seam

Using new fasters, attach J-channel along roof seam and seal as necessary

Grounding Rigid Fill Tube

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

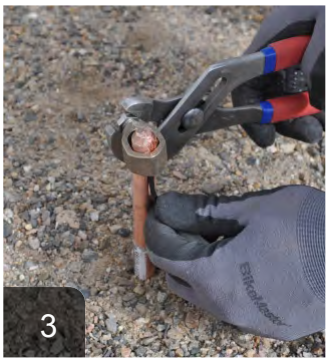
Specification(s):
Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded

For an additional level of protection, the metal coupler on the hose will be connected to the grounding wire
Grounding wire will be connected to the grounding rod
Grounding rod will be driven into the ground a minimum of 8' when possible

Objective(s):
Prevent injury to the installer

Select rigid fill tubes that are low conductivity -- Schedule 40 PVC fill tube

Attach grounding wire to fill tubes to minimize shock risk



Attach grounding wire to rod with coupler

Blow insulation

Tools:

1. Wrench

Materials:

1. Couplers
2. Schedule 40 PVC fill tube
3. Grounding wire
4. Grounding rod

Mobile Roof Attic Cavity Access

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

Specification Checklist:

- [ ] Access to the attic cavity will be created using one of these methods:
  - Drilling
  - Cutting
  - Continuous slicing along the center line (at the highest point of the roof)
- [ ] Access location will be placed to allow for consistent and uniform coverage of installed insulation throughout the attic assembly
- [ ] There will be, at a minimum, one opening between each roof truss
- [ ] Openings will be large enough to accommodate the chosen fill tube
- [ ] If subsheathing is present, access will be gained through subsheathing
- [ ] Attic will be visually inspected for the location of existing insulation, wiring, flues, obstructions, hazards, and construction type

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

Maintain the integrity of the roof truss

Protect roof from wind damage during installation

Determine technique for installing insulation

Manufactured home attic cavity accessed by cutting through roof.

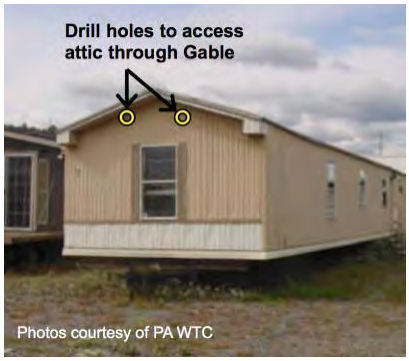
Mobile Roof Attic Cavity Access

Determine and mark truss locations on roof, and choose method of access. Avoid drilling or sawing into trusses

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

Regardless of access method, visually inspect attic for existing insulation, wiring, flues, obstructions, and hazards

Another option: cut the roof open along the highest point from end to end. Make crosswise cuts at each end if needed



Locate the ceiling level and truss framing prior to drilling through gable siding.

Gable end attic access: when the manufactured home has partial vaulted ceilings or a compromised roof, access may be gained through the gable ends for the flat ceilings. Gable end access requires patching the siding with sheet metal, siliconized caulk, and optional vent cover to conceal patch.

Always use hand protection when working with metal edges and/or sharp tools.

MH Roof Patching and Sealing Openings

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

Specification(s):
If the roof is sliced:

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

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

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

If a metal patch is used:

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

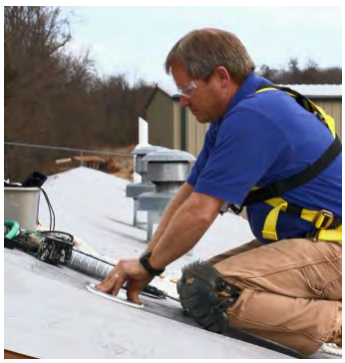
A durable and flexible 45 mil adhesive patch will be applied in accordance to manufacturer specifications over the initial patch and will have at a minimum:

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

Objective(s):
Effectively patch and seal all openings

MH Roof Patching and Sealing Openings (cont)

Insert 6" plug and seal around the perimeter of the opening.

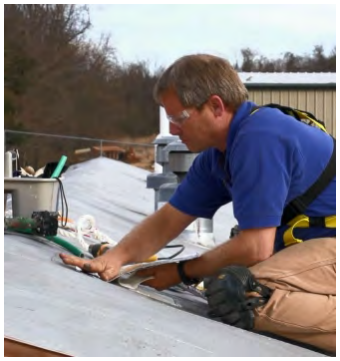


Firmly push the plug into place, until it is flush with the roof surface.

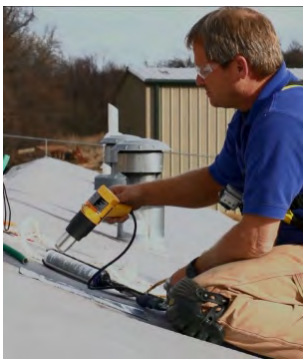
Use a 10"x10" sheet metal patch to mark the center of the hole.

Apply sealant to the underside of the sheet metal patch.

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



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



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

Forcefully roll the patch into place, starting from the center and working toward the edge.

Tools:

1. Roller
2. Self adhering patch
3. sheet metal
4. 6" duct cap(to match 6" hole)
5. heat gun
6. drill

MH Blown Insulation Interior Prep

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

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

Objective(s):
Protect occupant health and safety

Protect occupant belongings

Bad Practice

Improperly prepared workspace with cellulose all over client belongings and bedroom

Best Practice

Worker has removed or covered occupant belongings. Be sure to ask permission before removing any client belongings

Tools:

1. Utility knife

Materials:

1. Plastic sheeting
2. Removable, low-residue tape

MH FG Blown Insulation, Installation from Interior

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

Specification Checklist:

- [ ] Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot
- [ ] Using fill tube, 100% of each cavity will be filled to a consistent density
- [ ] Fill tube will be inserted within 6" of the end of each attic cavity
- [ ] Insulation will be installed into the void of the attic cavity:
  - If existing insulation is roof-mounted, insulation will be blown below
  - If existing insulation is ceiling-mounted, insulation will be blown above
  - If existing insulation is mounted at both locations, insulation will be blown in between
- [ ] Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84

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

Avoid clogging of the cavity and the fill tube

Prevent damage to the ceiling

Fire safety will be maintained

Attic insulation should be consistently installed in each cavity to the edge.

Holes should be effectively sealed, as well as aesthetically pleasing.

MH Marriage Line Air Sealing

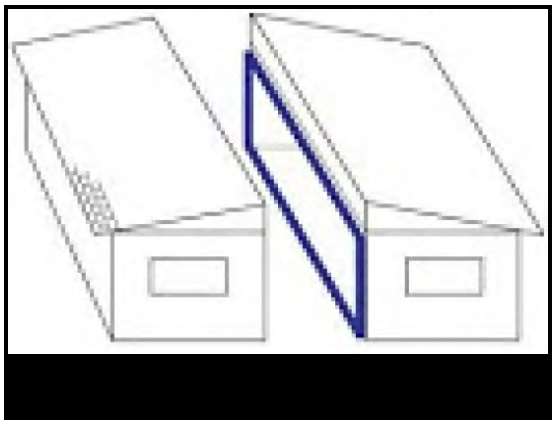
Desired Outcome:
Penetrations sealed to minimize air leakage and moisture movement between unconditioned and conditioned space;

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

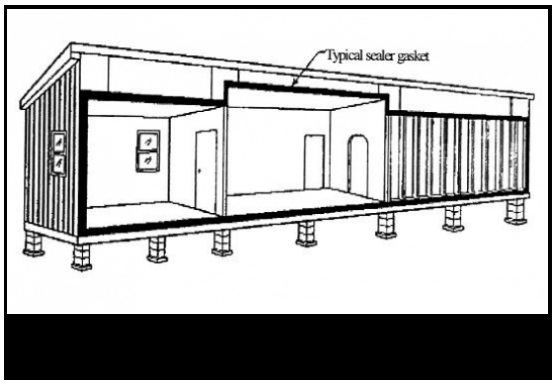
Backing or infill will be provided at the marriage line as needed

All remaining gaps will be sealed with an approved material

Objective(s): Minimize air leakage, Maintain durability, Ensure sealant is effective and durable



The marriage line is a common location of air leakage in a mobile home building shell.



