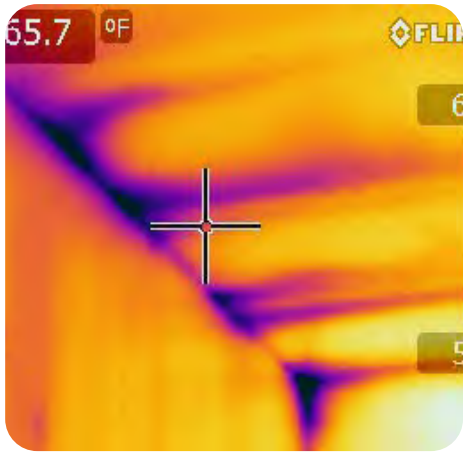
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RETROFITTING KANSAS

STANDARD WORK SPECIFICATION-ALIGNED FIELD GUIDE





KANSAS HOUSING

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Last updated December 2025
Created by the Energy Smart Academy at Santa Fe Community College
For the Weatherization Collaborative
In alignment with the Standard Work Specifications
Created by the National Renewable Energy Laboratory,
found at https://sws.nrel.gov

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1-1 INTERIOR LEAD-SAFE WEATHERIZATION

Aligns with Lead RRP





BEFORE

✗ Homes built before 1978 have the potential for lead paint and require special considerations during retrofitting

AFTER

✓ No lead dust or debris remains inside the home

✓ Contaminated materials have been disposed of or cleaned properly

✓ Disposal containment is securely closed

TOOLS

- Zip Walls
- HEPA Vacuum
- Hand Tools or Shrouded Power Tools
- Half or Full-face Respirator (Fit-Tested)

MATERIALS

- 6-Mil Plastic Sheeting
- Signage
- Tack Pads
- Painters Tape
- Trash Bags
- Disposable Tyvek Suits
- Booties
- Nitrile Gloves
- P-100 Filters

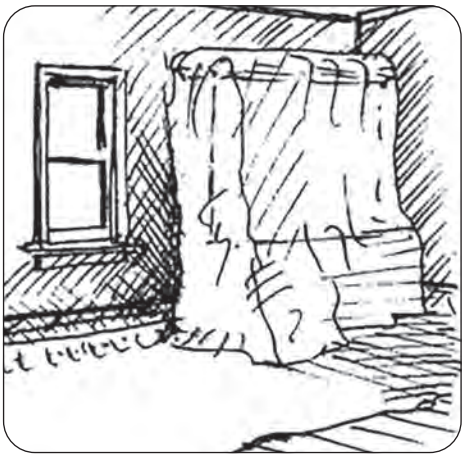
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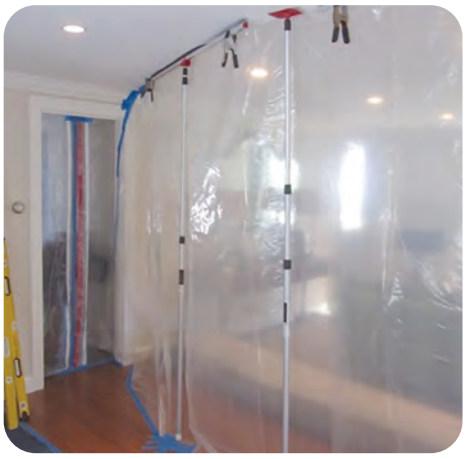
** weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

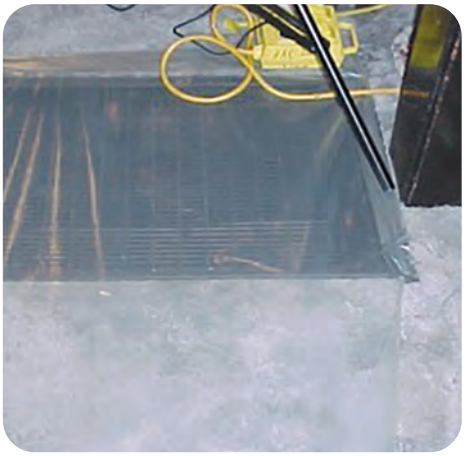
1-1 INTERIOR LEAD-SAFE WEATHERIZATION



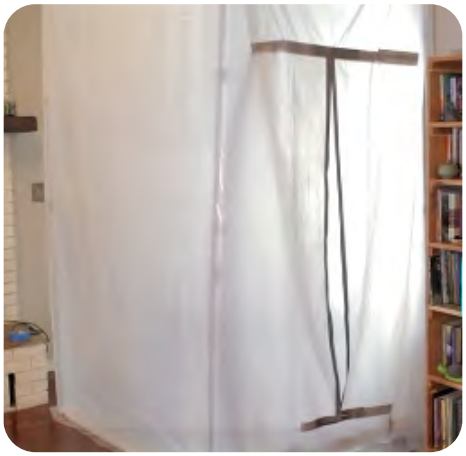
1. Move furniture out of work area and, if it cannot be removed, securely cover horizontal area with plastic sheeting



2. Use disposable physical barriers to mark out and contain work area dust and debris



3. Six feet in any direction from the work area, cover surfaces with plastic sheeting, taped in place, including HVAC access points



4. Block off access doorways and install zippers to contain debris in work area

NOTES

Half and Full-face respirators, required for Lead Renovation work,must be fit-tested on all workers at least once a year. The respirator must form atight seal at the face and neck. Workers who have a beard cannot wear a half- or full-face respirator, since they will not form a tight seal and contaminants can bypass the respirator. Bearded workers need to wear a PAPR, or powered air-purifying respirator.