Identify leaks in marriage line using a blower door

Marraige Line Checklist:

- [ ] The marriage line is air sealed from inside the home and from underneath.
- [ ] Use a blower door and chemical smoke to pinpoint air leakage locations.
- [ ] You may need to remove interior trim to determine what type of sealing is needed at the marriage line.
- [ ] Some double wide manufactured homes are constructed with a compressed open-cell polyurethane foam sealing strip with excellent air sealing properties and will need little or no additional work.
- [ ] Other construction methods may feature fiberglass or other ineffective air sealing measures and require extensive caulking and foaming to reduce air infiltration.

Floor Repair

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

Specification Checklist:

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

Objective(s):
Ensure floor is structurally sound

Minimize air leakage

Remove floor coverings from damaged area

Completed floor repair

MH Repair Duct Trunk Access

Desired Outcome:

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

Specification(s):

Point of access options include:

Option 1: Through the trunk duct

- Repair and seal access hole in the trunk duct
- Install insulation
- Repair belly/bottom liner

Option 2: Remove crossover duct

- Reattach crossover duct
- Seal and insulate crossover duct
- Repair belly/bottom liner

Option 3: Remove air handler

- Install new gasket, if necessary
- Mechanically attach furnace to the structure
- Reconnect utilities
- Replace and seal panels

Option 4: Through the furnace panel

- Replace and seal panels

Best Practice

Various methods can be employed, but the key is to seal the furnace to trunk duct connection

Objective(s):

Repair work access

Prevent condensation

Minimize heat loss and heat gain from plenum

Choose the least invasive and labor-intensive method that will allow full access for sealing.
Patch trunk using sheet metal patch, fastened mechanically and sealed with mastic.
Always wear hand protection when working with sharp objects.

MH Repair Duct Trunk Access (cont)

For electric furnaces, follow lockout/ tag-out procedures to break circuits that supply furnace with electricity.

Cut belly to expose duct trunk. Use a utility knife to cut access under furnace plenum

Create an opening large enough to completely seal the plenum to the trunk line. Patch opening with sheet metal and seal.

Using mastic and mesh tape, fully seal the furnace to the trunk line. Repair and seal the access holes in duct and belly

Removing the crossover duct may provide access to the plenum. Replace and seal the crossover duct after sealing plenum

Remove the furnace panel. If the plenum to trunk connection is accessible here, complete sealing from this point

Plenum to duct trunk connection coated with mastic sealant

As with all duct sealing and repair, confirm success with pressure diagnostics.

MH Crossover Duct Repair

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

- [ ] Flexible crossover duct connections will be added, rebuilt, or repaired using compatible materials
- [ ] Mechanically fastened at both inner and outer liner
- [ ] Sealed using UL -listed sealant that is durable, structurally sound, insulated
- [ ] Equipped with a vapor retarder
- [ ] Whenever possible, rigid elbow or equivalent will be installed in crawl space crossover ducts
- [ ] Floor insulation will be in contact with the outer liner of the crossover duct
- [ ] Crossover duct vapor retarder will be sealed to the bottom liner (e.g., belly fabric)
- [ ] New flex duct installation will be insulated to a minimum of R-8
- [ ] When feasible, 26-gauge hard duct should be installed
- [ ] If a new crossover is required, it must be insulated to at least R-8 and be air sealed

Before

Poorly performing crossover duct: poor materials, excess length and contacting ground.

Best Practice

Crossover duct of rigid material, sealed, insulated and supported to specification.

Notes: Crossover duct support shall comply with *3.1601.3a - Support*

MH Rigid Crossover Duct Install

Attach elbow duct and orient in correct direction to minimize duct run

Fasten elbow in place with at least three evenly-spaced fasteners

Apply mastic at all metal-to-metal connections

Apply mastic to all elbow joints and flange

Insulate and support crossover duct

When clearance requires crossover to contact ground, crossover shall rest on vapor barrier and closed cell rigid foam.

All duct sealing and repair will be confirmed with pressure diagnostics.

Tools:

1. Drill
2. Metal snips
3. Metal crimper

Materials:

1. Rigid ducting: elbows, straight sections
2. Sheet metal screws
3. Mastic or other appropriate sealant
4. Vinyl-faced fiberglass insulation, R-8 or greater.
5. Nylon twine or wire
6. Rigid foam
7. Duct support materials

MH Preparation for Belly Insulation Blow

Desired Outcome:
Belly floor cavity ready for insulation

Specification(s):
Where bottom board/rodent barrier is missing or damaged and accessible, the following will be ensured:

- Duct sealing completed
- Water line will be located on the warm side of the insulation; if not, the water lines will be insulated appropriately
- No water or gas leaks are present
- Gas, water, and electrical lines secured at least every 4' to a floor joist or framing member
- Bottom board/rodent barrier is sound/strong enough to support insulation

When bottom board is intact, the following will be ensured:

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

Problems will be corrected before floor cavity insulation work begins

Objective(s):
Ensure problems are corrected before floor cavity insulation work begins

Keep pipes from freezing

Damaged rodent barrier ("belly") must be patched prior to insulating, or to reduce air flow if not insulating.

Belly with patching complete.

MH Preparation for Belly Insulation Blow (cont)

Belly damage: rodent barrier and insulation are damaged, revealing a main supply duct known as a trunk.

Mobile home duct systems (plenum, trunk terminations) should be sealed from below prior to patching the belly.

Workers install new material where rodent barrier is missing.

Maintain all combustion air intake openings when patching belly material.

Pin up sagging belly material to prevent installing excessive amounts of insulation material.

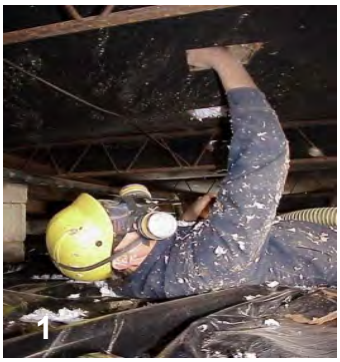
MH Insulate Belly with Loose Fill

Desired Outcome:
Consistent thermal boundary between conditioned and unconditioned space that reduces heat flow

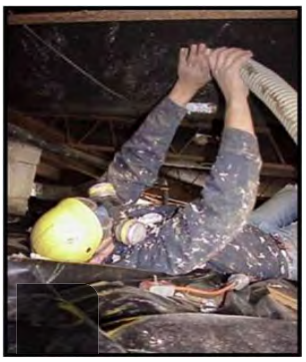
Specification(s): Each cavity will be insulated to specified R-value and density

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

Objective(s): Eliminate voids and settling



Holes are cut through rodent barrier (belly material) to insert insulation blow hose.

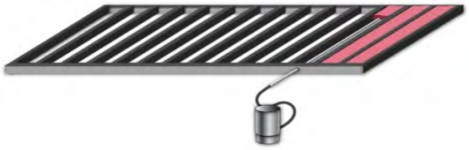


Loose fill insulation is blown into mobile home belly cavity.

Blow holes in belly material patched.

Belly cavity blown by drilling through rim joists.

Cross section of belly cavity viewed from end of mobile home with lengthwise joists. Note duct location.



Cut away view of belly cavity with joists running crosswise. Insulation blown through rim joist.

Cross section of belly cavity viewed from end of mobile home with crosswise joists. Note duct location.

Cut away of belly cavity with joists running lengthwise. Insulation blown through rim joist.