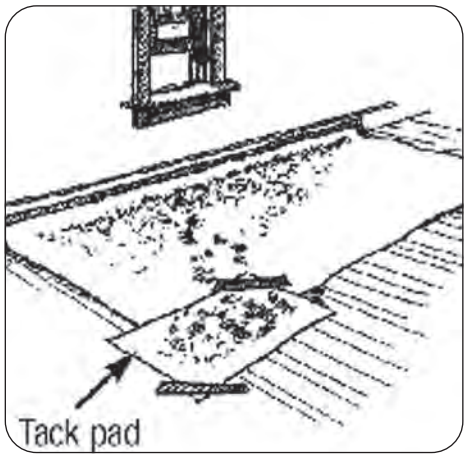
Follow all KDHE lead based paint requirements.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

1-1 INTERIOR LEAD-SAFE WEATHERIZATION



5. Post signs outside work area to prevent anyone from entering work area unintentionally



6. Use tack pads at access points to containment area to minimize dust and debris being tracked outside area



7. Wear appropriate PPE, including Tyvek suit, gloves and P-100 HEPA Disposable or Fit-Tested Respirator



8. Utilize hand tools and/or shrouded tools that minimize dispersion of dust and debris

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

1-1 INTERIOR LEAD-SAFE WEATHERIZATION





Folding poly to the inside and bagging.

9. Wipe down surfaces and vacuum work area, taking special care and attention of cracks and crevices where dust and debris might collect

10. Carefully roll up and dispose of any plastic sheeting or other disposable materials in the work area



11. Doff PPE outside, avoiding contact with contaminated surfaces of suit, gloves, etc., and dispose immediately

NOTES

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

Follow all KDHE requirements.

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1-2 EXTERIOR LEAD-SAFE WEATHERIZATION

Aligns with Lead RRP





BEFORE

✗ Homes built before 1978 have the potential for lead paint and require special considerations during retrofitting

AFTER

✓ Detailed attention needs to be paid to every aspect of work with lead-based paint, from start to finish

PPE



** situation dependent ** weather dependent*

TOOLS

- HEPA Vacuum
- Hand Tools or Shrouded Power Tools
- Half or Full-face Respirator (Fit-Tested)

MATERIALS

- 6-Mil Plastic Sheeting
- Catchment Poly Bags
- Signage
- Tack Pads
- Painters Tape
- Trash Bags
- Scaffolding
- Disposable Tyvek Suits
- Booties
- Nitrile Gloves
- P-100 Filters

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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1-2 EXTERIOR LEAD-SAFE WEATHERIZATION



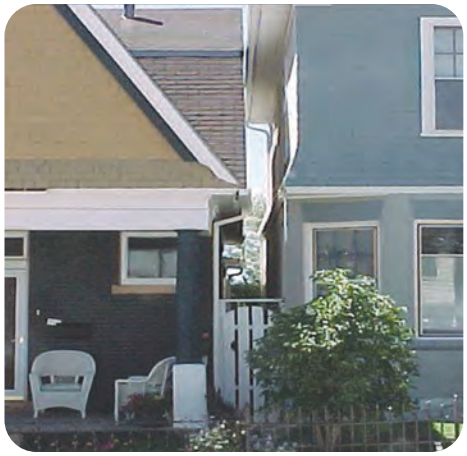
1. Create containment area with plastic sheeting 10 feet in any direction from work area



2. Post signs at least 20 feet from work area to prevent anyone from entering work area unintentionally



3. Seal off all exterior access points to home within containment area, including windows, doors, mail slots and vents



4. Where houses are located close together, vertical containment will be necessary

NOTES

Half and Full-face respirators, required for Lead Renovation work, must be fit-tested on all workers at least once a year. The respirator must form a tight seal at the face and neck. Workers who have a beard cannot wear a half- or full-face respirator, since they will not form a tight seal and contaminants can bypass the respirator. Bearded workers need to wear a PAPR, or powered air-purifying respirator.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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1-2 EXTERIOR LEAD-SAFE WEATHERIZATION



5. Tape plastic up onto work surface and utilize systems to catch debris while limiting damage to exterior plantings



6. Don proper PPE, including tyvek suit with hood, gloves, booties and half- or full-face respirator (see notes). Be aware of potential for thermal stress when working in full PPE



7. Use hand tools or shrouded power tools to limit dispersal of contaminated dust and debris



8. Clean work area and carefully fold and dispose of plastic sheeting



9. Doff PPE outside, avoiding contact with contaminated surfaces of suit, gloves, etc., and dispose immediately

NOTES

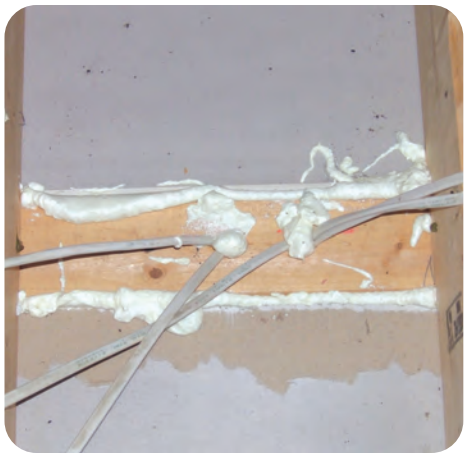
Follow all KDHE requirements

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2-1 AIR SEAL TOP PLATES IN ATTIC

Aligns with SWS 3.0101.1, 3.0102.11





BEFORE

✗ Air can move around unsealed top plates in attic, making new insulation less effective

AFTER

✓ Seal perimeter at all gaps and extend sealant up onto adjacent materials

TOOLS

- Caulk Gun
- Spray Foam Dispensing Gun

MATERIALS

- Caulk
- 1-part Polyurethane Spray Foam
- Mastic

PPE



** weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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2-1 AIR SEAL TOP PLATES IN ATTIC



Apply caulk to areas with gap 1/4 inch or smaller



Apply sprayfoam or mastic to gaps 1/4 inch to 2 inches wide

NOTES

Add backer rod or filler as necessary.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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2-2 AIR SEAL AN ATTIC SOFFIT OR LARGE OPENING

Aligns with SWS 3.0101.1, 3.0102.9





OPTION A SEAL SOFFIT INTO CONDITIONED SPACE

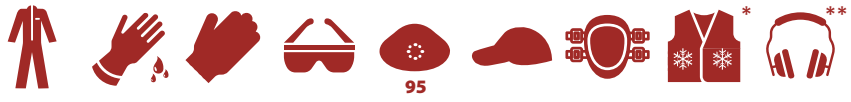
Soffits, coffered ceilings and other design details can create lower sections in the ceiling line and often are not sealed or insulated properly

OPTION B SEAL SOFFIT OUT OF CONDITIONED SPACE

From the attic side, it is best to determine if it's better to leave the soffit connected to the conditioned space (inside the house) or seal it off as part of the unconditioned space

R-board can be substituted for EPS or XPS.

PPE



** situation dependent ** if cutting lumber*

TOOLS

- Caulk Gun
- Utility Knife
- Measuring Tape
- Drill
- Spray Foam Nozzle

MATERIALS

- Spray Foam
- Lumber for Support
- Expanded Polystyrene (EPS)
- Extruded Polystyrene (XPS)
- Gypsum Board
- Plywood
- Caulk
- Mechanical Fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-2 AIR SEAL AN ATTIC SOFFIT OR LARGE OPENING

OPTION A – SEAL SOFFIT INTO CONDITIONED SPACE



A-1. For openings larger than 24 inches, support braces will be necessary



A-2. Attach bracing across joists securely, spacing no more than 24 inches apart



A-3. Apply sealant along top plates, bracing, and framing members adjacent to opening more than 24 inches apart



A-4. Place Infill material over opening and secure in place with mechanical fasteners



A-5. When support bracing has been used, screw infill material to bracing as well

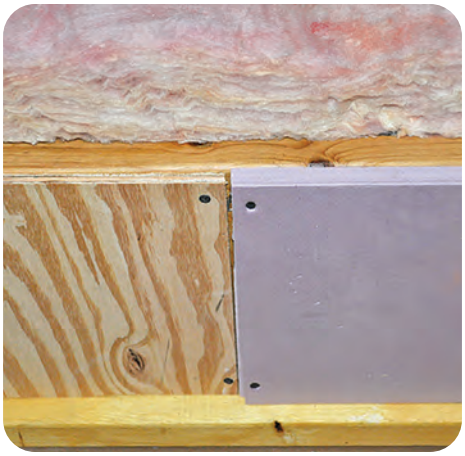
NOTES

The entire opening will be spanned with rigid material, permanent, and support necessary loads.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-2 AIR SEAL AN ATTIC SOFFIT OR LARGE OPENING

OPTION B – SEAL SOFFIT OUT OF CONDITIONED SPACE



B-1. Seal off framed openings with rigid material, such as gypsum board, XPS, EPS, or OSB



B-2. Seal around infill materials

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-3 AIR SEAL AN ATTIC CHASE OR SMALL OPENING

Aligns with SWS 3.0102.1





BEFORE

✗ Open chases for electrical and plumbing allow air movement from subspace and/or conditioned space

AFTER

✓ When properly sealed, air movement will cease through these spaces

R-board can be substituted for EPS or XPS.

PPE



** weather dependent*

TOOLS

- Measuring Tape
- Drill
- Utility Knife
- Caulk Gun
- Spray Foam Gun

MATERIALS

- Extruded Polystyrene (XPS)
- Expanded Polystyrene (EPS)
- Gypsum Board
- Plywood
- Spray Foam
- Mechanical Fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-3 AIR SEAL AN ATTIC CHASE OR SMALL OPENING



1. Measure the opening of the chase in a location that will maintain the pressure plane



2. Cut material to fit for each space where it is needed, paying attention to locations of wires and pipes



3. Rigid material to cover the span can be XPS, EPS, gypsum board or plywood, as appropriate for the location



4. Seal rigid material into place securely and air seal with caulk, spray foam or mastic



5. Extend sealing to adjacent materials to ensure a complete air seal

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-4 AIR SEAL BALLOON FRAMING FROM ATTIC

Aligns with SWS 3.0101.1, 3.0102.4





BEFORE

✗ Balloon framing leaves cavities open from the basement to the attic, allowing for large amounts of air movement

AFTER

✓ By sealing at the top of the cavity, air flow is stopped and the cavity below is another step closer to being ready to insulate

R-board can be substituted for EPS or XPS.