MH Access Wall Cavities for Insulating

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

Specification(s):
If skirting overlaps siding, skirting will be detached to allow access to the wall cavity

Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6" without damaging the siding

Temporary fasteners will be installed near the bottom of the siding panels at the seams to prevent separation

If a subsheathing is present under the siding, access through the subsheathing will be required

Objective(s): Gain access to the wall cavity without damaging or separating the siding

Remove fasteners from along bottom and side seams to access wall cavity

Remove enough fasteners to create at least a 6in gap without damaging siding

If skirting overlaps siding, remove skirting

Temporarily fasten siding panels at joint to hold seam together

Seam should remain together with temporary fastener

MH Exterior Wall Cavity Inspection for Adding Insulation

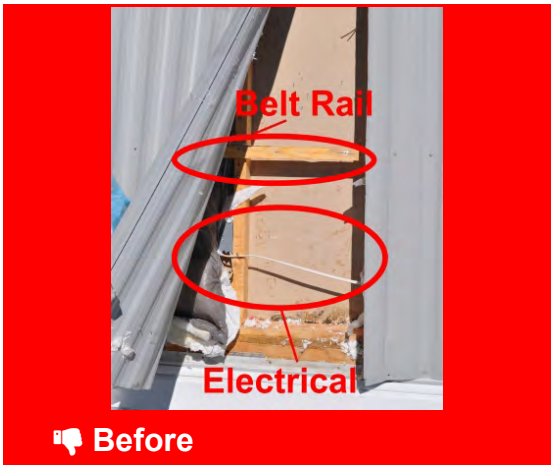
Desired Outcome:
Consistent thermal boundary and air barrier between the conditioned space and unconditioned space

Checklist:

- ☐ Wall cavities will be inspected for moisture damage, pest locations, and integrity of the wiring, and holes to the interior.
- ☐ Siding will be repaired as necessary
- ☐ Location of belt rails, obstructions, and existing insulation will be identified
- ☐ All interior surfaces of exterior walls will be inspected for loose paneling joints, occupant wall hangings, location of switches and outlets, and other wall obstructions
- ☐ Objects will be removed from the interior surfaces of the walls being insulated.
- ☐ Interior paneling will be repaired as necessary

Objective(s):
Prepare wall cavity for insulation

Prevent water leaks from occurring



Take note of obstacles in the wall cavity, such as belt rails and electrical wiring

Assess that holes in both exterior siding and interior walls have been patched before beginning installation

MH Fiberglass Batt Installation Tool (Stuffer)

Desired Outcome:

Consistent thermal boundary and air barrier between the conditioned space and unconditioned space

Specification(s):

A sheet of polycarbonate, such as Lexan, will be cut to the following specifications to create a stuffer tool:

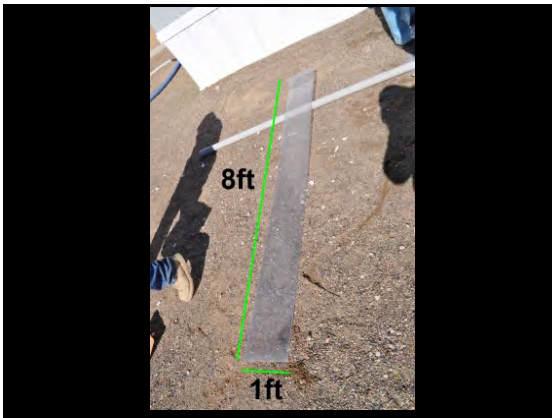
- Approximately 1' x 8' x ¼" with a 5 degree bend 7' ½" from the bottom
- All corners of the Lexan (polycarbonate) will be rounded and all edges will be sanded

  Other clear sheet plastics will not be used due to a tendency to shatter under stress

Objective(s):

Create a tool to install a fiberglass batt into the cavity

Ensure worker safety



Best Practice

Insulation stuffing tool should be made of 1/4" polycarbonate, cut to 1' wide and 8' long

Best Practice

At one end, a bend of 5 degrees (175 degree supplement) should be made 7 1/2" from narrow edge

Tools:

1. Heat-resistant gloves
2. Table saw with fine-toothed blade
3. Sander
4. Heat gun
5. Clamp
6. Protractor
7. Tape measure

Materials:

1. Polycarbonate, like Lexan
2. Sandpaper

Most crews should have this tool in their supply. If one needs to be fabricated, find someone who has worked with polycarbonate before and ensure correct tool usage as well as proper PPE during fabrication.

MH Fiberglass Batt Wall Installation

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

Specification Checklist

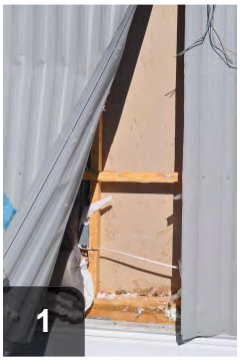
- ☐ Thickness of the batt will fill the void without deforming siding or damaging structure
- ☐ Fiberglass batts will fill the cavity (e.g., batt may be cut approximately 1" longer to ensure proper fill and allow for lap at the top)
- ☐ Flexible membrane will have an appropriate perm rating for the region
- ☐ Flexible membrane will be cut 2" wider than the cavity and approximately 1' longer than the batt
- ☐ Stuffer tool, membrane, and fiberglass batt will be aligned for installation
- ☐ Stuffer tool will be used to install the fiberglass batt and membrane at the same time
- ☐ Excess fiberglass batt and membrane vapor retarder will be trimmed to fit.
- ☐ A poly-encased fiberglass batt may be used in place of the fiberglass batt and membrane assembly
- ☐ The membrane will be installed in contact with the side of the wall that is compatible with the local climate zone.

Objective(s):
Maintain integrity of the batt

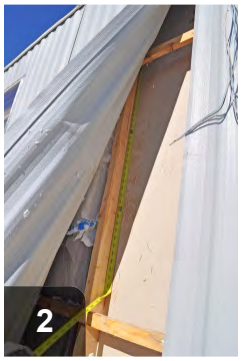
Aid in the installation process

Fiberglass batt should fill entire cavity without creating bulging in exterior paneling

MH Fiberglass Batt Wall Installation (cont)



Uninsulated wall cavity can be accessed from exterior of mobile home through paneling

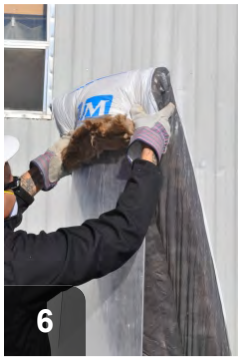


Measure length of cavity

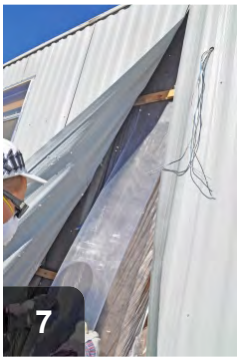
Measure depth of cavity

Select appropriate batt thickness and R-value. Wrapped batts provide a built in vapor barrier

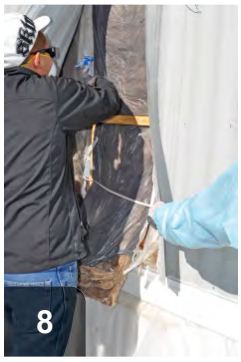
Measure batt to length of cavity with extra for overlap from stuffing tool



Lap cut batt over bent end of stuffing tool



Beginning with lapped end, tuck batt under top belt rail and stuff batt up to top of cavity. Remove stuffing tool



Tuck bottom of batt behind bottom belt rail. If longer than cavity, cut to within 1" longer, roll and tuck into cavity

MH Reattachment of Siding

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

Specification(s):
If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting

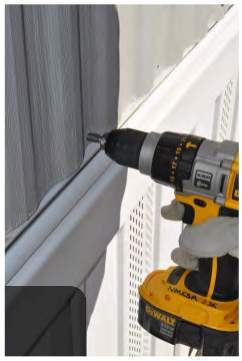
Siding will be reattached with new fasteners

Siding will be reattached without bulges or wrinkles

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

Return siding to existing conditions without damage

After wall cavities have been stuffed, paneling needs to be put back into place and refastened



Using new fasteners, reattach paneling

Verify that siding and skirting have not been damaged and show no signs of bulging