PPE



** weather dependent*

TOOLS

- Measuring Tape
- Drill
- Utility Knife
- Saw
- Sprayfoam Gun
- Caulk Gun

MATERIALS

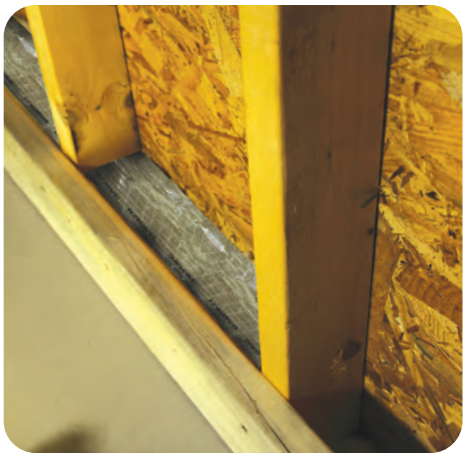
- Extruded Polystyrene (XPS)
- Gypsum Board
- Plywood
- Plastic-wrapped/Bagged Fiberglass Batts
- 1-part Sprayfoam
- Caulk
- Mastic
- Mechanical Fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-4 AIR SEAL BALLOON FRAMING FROM ATTIC



1. Block the opening of balloon framed sidewalls in alignment with the pressure boundary



2. Blocking material options include lumber, gypsum board, XPS, or bagged fiberglass batts



3. Blocking material needs to be appropriate for potential weight load



4. And securely fastened rigid material to withstand pressure of dense-packing beneath



5. Seal any remaining gaps with caulk or 1-part spray foam, extending sealing to adjacent materials

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-5 SEAL INSULATION-CONTACT RATED CAN LIGHTS

Aligns with SWS 3.0101.1





BEFORE

✗ Insulation-Contact rated Can lights are commonly installed in the ceiling between the upper story and the attic, meaning gaps around them allow for significant air leakage

AFTER

✓ By sealing around an IC-rated can light, a continuous pressure boundary is maintained

TOOLS

- Caulk Gun

MATERIALS

- Caulk

NOTES

See job aid 3-2 for non-IC rated lights.

PPE



** weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-6 SEAL ELECTRICAL AND OTHER PENETRATIONS IN ATTIC

Aligns with SWS 3.0101.1, 6.0201.1, 6.0201.2



1. Electrical, plumbing and HVAC penetrations are often oversized



2. For smaller gaps, caulk is enough to seal the hole

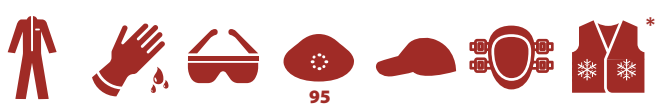
TOOLS

- Caulk Gun
- Spray Foam Gun
- Utility Knife

MATERIALS

- Caulk
- Spray Foam
- Backer Rod

PPE



** weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-6 SEAL ELECTRICAL AND OTHER PENETRATIONS IN ATTIC



3. Holes larger than 1/4 inch may require support for the sealant



4. Inserting backer rod provides infill to support the sealant



5. Seal to cover entire opening, including all backer rod

NOTES

For gaps larger than 3 inches, see 2-3 Air Seal an Attic Chase or Small Opening

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-7 AIR SEAL A FLOORED ATTIC

Aligns with SWS 3.0101.1





BEFORE

✗ Check floor joist cavities for blocking material and penetrations

AFTER

✓ Air seal cracks and penetrations in floored attic spaces

NOTES

Spray foam will not be used in spaces that will be exposed to habitable living spaces.

EXCEPTION- Professionally applied rim & band SPF.

R-board can be substituted for EPS or XPS.

PPE



** situation dependent ** if cutting lumber*

TOOLS

- Saw
- Drill
- Measuring Tape
- Utility Knife
- Caulk Gun
- Spray Foam Gun

MATERIALS

- Caulk
- Extruded Polystyrene (XPS)
- Lumber
- Gypsum Board
- 1-part Spray Foam
- Mechanical Fasteners
- Backer Rod

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

2-7 AIR SEAL A FLOORED ATTIC



1. With property owner permission, remove flooring material to access cavities



2. Remove only as much flooring as necessary to gain access to every cavity and any large air sealing areas



3. Place blocking material, as needed, aligned with the pressure and thermal boundary and air seal



4. In rare cases it may be easier to access to locate blocks from below floored attic spaces



5. Air seal gaps and seams in joist cavities as accessible



6. Check for and air seal electrical, plumbing, and HVAC penetrations properly

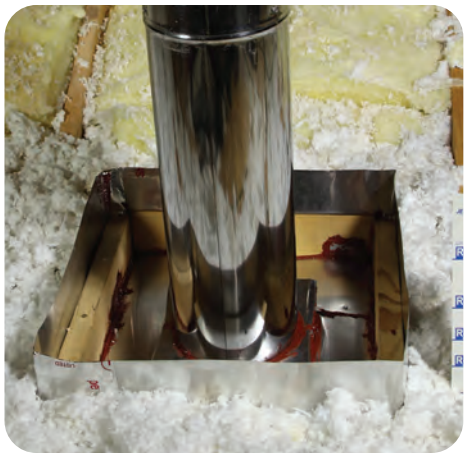
Photo credits: REUK.co.uk – After; Home Insulation of Syracuse – Step1 and Step 2

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3-1 SEAL AROUND CHIMNEYS AND FLUES

Aligns with SWS 3.0102.2





BEFORE

✗ Even high-temperature sites need air sealing

AFTER

✓ Maintain 3-inch clearance from flue for all combustible materials

TOOLS

- Caulk Gun
- Metal Snips or Nibbler
- Drill
- Tape Measure

MATERIALS

- 26-Gauge Sheet Metal
- Mechanical Fasteners
- Lumber

PPE



** situation dependent ** if cutting lumber*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

3-1 SEAL AROUND CHIMNEYS AND FLUES



1. Select high-temperature caulk sealant that will adjust to temperature differences between materials

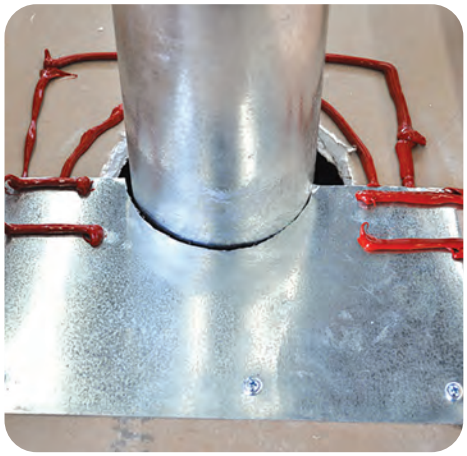


2. Apply unbroken ring of caulk directly to clean decking around entire perimeter of flue or chimney



3. Apply unbroken ring of caulk directly to clean decking to match perimeter of sheet metal backing

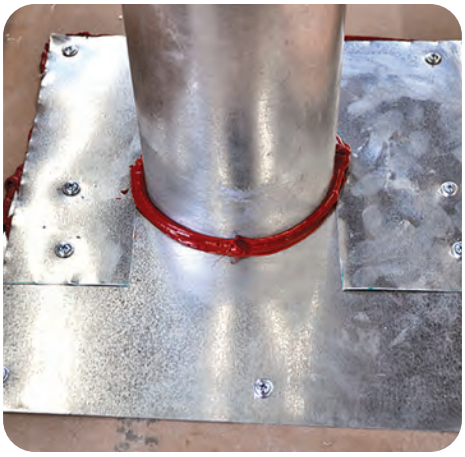
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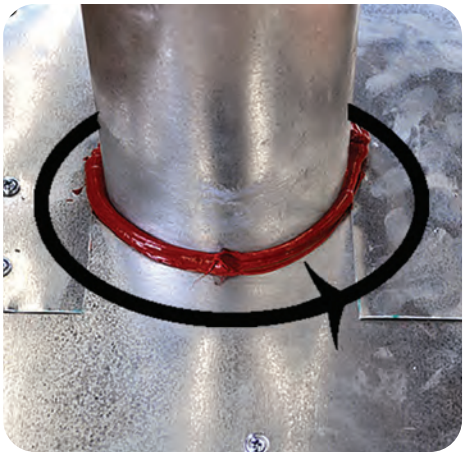


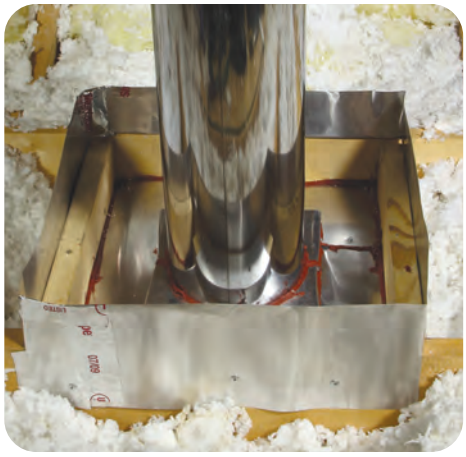
4. Install first layer of metal sheeting and apply additional caulk to complete new perimeter for second layer of sheeting

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

3-1 SEAL AROUND CHIMNEYS AND FLUES







5. Set second layer of sheeting to complete ring around flue or chimney. Fasten sheeting mechanically

6. Run bead of high-temperature caulk around flue at backing to seal remaining gaps < 1/4 inch

7. Create a durable, fixed dam, at least 2 inches higher than final insulation level, keeping all combustible materials at least 3 inches away from flue or chimney

NOTES

Refer to Local Codes. B-vent typically requires a 1 inch clearance and single wall typically requires 6 inches of clearance.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

3-2 SEAL AROUND NON-INSULATION CONTACT-RATED (NON-IC) CAN LIGHTS

Aligns with SWS 3.0102.1





BEFORE

✗ Non-Insulation Contact-rated can lights create a fire hazard in well-insulated attics

AFTER

✓ When boxed with appropriate clearances and fire-rated materials, fire risk is mitigated

Commercially available fire-rated air barrier systems may also be used. A full metal enclosure that is air sealed, provides the required clearances, and is not insulated on top, also meets the specification.