Combustion Safety Test Form

3/1/2019
BPI1200

				PRE		POST
	Client		Date			
	Job #		Technician Name			
1	**START test equipment outside the building- turn on Combustion Analyzer, CGD (gas sniffer), & 4 Gas Monitor ✓ CO and LEL for safe levels**					
2	**Natural Gas and LP Piping Leakage Testing**		PRE	POST		
2a	Leaks Detected?					
2b	Leak(s) confirmed using leak detection fluid					
3	**Identification of Appliances**					
3a	**Appliance name:**	1:			2:	
4	**Visual Inspection of CAZ for Unsafe Conditions**		PRE	POST	PRE	POST
4a	CAZ free of flammable products					
4b	CAZ free of combustibles (rags, paper in the immediate area of appliance)					
4c	Water heater in garage is 18" above the floor or FVIR listed					
4d	Combustion appliance vent type?	Meet clearance?				
	Comments:					
5	**Setting up CAZ in worst case**		PRE	POST	PRE	POST
5a	***Record*** baseline pressure in CAZ WRT outside					
5b	***Turn on*** EXHAUST equipment ONLY & ***Record*** pressure WRT outside					
5c	***Turn on*** Forced air blower & ***Record*** pressure WRT outside					
	If CAZ more negative with blower on, ***leave on.*** *If CAZ more positive,* ***turn blower off*** *for the rest of the test*					
5d	***Close*** CAZ door & ***Record*** pressure in the CAZ WRT outside					
5e	***Open*** CAZ door & ***Record*** pressure in the CAZ WRT outside					
	Test house *with the largest negative pressure in the CAZ based upon test results above*					
6	**CO & SPILLAGE Assessment** (Single Vent)		PRE	POST	PRE	POST
6a	***Record*** ambient CO BEFORE test starts ***then start appliance***					
6b	Did the appliance spill at 2 minutes of main burner operation?					
6c	***Record CO AIR FREE*** of undiluted flue gases at 5 minutes					
6d	***Record*** ambient CO AFTER test					
7	**CO & SPILLAGE Assessment** (Common Vent **ONLY**)		PRE	POST	PRE	POST
7a	***Record*** ambient CO BEFORE test starts ***then start appliance(s)***					
7b	Spillage FIRST appliance (***Test*** at 2 minutes after second appliance)					
7c	Spillage SECOND appliance (***Test*** at 2 minute mark)					
7d	***Record CO AIR FREE*** of undiluted flue gases at 5 minutes					
7e	***Record*** ambient CO AFTER test					
8	**CO Assessment-Furnace ONLY** (**WITHOUT** draft hood or barometric damper)		PRE	POST	PRE	POST
8a	***Record CO AIR FREE*** of undiluted flue gases at 5 minutes					
8b	***Record*** ambient CO AFTER test					
9	**Natural Gas and LP Oven Testing**		PRE	POST	PRE	POST
9a	***Conduct visual inspection:*** oven & range burner cleanliness & any stored material					
9b	***Record CO AS MEASURED*** of undiluted flue gases at 5 minutes					
9c	***Record*** ambient CO AFTER oven test					
10	**Woodstove/Fireplace (FPWSZ)**		PRE	POST	PRE	POST
10a	***Measure & Record*** FPWSZ pressure WRT outside					
10b	Vent pipe, chimney, or clearance problems observed (note in margin below)					

Install CO detectors before weatherization work begins

COMBUSTION SAFETY TEST FORM REFERENCE TABLES

Vent Categorization Per NFPA 54

(line 3)

Category I: *NFGC*		AFUE 65-83%
Non-Condensing	**Typical Materials**	**Clearance**
Negative Pressure (-)	B-vent	1"
High Temperature Flue Gases	Single wall metal	9"
Natural or Fan Assisted Drafts	L-vent	6"
	Lined Masonry	no extra

Category III: *Airtight*		AFUE 78-87%
Non-Condensing	**Typical Materials**	**Clearance**
Positive Pressure (+)	Sealed metal	NA
High Temperature Flue Gases	Sealed plastics	NA
Fan Assisted Draft	per manufacturer	

Category II: *Corrosion Resistent*		<<Rare>>
Condensing	**Typical Materials**	**Clearance**
Negative Pressure (-)	Special	as needed
Low Temperature Flue Gases	as designated by manufacturer	

Category IV: *Airtight & Corrosion Resistent*		AFUE 90%+
Condensing	**Typical Materials**	**Clearance**
Positive Pressure (+)	Sealed plastics	NA
Low Temperature Flue Gases	per manufacturer specification	
Sealed Combustion		

ANNEX D (BPI-1200) ACTION LEVELS FOR SPILLAGE AND CO IN COMBUSTION APPLIANCES

(line 6)

Test Results	Action Required
Greater CAZ depressurization occurs with the air handler on *	**CONDUCT** further analysis of the distribution system to determine if leaky ducts or other HVAC induced imbalances are the cause of the spillage. **Specify measures** to mitigate CAZ depressurization.
Greater CAZ depressurization occurs with door to CAZ closed, but is alleviated when the door to CAZ is open *	Specify measures to improve air transfer between the CAZ and the core of the house.
Spillage traced to excessive exhaust ** independent of CAZ door position, air handler, or a problem with the flue +	**VERIFY** sufficient combustion air is available per ANSI Z223.1/NFPA 54 for gas-fired appliances & NFPA 31 for oil fired appliances or have verification by a qualified professional **Specify** further evaluate/service by professional to address venting/combustion air issue

* In the case where both spillage and excessive CO are present, in addition to the specific directions above, **Specify** that the appliance be shut down until it can be serviced by a qualified professional.

** Refers to exhaust caused by mechanical ventilation and/or other means of exfiltration.

\+ When a recommendation to replace atmospherically vented combustion equipment inside the pressure boundry is made, and when cost-effective, Specify replacement with direct or power vented equipment (or non-combustion equipment, such as a heat pump), which is ENERGY STAR© labeled.

CO ACTION LEVELS (& LEL)

(lines 1,6,7,&9)

CO Levels 70 ppm and GREATER * **
1. Immediately TERMINATE inspection
2. Notify occupants to evacuate the building
3. Notify emergency services from outside building
CO Levels 36 ppm - 69 ppm
1. Notify occupants of elevated levels
2. Open windows and doors
3. RECOMMEND to the occupant that a possible source of CO be turned off immediately
4. RECOMMEND occupants contact qualified professional to service permanently installed appliance
CO Levels 9 ppm - 35 ppm
1. Notify occupants that CO has been detected
2. RECOMMEND to open doors and windows
3. RECOMMEND checking possible sources of CO
4. Recommend occupants contact qualified professional to service permanently installed appliance
CO Levels BELOW 9 ppm
1. Do nothing

***** Actions also required if LEL ≥ 10%**

CO THRESHOLDS for Fossil-Fuel Fired Combustion Appliances

(lines 6,7,&9)

Appliance	Threshold Limit**
Central furnace (all categories)	400 ppm air free
Boiler	400 ppm air free
Floor Furnace	400 ppm air free
Gravity Furnace	400 ppm air free
Wall Furnace (BIV)	200 ppm air free
Wall Furnace (Direct Vent)	400 ppm air free
Vented Room Heater	200 ppm air free
Unvented Room Heater	200 ppm air free
Water Heater	200 ppm air free
Oven/Broiler	225 ppm AS MEASURED

Action Level
If CO level above threshold-notify client and recommend service

Daily In-Progress Combustion Safety Test Form

3/1/19
BPI1200

Client		Work Dates					
Job #		Test Technician					

Designate Combustion Appliances to be spillage tested by work crew at end of work day

TEST		Appliance	Location
	App 1:		
	App 2:		

Confirm CO Detectors are in place and operational	yes / no	**If no install**

	Set up CAZ in Worst Case Depressurization
1	Place all combustion appliances located within the CAZ in their standby mode and prepare for operation
2	Set up manometer CAZ WRT Outside
3	Fires in woodstoves and/or fireplaces shall be fully extinguished, dampers closed
4	Close all building exterior doors and windows
5	Close all CAZ doors. *Close the interior doors of all rooms except for rooms with an exhaust fan and rooms*
6	Turn on exhaust equipment: clothes dryers, range hoods, and other exhaust fans.
7	Turn on central forced air blower, *if CAZ goes more negative with blower on leave on , more positive turn off*
8	Open the CAZ door, if CAZ goes more negative leave open, if not leave closed

9	**Turn on Appliance**	Day One		Day Two		Day Three	
		App 1	App 2	App 1	App 2	App 1	App 2
10	Did the equipment spill gasses for more than 2 min	yes / no	yes / no	yes / no	yes / no	yes / no	yes / no

If answer is "yes," ACTION is required.