PPE



** situation dependent*

TOOLS

- Measuring Tape
- Utility Knife
- Caulk Gun

MATERIALS

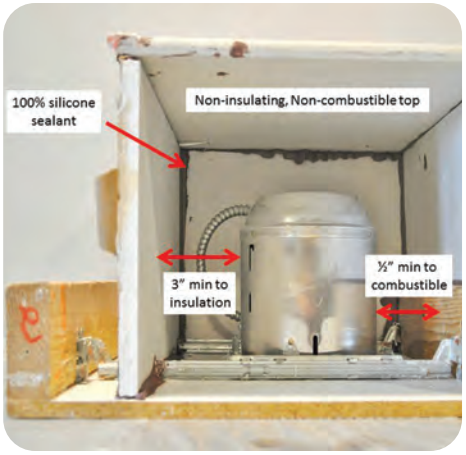
- 5/8 Inch Gypsum Board
- High-Temperature Caulk
- 100% Silicone Sealant

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

3-2 SEAL AROUND NON-INSULATION CONTACT-RATED (NON-IC) CAN LIGHTS



1. Clear any debris from around non-IC-rated can light



2. Enclosure has 3 inches of clearance from lamp to insulation on all sides, at least 1/2 inch from any combustible material, such as wood



3. Premade boxes can make installation easier when installation site is clear of framing members

NOTES

Non "Insulation Contact" Can Lights are designed to vent heat from the lamp into the cavity around them. They are safe to use in non-insulated cavities, such as the ceiling/floors between different stories in a home. IC-rated Can Lights have a secondary housing to keep the heat of the lamp from contacting the insulation. They are also recommended for use with lower wattage lamps.

Commercially available fire-rated air barrier systems may also be utilized. A full metal enclosure that is airsealed, provides the required clearances, and is not insulated on top, also meets the specification.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

3-2 SEAL AROUND NON-INSULATION CONTACT-RATED (NON-IC) CAN LIGHTS



4. Seal box on all sides and edges to make continuous barrier from attic, using high temp caulk where appropriate



5. Top of box must be R-1 or less and left free of insulation. Flag enclosure for added visibility

NOTES

A licensed electrician can also replace non-IC rated lights with air-tight units, LED retrofit inserts, or surface-mounted LED fixtures. Installing an LED bulb in a non-IC rated fixture does not change the rating of the fixture or the need for an air-tight enclosure.

See job aid 2-5 for IC rated lighting.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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4-1 PREPARE ATTIC FLOOR FOR INSULATION

Aligns with SWS 4.0103.1, 4.0103.2, 4.0103.3, 4.0103.4, 4.0103.5, 4.0103.6, and 4.0103.8

BEFORE YOU BEGIN





✓ Check for live knob & tube wiring and dam off when possible, or replace with modern wiring





✓ Enclose splices in UL listed enclosures and secure flags at junctions to be seen above the final level of insulation.

TOOLS

- Non-Contact Tester
- Utility Knife
- Drill
- Hole Saw
- Caulk Gun
- Staple Gun
- Metal Snips
- Nibbler

PPE



** if cutting lumber or sheet metal ** situation dependent *** if cutting lumber*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

4-1 PREPARE ATTIC FLOOR FOR INSULATION



1. Remove stored materials



2. Run exhaust fan ducts to outside, insulate to R-8



3. Ensure air sealing, if any, is completed



4. Install baffles at soffit vents if present. Ensure 1-2" vent space between baffle and roof deck for air flow. Baffles must extend a minimum of 6" beyond final insulation level.

MATERIALS

- Plywood
- Drywall
- XPS
- Junction Box Covers
- Flags
- Vent Caps
- Rigid Duct
- Mechanical Fasteners
- Foil Tape
- R-8 Duct Insulation
- Soffit Baffles
- Depth Rulers
- 26-Gauge Steel Sheeting
- High-Temperature Caulk

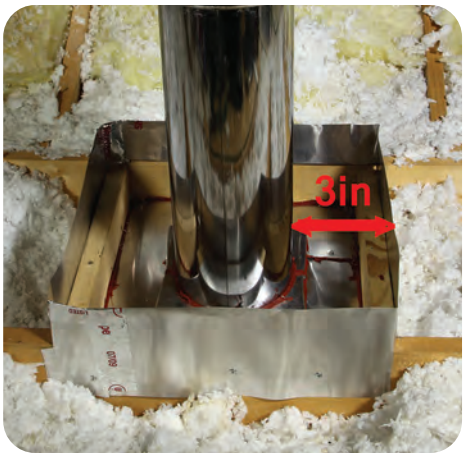
R-board can be substituted for EPS or XPS.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

4-1 PREPARE ATTIC FLOOR FOR INSULATION



5. Depth rulers installed, 1 per 300 square feet



6. All dams are built, as needed

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

Insulation dams will be installed where necessary and appropriate. Where building the dam is cheaper and accessible, said dam must be installed. When the conditioned space to be insulated is adjacent to unconditioned space (ie. garages and porches), it is acceptable to omit the insulation dam and blow insulation over the area as long as it's cheaper to do so and not in excess.

NOTES

Knob-and-tube can be replaced by a duly qualified professional.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

5-1 DAM, SEAL & INSULATE AN ATTIC HATCH

Aligns with SWS 3.0103.1





BEFORE

✗ Uninsulated attic access points allow conditioned air to escape the home in all seasons

AFTER

✓ Safely and durably sealing and insulating attic access doors prevent air movement and reduces heating and cooling loads

R-board can be substituted for EPS or XPS.

PPE



** if cutting lumber ** situation dependent*

TOOLS

- Measuring Tape
- Saw
- Drill
- T-Square
- Utility Knife
- Caulk Gun

MATERIALS

- Lumber
- Mechanical Fasteners
- Extruded Polystyrene (XPS) or Other Rigid Foam Insulation Board
- Foam Tape
- Adhesive
- Latch

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

5-1 DAM, SEAL & INSULATE AN ATTIC HATCH



1. Rigid, durable attic hatch blocking/dam is installed in a permanent way



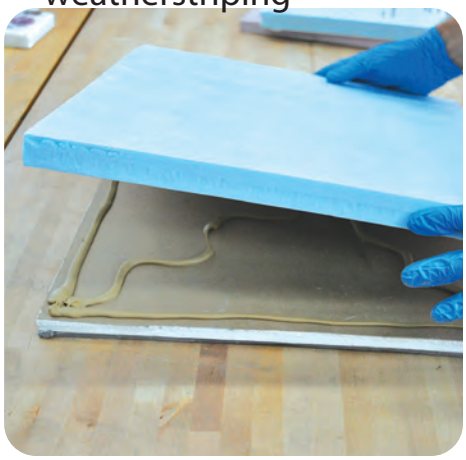
2. Dam is at least 2 inches taller than the final attic insulation depth



3. Cut gypsum board to hatch size for "friction fit" and air seal bottom of hatch with unbroken ring of Q lon type weatherstriping

NOTES

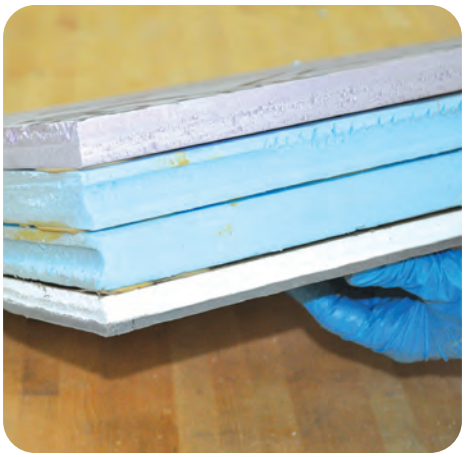
Photo 3 shows adhesive type weatherstriping. Q lon type weatherstriping is the expectation.



4. Cut and stack rigid foam insulation, gluing with appropriate adhesive, to build up R-value

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

5-1 DAM, SEAL & INSULATE AN ATTIC HATCH



5. Hatch is insulated to proper R-value (must equal the R-value of the surrounding attic)



6. Trim is air-sealed with appropriate material



7. For vertical accesses, run weatherstripping to air seal at these doorways too. Hold vertical accesses closed with latch if necessary

NOTES

Q lon type weatherstriping is required.

Paint and or seal new surfaces to prevent moisture intrusion. New hatches must be finished to nearly match the surrounding ceiling.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

5-2 DAM, SEAL & INSULATE A PULL-DOWN ATTIC STAIRWAY

Aligns with SWS 3.0103.1





BEFORE

✗ Pull-down stairs can be a weak point in thermal/pressure boundaries, as well as creating a place where insulation can fall down into the home

AFTER

✓ Attic pull-down stairs are safely and durably sealed and insulated to prevent air movement

R-board can be substituted for EPS or XPS.

TOOLS

- Measuring Tape
- Utility Knife
- Saw
- Caulk Gun
- Spray Foam Gun
- Drill

MATERIALS

- Extruded Polystyrene (XPS)
- Expanded Polystyrene (EPS)
- Polyiso
- Plywood
- 1-Part Spray Foam
- Spray Adhesive
- Caulk Adhesive
- Foil Tape
- Mechanical Fasteners
- Foam Tape
- Weatherstripping
- Latches

PPE



** if cutting lumber ** situation dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

5-2 DAM, SEAL & INSULATE A PULL-DOWN ATTIC STAIRWAY



1. Build cover above and around pull-down stair, taller than final insulation height



2. Insulate top and sides of dam cover, to match the R-value of the surrounding attic



3. Air seal all edges of trim



4. Air seal with foam tape or weatherstripping



5. Install latches to ensure hatch remains closed and air sealed if it does not remain closed with a 'friction fit'

NOTES

An inoperable whole house fan can be treated the same as pull-down stairs

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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6-1 INSULATE AN UNFLOORED ATTIC

Aligns with SWS 4.0103.2, 4.0103.4, 4.0103.6





BEFORE

Ensure that attic prep work has been completed before starting installation (See 4-1 Prep Attic Floor for Insulation)

AFTER

FINAL CHECKLIST

- ✓ Appropriate insulation material used
- ✓ Correct depth, as specified in work order
- ✓ Insulation level is even

NOTE - Fiberglass insulation will be utilized for manufactured homes and cellulose will be utilized for stick built homes unless the work scope specifies otherwise. Cellulose will never be allowable for manufactured homes.