Action

	Document ACTIONS Taken	**√ Done**		**Initials**	**Date**
	Call Assessor for direction if spillage test fails				
OR	Do one or more of the following to mitigate issue for interim				
	Reduce depressurization		Note:		
	Disable/Disengage fan that is creating problem:				
	Tape switch in Off position				
	Other:				
	Ventilate		Note:		
	Provide makeup air for interim				
	Open window:				
	Other:				
	Inform Client of ACTION(s) taken (temporary)	Client signature - received education			
	Educate Client on steps to take (or not) to remain safe				
	Re-test and Document after taking mitigation actions:				

Notes:

Revised Mar 2019 db

AK Combustion Safety Test Form (CSTF) Technical Support Document

This document is intended to support in detail the Combustion Safety Test Form. The Combustion Safety Test Form is a tool to document the condition of two (2) appliances and their performance. Each combustion appliance in homes that are weatherized or repaired must be documented. The pre- and post- tests are documented on the Combustion Safety Test Form. The CSTF is filled out by the Energy Auditor and the Quality Control Inspector respectively.

The Combustion Safety Test Form must be filled out in detail for each completed project. You must document in the comments section of the Combustion Safety Test Form any special circumstances or health and safety related concerns that might help someone understand the condition of the home (pre- and post-), as well as the concerns expressed by the occupants, or the agency concerns for the occupants safety at the time testing was performed.
The testing procedure outlined in this document is intended to be the minimum tests needed to understand the condition and performance of an appliance. It is recommended that more in-depth testing be performed where multiple appliances share a chimney, or where other indications of potential problems exist.

Line 1

Always start testing safely.

Start all testing tools, Combustion Analyzer, Combustibles Gas Detector, 4 Gas Monitor outdoors.

Confirm readings outside, away from combustion and roadways.

- Use your 4 gas monitor to confirm you are working in a safe environment.
- Monitor ambient Carbon Monoxide before testing and during all testing.

Walk into the building and monitor an indoor ambient air CO reading and a combustible gas %LEL reading on each floor.

Use the appropriate action level table to assess the safe environment.

Safe Environment

If any Ambient CO is found,
Reference the ***CO Action Levels (& LEL)*** table (on page 2 of form) for guidance.

Line 2 Natural Gas and LP Piping Testing

With your Combustible Gas Detector (CGD) check for leaks at the tank/meter, gas lines, pipe fittings, supply lines connecting to the appliance, appliance gas valve and regulator.

Document if leaks were found YES / NO and follow appropriate action level:

2a. When the CGD indicates that combustible gas exists in the ambient atmosphere (at any level below 10% of LEL) and a gas leak cannot be confirmed with the use of leak detection solution, the auditor shall inform the homeowner/occupants and advise the homeowner/occupant to notify the gas company and/or a qualified professional.

2b. Detected leaks confirmed with fluid?

Action Level

Where the auditor identifies deficiencies in gas piping materials, connections, components, or supports, the deficiencies shall be noted in project documentation along with a recommendation that the homeowner/occupant contact a qualified professional to inspect the system.

Line 3a Identification of Appliances

3a. What kind of appliances are being tested?

Line 4 Visual Inspection of CAZ for Unsafe Conditions

Is there anything in the CAZ that could be considered a health and safety problem? Indoor Air Quality (IAQ), electrical discrepancies, fire hazards, combustibles, or potential testing problems that should be documented. If yes, ***follow the action level table required.***

4a. The CAZ must be free of flammable products such as liquid and pressurized vapors

4b. The CAZ must be free of combustibles such as rags and paper in the immediate area of the appliance.

4c. Water Heaters in garages must be 18" above the floor or Flame Vapor Ignition Resistant listed.

- Residential water heaters manufactured after 2003 are **"FVIR"** (Flammable Vapor Ignition Resistant) compliant, this means that the combustion chamber is now sealed. In order to light the water heater, you must use the pilot mechanism and you can no longer use a match.
- Effective July 1, 2003, all water heater manufacturers are required to build their 30, 40, & 50 gallon atmospheric vent water heaters to new government standards. The American National Standards Institution (ANSI) has established these new standards to prevent accidental or unintended ignition of flammable vapors, such as those emitted by gasoline.

4d. The combustion appliance vent must have appropriate clearance to combustibles.

Use the table to assess clearance to combustibles and document.

Actions Required/Guidance

1. Unsafe conditions may be alleviated by removal of obstructions and materials and advise the occupant is what has been done.
2. Unsafe conditions that cannot be immediately fixed, the occupant shall be advised appliance should not be used until the unsafe condition is fixed.

3. Unsafe condition WATER HEATER IN GARAGE is not at least 18" above the floor and is not FVIR listed. Advise occupant of the unsafe condition.
4. Unsafe conditions shall be noted in project documentation.

Line 5-5e Setting up CAZ in worst case

The intent of setting up the CAZ in worst case is to set it up with the greatest negative pressure. This may require opening and closing doors and turning on and off fans to attain this pressure.

The intent of documenting lines 6a-6i is to show in what condition the greatest negative pressure was achieved. With that information if spillage occurs use table:
ANNEX D (BPI 1200) ACTION LEVELS FOR SPILLAGE AND CO IN COMBUSTION APPLIANCES.
This table states the 3 conditions that spillage occurs, read the table carefully and be aware of spillage and excessive CO requirement.

Procedure for setting up the CAZ in Worst Case.

1. Place all combustion appliances located within the CAZ in their standby mode and prepare for operation.
2. Turn off any mechanical ventilation and forced air cooling or heating system blowers.
3. Fires in woodstoves and/or fireplaces shall be fully extinguished, with no hot coals or embers, prior to performing a depressurization test. Close fireplace dampers and any fireplace doors.
4. Close all building exterior doors and windows. **Close all CAZ doors**. Close the interior doors of all rooms except for rooms with an exhaust fan and rooms with a central forced air system return. Outdoor openings for combustion air shall remain open.
5. Using a calibrated manometer or similar pressure measuring device intended for this purpose, measure and record the baseline pressure in the **CAZ with reference to (WRT) outside pa.**
6. Turn on the following exhaust equipment: clothes dryers (check and clean the dryer filter and look for blockage at the external vent damper prior to operation), range hoods, and other exhaust fans. If there are speed controls, operate the exhaust equipment at the highest speed setting. Do not operate a whole house cooling exhaust fan. Measure and record pressure in the **CAZ with reference to (WRT) outside pa.**
7. Turn on central forced air blower. Measure and record pressure in the **CAZ with reference to (WRT) outside pa.**
8. IF the CAZ goes more negative with blower on leave on for the test, if the CAZ goes more positive leave off for the test.
9. Open the CAZ door measure and record pressure in the **CAZ with reference to (WRT) outside pa.**
10. If the changing the CAZ door makes it more negative leave it open for the test, if not leave it closed.
11. Start the spillage test with largest negative pressure in the CAZ with reference to (WRT) outside.

Line 6a-6d CO and Spillage Assessment single vent

CO and Spillage assessments are performed on open combustion natural draft appliances that have a draft hood or barometric damper. Examples are gas or oil fired water heaters, gas or oil fired furnaces and decorative room heaters with a draft hood.

Spillage is assessed at 2 minutes operation (warm vent) in appliances that are in on position when you are there for your energy audit. Spillage is assessed at 5 minutes of operation (cold

vent) on appliances that are not in on position when you are auditing the home. Examples might be a furnace in off position because it is summer or a decorative room heater set to pilot because it is only used on holidays.

If spillage fails it is suggested you take your CO measurement as soon as possible to avoid exposing yourself to excessive combustion gas.

CO is assessed at 5 minutes of burner operation unless the appliance has failed spillage.

CO assessments in combustion appliances are done in the undiluted flue gases.

CO measurements are done AIR FREE. Air FREE is only available on a combustion analyzer that has and oxygen sensor.

Ambient CO is measured at during the test and at the end of the test.

Line 7 CO Assessment _mutiple appliances common vent

Test appliances in order from lowest BTUh rating to highest.

The appliance with lowest BTUh input rating shall be assessed for spillage and CO measurement in undiluted flue gas conducted in accordance to above instructions.

Upon completion of first appliance test, place next largest appliance in operation, while first appliance is still operating.

Retest first appliance for spillage when second appliance has reached 2 minutes of main burner operation. Test second appliance for spillage immediately thereafter.

Measure CO of the second appliance at 5 minutes of its main burner operation. Continue this operation for each additional appliance.

Actions Required/Guidance *for lines 6 and 7*

If the any CO Threshold Limits are exceeded, then the Local agency must take steps to eliminate the problem:

- Advise the homeowner/occupant that the appliance should be serviced immediately by a qualified professional.
- The SWS and the AK Field Guide require service to be provided.

Line 8 CO Assessment – Furnace ONLY

Appliances that are not tested for **spillage** but are tested for **CO** would include appliances; closed combustion, direct vent, induced draft, category 3 and category 4 appliances.

Induced draft appliances that are vented in common with natural draft water heaters will be tested for CO and spillage.

- CO is assessed at 5 minutes of burner operation.
- CO assessments in combustion appliances are done in the undiluted flue gases.

- CO measurements are done AIR FREE. Air FREE is only available on a combustion analyzer that has an oxygen sensor.

Ambient CO is measured during the test and at the end of the test

Line 9-9c Natural Gas and LP Oven Testing

9a. Always check in the oven for stored items before starting the oven.

Assess Burner Flame Quality: Yellow flame?

Start the oven at 350 degrees, after 5 minutes turn the oven up to 500 degrees to make sure the oven is on when taking your measurement.

9b. Record the CO as measured after 5 minutes of operation.

Use the ***CO Thresholds For Fossil-Fueled Fired Combustion Appliances*** table to determine whether the CO level is acceptable. Based upon the result follow the action required using the ***CO Action Levels (&LEL)*** table.

Oven CO measurements are done in the vent of the oven and are done in CO as measured. This is a different line, window, in the menu on your combustion analyzer.

If the CO Threshold Limit (*per BPI for Oven/Broiler if CO > 225 as measured*) is exceeded,

- The SWS and the AK Field Guide require service to be provided.
- If it is not possible to eliminate the problem, document in the client file the actions taken and confirmation the client was informed of the issue.

Line 10 WoodStove/FirePlace

Set up your manometer in the room with the woodstove and measure the pressure “fireplace woodstove zone with reference to outside”. Document the number. If the measurement exceeds the limit, action must be taken.

Client Name:

Address:

Pre Blower Door:				
i.	Client Eligibility Date:			
ii.	Audit Date:			
iii.	Client Interview Performed?		Yes	No
iv.	Pollution Source Survey Completed?		Yes	No
v.	Contaminants present that would either prohibit blower door test completely or require pressurization test:			
vi.	Technician:			
vii.	Date:			

	CALCULATIONS	Pre	In-Progress	Post
1	Calculated total square footage of heated area			
2	Calculated volume of conditioned space			

	BASELINE CONDITIONS & HOUSE TIGHTNESS - Blower door	Pre	In-Progress	Post
3	Primary heat source fuel type (example: nat. gas, electric, propane, wood)			
4	Windspeed MPH			
5	Outside temperature °F			
6	Blower door location			
7	Baseline without blower door on in pa (stack effect)			
8	Blower door configuration: O=open fan A=ring A B=ring B LF= low flow ring			
9	Total CFM50			

10	ZONAL PRESSURES - Blower door		Pre	In-Progress	Post
	ATTIC	WRT house			
	CRAWLSPACE	WRT house			
	GARAGE	WRT house			
	OTHER:	WRT house			
	OTHER:	WRT house			
	OTHER:	WRT house			
11	Location of existing ducts: A=inside B=outside C=inside/outside				

12	12. Duct Pressure Test - Blower Door

13			13. Room Pressure - HVAC fan only Room WRT main body		Pressure Pan: House WRT Duct		
	Location	S/ Supply R/Return	Pre	Post	Pre	In Progress	Post
a.							
b.							
c.							
d.							
e.							
f.							
g.							
h.							
i.							
j.							
k.							
l.							

	TESTING AIRHANDLER (HVAC) EFFECTS: HVAC fan only	Pre	In-Progress	Post
14	**Dominant Duct Leak Test:** Main Body WRT outside (all interior doors open)			
15	**All Doors Closed Effect:** Main Body WRT outside (all interior doors closed)			
16	Duct location after Wx and Repairs: A=inside B=outside C=inside/outside			
17	Electric furnace heat rise test (*supply°F–return°F*) acceptable range:>40°to<70°			
18	Return house to pre test conditions (Check box when done)	☐	☐	☐

NOTES/DOCUMENTATION:

Revised July 2013

Pressure Pan Tests

In typical mobile home duct configura ions, pre pressure pan tests help locate areas of significant leakage or disconnected duct work. After belly is filled with insulation, post pressure pan tests results may not be useful.

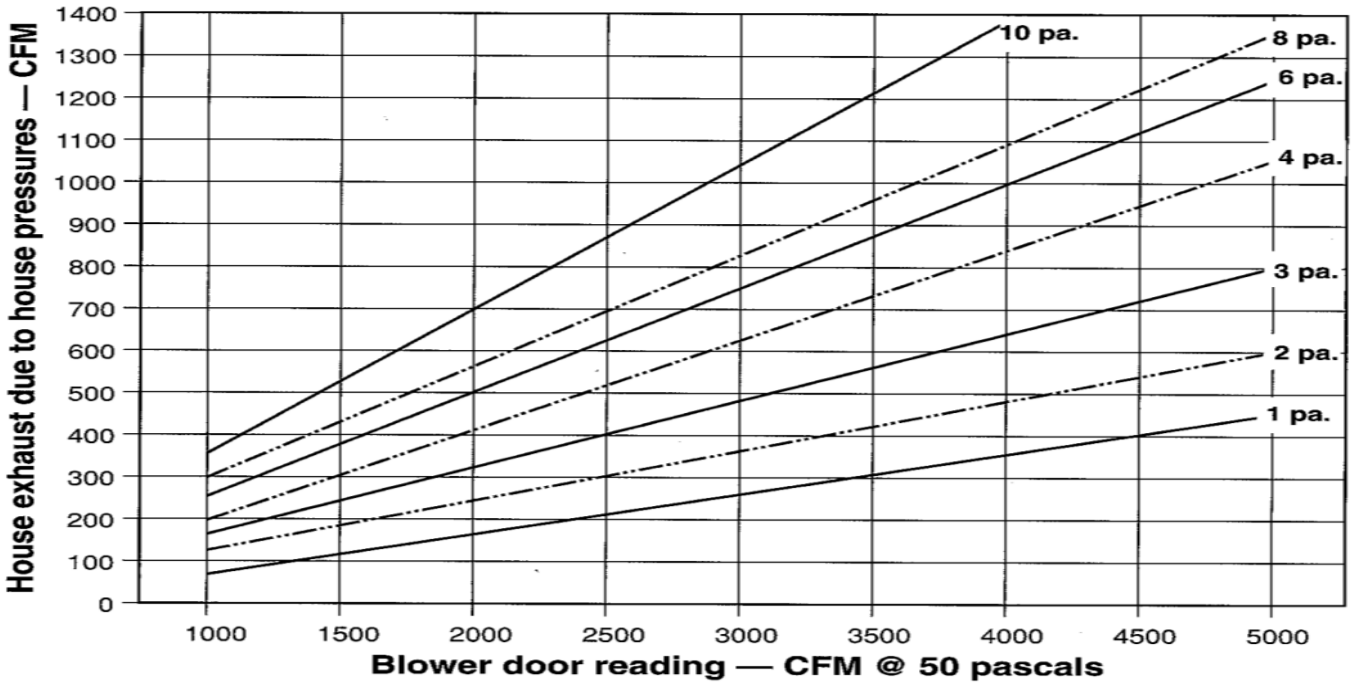
In site built homes with supply and return duct systems enclosed entirely within the thermal and pressure boundaries, pressure pan tests are not required.

Dominant Duct Leak Test

In typical mobile home duct configura ions, dominant duct leak tests are especially useful. You can quantify the amount of duct leakage by using the Air Leakage Chart (aka Tooley Chart) if the return is isolated in the conditioned space and the supplies are isolated in the belly. No more than 100CFM of total supply duct leakage is recommended.

In site built homes with supply and return duct systems enclosed entirely within the thermal and pressure boundaries, dominant duct leak tests are not required.

Air Leakage Chart



Revised July 2012

State of Washington, Weatherization Assistance Program

Technical Support Document (TSD)

Diagnostic Test Report

This document is intended to support in detail the Diagnostic Test Report. The Diagnostic Test Report must be filled out in detail for each completed project. You must document in the comments section of the Diagnostic Test Report any special circumstances or health and safety related concerns that might help someone understand the condition of the home (pre- and post-), as well as the concerns expressed by the occupants, or the agency concerns for the occupants safety at the time testing was performed.

The testing procedure outlined in this document is intended to be the minimum tests needed to understand the condition of the home.

Pre Blower Door

i. Client Eligibility date:

Enter date Client was determined eligible. Ensure both Client Eligibility and Energy Audit dates are within the Period of Eligibility. See **Section 1.3, *Period of Eligibility***

ii. Audit Date:

Enter date Energy Audit was performed.

iii. Client Interview Performed?

Answer yes/no

iv. Pollution Source Survey Completed?

Answer yes/no

v. Contaminants Present that would either prohibit blower door test completely, or require pressurization test:

(including but not limited to: Lead, Friable Asbestos, Mold, Smokers, Pets, Sewage, etc)
Document any contaminants or conditions that would prevent blower door testing or require pressurization testing.

vi. Technician:

Enter name of Technician performing: Pre, In-Progress, and Post diagnostic testing.

vii. Date:

Enter date Technician is performing: Pre, In-Progress, and Post diagnostic testing.

Baseline Conditions & House Tightness – Blower Door

Line #7 Primary heat source fuel type (example: nat gas, elec, propane, oil, wood)

Determine by interviewing (not their HIF or Wx application) the occupants, observing their habits and analyzing their heating bills what their primary heat source is and circle the type of fuel that is used in the appliance. Document the type (boiler, woodstove, forced air etc.) in the comments section.

Line #8 Windspeed MPH

Record or estimate wind speed before setting up the blower door. Measure the wind speed with a wind gauge (record if there is apparent steady or gusting wind).

Line #9 Outside temperature °F

Record outside temperature in degrees Fahrenheit

Line #10 Blower door location

Record which doorway the blower door was mounted in for testing procedures. Mount the blower door in the doorway which has the least obstructions in the pathway of airflow (of the blower door) both inside and outside.

Note: Blower door set up procedure: follow manufacturer's instructions.

Line #11 Baseline without blower door on in pa (stack effect)

Measure the house with reference to outside without the blower door running. Make sure the blower door fan is covered and the house is prepared for blower door testing.

Line #12 Blower door configuration
O=open fan A=ring A B=ring B LF=low flow ring

Record which ring or configuration (number of holes unplugged) the blower door was set up in for testing lines 13 through 16.

Note: Always use the smallest ring possible to get the highest fan pressure when performing blower door testing. The higher the fan pressure the more accurate the test.

Line #13 Total CFM50

Prepare the house for blower door testing. Normally test should be taken in the negative pressure mode, if positive pressure is used for testing note in the comments section and set up the house per manufacturer's specifications in the blower door manual.

Zonal Pressures – Blower Door

Line# 14 Zonal Pressures

Hook up your manometer as indicated on the field form for each test and record the pressure. Be sure to take verifying tests (house WRT zone, zone WRT outside, etc.). Start in a clockwise direction and describe room on the adjacent line and record pressures, zone WRT outside (confirming test: zone WRT outside).

Line #15 Location of existing ducts:
A=Inside B=outside C=inside/outside

Determine and record where the duct system was designed to be located originally, inside the thermal boundary, outside the thermal boundary, or a combination of inside and outside.

Duct Pressure Test – Blower Door
Line #16 Duct Pressure Test – Pressure Pan
House WRT Duct (clockwise from front door)

Face the front door looking out. Record (down to tenths) whether the duct tested is a supply or return duct and what zone it is located in from line #15. Record whether it is located inside or outside the intended thermal envelope (by design).

Testing Air Handler Effect – HVAC fan only

The tests performed in lines 17 through 19 are performed with only the furnace air handler fan on. The blower door or any exhaust fans should be turned off during these tests. These tests indicate the effect of the air supply and return on pressures in rooms and the house.

Line #17 Room Pressure:
Room WRT Main Body (interior doors closed)

This testing is to see if there are large pressure differentials between rooms of the home that could possibly cause a problem to the operation of the combustion appliance or cause moisture damage the structure of the house.

Line #18 Dominant Duct Leak Test:
Main Body WRT Outside (all interior doors open)

Record the pressure of the main body of the house WRT outside with all interior doors open.

Line #19 All Doors Closed Effect:
Main Body WRT outside (all interior doors closed)

Now close all the interior doors and record main body WRT outside.

Line #20 Duct location after Wx and repair: A=inside B=outside C=inside/outside

Did you change the location of the ducts or are they in the same place as before? If as a result of the retrofit the location (inside to outside, outside to inside, etc.) of the duct system has been changed document in the comments section.

Line #21 Electric furnace heat rise test: Heat Rise = supply°F – return°F

With the electric furnace running, measure the temperature in the supply air plenum and return air plenum. Subtracting the return plenum temperature from the supply air temperature equals the "heat rise". Take these temperature measurements in the plenums as close to the furnace as possible. Record in degrees Fahrenheit. The manufacturer's acceptable range for heat rise for the unit is often on the nameplate of the furnace.

****Action level:** If the heat rise (the difference between return air temp at the plenum and supply air temp at the plenum) is outside the manufacturer's acceptable range the system fails and there must be a referral made for further analysis by a furnace technician. If the heating unit has not been serviced within the last twelve months, a furnace clean and tune is recommended.

Exception: If manufacturer's acceptable heat rise range is unavailable, the default acceptable heat rise range is greater than 40° and less than 70° Fahrenheit.

Line #22 RETURN HOUSE Pre Test Conditions

Check box when done.

Exhaust Fan Testing

Line #23 Exhaust Fan Testing (Actual CFM)

Test and record flow for all exhaust fans (local (source specific) and whole building (whole house)) using exhaust fan flow meter and digital pressure gauge.

Specifications:

Flow Accuracy: ±10% of reading when used with a 1% accurate pressure gauge with a display resolution of 0.1 Pa. (such as a DG-700,)

Flow Range:
Door position E1 44 - 124 cfm
Door position E2 21 - 59 cfm
Door position E3 10 - 28 cfm

Checklist: ENCLOSED WALL CAVITY INSULATION (Dense Pack) Project:

✓	N/A		PREP
☐	☐	1	Complete a combustion safety test and record the results.
☐	☐	2	Review ventilation strategy and plan any exhaust fan, electrical, or ducting install work before insulating.
☐	☐	3	Put on all personal protection equipment (PPE).
☐	☐	4	Identify all worker and occupant safety hazards.
☐	☐	5	Identify any exterior lead-based paint hazards and set up RRP-compliant containment accordingly.
☐	☐	6	Assess walls from the interior of home to identify weak plaster, drywall, or panelling.
☐	☐	7	Identify any durability issues such as signs of moisture or pests.
☐	☐	8	Address all combustion safety, worker safety, occupant safety and durability issues prior to starting work and notify the occupant. Do not complete work if a life safety hazard is identified.
✓	N/A		WORK
☐	☐	9	Remove siding and drill through sheathing to gain access to all wall cavities and probe for obstructions and/or hazards.
☐	☐	10	Install insulation according to the manufacturer's specifications.
☐	☐	11	View completed sections using an IR camera with a blower door operating. Drill and repack any voids or low density areas.
☐	☐	12	Seal access points of all wall cavities and reinstall siding. Any new siding installed will match existing style and be primed and painted to match.
✓	N/A		CLOSE OUT
☐	☐	13	Clean the work areas.
☐	☐	14	Educate the occupants on the work completed.
☐	☐	15	Post Insulation Certificate and insulation manufacturer's coverage chart.

Checklist: FLOOR INSULATION

Project:

✓	N/A		PREP
☐	☐	1	Review ventilation strategy and plan any exhaust fan, electrical, or ducting install work before insulating.
☐	☐	2	Put on all personal protection equipment (PPE).
☐	☐	3	Identify all worker and occupant safety hazards.
☐	☐	4	Identify any durability issues such as signs of moisture or pests.
☐	☐	5	Address all combustion safety, worker safety, occupant safety and durability issues prior to starting work and notify the occupant. Do not complete work if a life safety hazard is identified.
✓	N/A		WORK
☐	☐	6	Identify areas where insulation will not be installed.
☐	☐	7	Remove existing damaged insulation from the crawlspace and/or basement.
☐	☐	8	Complete air sealing according to location of pressure boundary (floor plane, perimeter, or combination): seal all holes between the crawlspace and/or basement and the interior and/or exterior of the house.
☐	☐	9	Install insulation according to the manufacturer's specifications and Insulation Support Matrix. Verify that all insulation has no gaps, voids, compression or misalignment.
☐	☐	10	Install baffles at foundation venting if needed.
✓	N/A		CLOSE OUT
☐	☐	11	Clean the work areas.
☐	☐	12	Educate the occupants on the work completed.
☐	☐	13	Post Insulation Certificate and insulation manufacturer's coverage chart.

Checklist: ATTIC INSULATION

Project:

✓	N/A		PREP
☐	☐	1	Review ventilation strategy and plan any exhaust fan, electrical, or ducting install work before insulating.
☐	☐	2	Put on all personal protection equipment (PPE).
☐	☐	3	Identify all worker and occupant safety hazards.
☐	☐	4	Identify any durability issues such as signs of moisture or pests.
☐	☐	5	Address all combustion safety, worker safety, occupant safety and durability issues prior to starting work and notify the occupant. Do not complete work if a life safety hazard is identified.
☐	☐	6	If K&T present, confirm K&T inspection form complete.
☐	☐	7	Confirm all woring connections are in junction boxes.
✓	N/A		WORK
☐	☐	8	Flag junction boxes.
☐	☐	9	Install insulation depth measuring sticks.
☐	☐	10	Identify areas where insulation will not be installed.
☐	☐	11	Complete ceiling-plane air sealing: seal all holes between the interior of the house and the attic.
☐	☐	12	Install baffles at low venting.
☐	☐	13	Install insulation dams at attic accesses and around heat producing devices.
☐	☐	14	Install insulation according to the manufacturer's specifications. Verify that all insulation has no gaps, voids, compression or misalignment.
✓	N/A		CLOSE OUT
☐	☐	15	Clean the work areas.
☐	☐	16	Educate the occupants on the work completed.
☐	☐	17	Post Insulation Certificate and insulation manufacturer's coverage chart.

WALLS - common air leakage details include but are not limited to: **Project:**

✓	N/A		PREPARATION
☐	☐	1	Openings behind and under tubs, showers, and tub/shower enclosures
☐	☐	2	Annular space at wiring, pipe penetrations through plates, and at ceiling fixtures
☐	☐	3	Pocket door framing open into floor or attic above and exterior walls
☐	☐	4	Seams and openings in walls and ceilings between attached garages and house
☐	☐	5	All joints seams and penetrations in surfaces without an air retarding membrane
☐	☐	6	Gaps in tongue in groove paneling where angles change at hips, valleys, and where walls meet slants and ceilings
☐	☐	7	Built-in cabinets, dressers or book shelves in knee walls.
☐	☐	8	Common wall openings between dwelling units
☐	☐	9	Rim joist junctions and gaps between sill and foundation, including open block cores
☐	☐	10	Utility penetrations and direct openings through foundation walls
☐	☐	11	Openings in gypsum board including un-taped joints above suspended ceiling and behind cabinets
☐	☐	12	Openings between window and door assemblies and their respective jambs and framing when no interior or exterior trim is present

FLOOR PLANE - common air leakage details include but are not limited to: **Project:**

✓	N/A		PREPARATION
☐	☐	1	Plumbing wet walls, duct chases, duct seams, joints and boot leaks
☐	☐	2	Openings behind and under tubs, showers, and tub/shower enclosures
☐	☐	3	Annular space at wiring, pipe penetrations through plates, and at ceiling fixtures
☐	☐	4	Floors open under knee walls, walls open at level changes and gable ends
☐	☐	5	Pocket door framing open into floor or attic above and exterior walls
☐	☐	6	All joints seams and penetrations in surfaces without an air retarding membrane
☐	☐	7	Gaps below baseboard and behind carpet nailing strip at subfloor joint to exterior wall
☐	☐	8	Rim joist junctions and gaps between sill and foundation, including open block cores

ATTIC - common air leakage details include but are not limited to: **Project:**

✓	N/A		PREPARATION
☐	☐	1	Dropped soffits, dropped ceilings and ceiling height changes
☐	☐	2	Plumbing wet walls, duct chases, duct seams, joints and boot leaks
☐	☐	3	Chimney and combustion vent chases
☐	☐	4	Wall tops open into attic, gaps between gypsum ceiling and wall plates
☐	☐	5	Annular space at wiring, pipe penetrations through plates, and at ceiling fixtures
☐	☐	6	2nd story floors open to attached roofs over porches and additions or garages
☐	☐	7	Inside framing open into attic stairs and landings
☐	☐	8	Pocket door framing open into floor or attic above and exterior walls
☐	☐	9	Non-IC recessed light fixtures. IC rated fixtures with no airtight insert
☐	☐	10	Bath and kitchen fans venting into the attic
☐	☐	11	All joints seams and penetrations in surfaces without an air retarding membrane
☐	☐	12	Gaps in tongue in groove paneling where angles change at hips, valleys, and where walls meet slants and ceilings
☐	☐	13	Acoustical tile and suspended ceilings with no solid ceiling above.
☐	☐	14	Missing gypsum behind decorative ceiling light trays or above decorative ceiling beams
☐	☐	15	Built-in cabinets, dressers or book shelves in knee walls.
☐	☐	16	Attic access openings, operable doors and hatches without tight weather-strip
☐	☐	17	Pull down attic access stair or cover
☐	☐	18	Attic floor where interior surface will not support dense pack, has weak plaster, active Knob and Tube (K&T), non IC lights, vermiculite, etc.

AIR SEALING - common air leakage details include but are not limited to: **Project:**

✓	N/A		PREPARATION
☐	☐	1	Dropped soffits, dropped ceilings and ceiling height changes
☐	☐	2	Plumbing wet walls, duct chases, duct seams, joints and boot leaks
☐	☐	3	Chimney and combustion vent chases
☐	☐	4	Openings behind and under tubs, showers, and tub/shower enclosures
☐	☐	5	Wall tops open into attic, gaps between gypsum ceiling and wall plates
☐	☐	6	Annular space at wiring, pipe penetrations through plates, and at ceiling fixtures
☐	☐	7	Floors open under knee walls, walls open at level changes and gable ends
☐	☐	8	2nd story floors open to attached roofs over porches and additions or garages
☐	☐	9	Inside framing open into attic stairs and landings
☐	☐	10	Pocket door framing open into floor or attic above and exterior walls
☐	☐	11	Seams and openings in walls and ceilings between attached garages and house
☐	☐	12	Non-IC recessed light fixtures. IC rated fixtures with no airtight insert
☐	☐	13	Bath and kitchen fans venting into the attic
☐	☐	14	All joints seams and penetrations in surfaces without an air retarding membrane
☐	☐	15	Gaps in tongue in groove paneling where angles change at hips, valleys, and where walls meet slants and ceilings
☐	☐	16	Acoustical tile and suspended ceilings with no solid ceiling above.
☐	☐	17	Missing gypsum behind decorative ceiling light trays or above decorative ceiling beams
☐	☐	18	Built-in cabinets, dressers or book shelves in knee walls.
☐	☐	19	Gaps below baseboard and behind carpet nailing strip at subfloor joint to exterior wall
☐	☐	20	Common wall openings between dwelling units
☐	☐	21	Attic access openings, operable doors and hatches without tight weather-strip
☐	☐	22	Pull down attic access stair or cover
☐	☐	23	Rim joist junctions and gaps between sill and foundation, including open block cores
☐	☐	24	Utility penetrations and direct openings through foundation walls
☐	☐	25	Openings in gypsum board including un-taped joints above suspended ceiling and behind cabinets
☐	☐	26	Openings between window and door assemblies and their respective jambs and framing when no interior or exterior trim is present
☐	☐	27	Attic floor where interior surface will not support dense pack, has weak plaster, active Knob and Tube (K&T), non IC lights, vermiculite, etc.