PPE



** situation dependent*

TOOLS

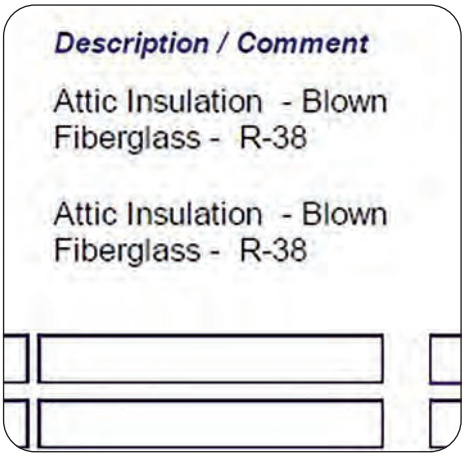
- Measuring Tape
- Insulation Machine
- Staple Gun

MATERIALS

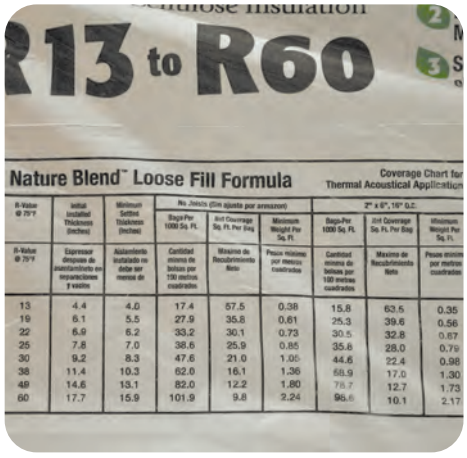
- Loose fill fiberglass or cellulose (as per work order)
- Staples

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

6-1 INSULATE AN UNFLOORED ATTIC



1. Verify against work order that correct insulation material is being installed



2. Verify insulation depth/density against manufacturer's density chart



3. While installing, regularly check depth of insulation for even coverage and to meet required depth



4. Ensure that insulation does not get into dammed-off areas, such as around chimneys and flues and inside soffit baffles



5. When complete, post insulation certificate by attic entrance

NOTES

Insulation certificate should include type, coverage area, installed thickness, minimum settled thickness, installed R-value, and number of bags installed.

Install attic insulation rulers every 300 sf.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

6-2 INSULATE UNDER A FLOORED ATTIC

Aligns with SWS 4.0103.6





BEFORE

✗ Attics with flooring often hide uninsulated cavities

AFTER

✓ An insulated attic floor provides a continuous, contiguous, safe, and compliant thermal boundary that prevents air movement

R-board can be substituted for EPS or XPS.

PPE



** situation dependent*

TOOLS

- Measuring Tape
- Utility Knife
- Insulation Machine
- Drill
- Hole Saw
- Prybar
- Caulk Gun

MATERIALS

- Loose Fiberglass or Cellulose Insulation
- Extruded Polystyrene (XPS)
- Caulk
- Mechanical Fasteners
- Gypsum Board
- Plugs

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

6-2 INSULATE UNDER A FLOORED ATTIC



1. Ensure that floor cavities are blocked securely at both ends



2. If boards can be loosened, pry up as few boards as possible to access all cavities. If flooring is in solid sheets, access holes may need to be drilled



3. Fill entire cavity with insulation to prescribed density

NOTES



4. Occasionally a homeowner may not want the attic floor to be disturbed. The cavities can also be accessed from below through the ceiling, particularly in garage spaces

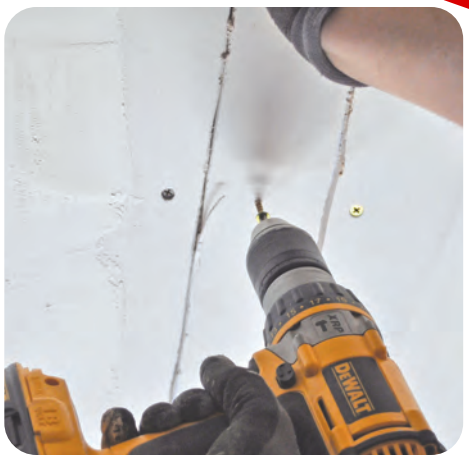
6-2 INSULATE UNDER A FLOORED ATTIC



5. Blocking still needs to be put into place



6. Blow insulation to completely fill cavities to prescribed density



7. Fill and reseal access holes to prevent air movement

NOTES

Conditioned spaces over garages are typically insulated via drill and blow from the garage interior.

Photo credit: Home Insulation of Syracuse – After

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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6-3 INSULATE AN ATTIC STAIRWAY

Aligns with SWS 4.0104.1, 4.0104.2, 4.0104.3, 4.0104.4, 4.0104.5, 4.0104.6, 4.0201.2, 4.0201.3, 4.0202.1



BEFORE

✗ Attic stairways can offer a unique set of insulation challenges. Clearly define where the thermal and pressure boundary are going to be located before starting insulation



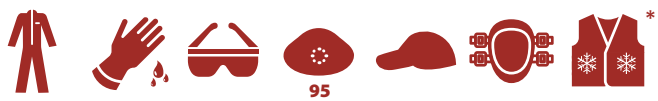
AFTER

✓ Insulation provides a continuous, contiguous, safe, and compliant thermal boundary that prevents air movement between the attic and the remainder of the home

TOOLS

- Measuring Tape
- Drill
- Utility Knife
- Hole Saw
- Insulation Machine
- Spray Foam Gun

PPE



** situation dependent*

MATERIALS

- Kraft-Faced Fiberglass Batts
- Loose Cellulose or Fiberglass Insulation
- Netting
- Furring Strips
- Staples
- Mechanical Fasteners
- Extruded Polystyrene (XPS)
- 2-Part Spray Foam
- 1-Part Spray Foam
- Plywood
- Gypsum Board
- House Wrap

R-board can be substituted for EPS or XPS

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

6-3 INSULATE AN ATTIC STAIRWAY



1. If walls are accessible from the attic side, choose between batt or blown-in insulation



2. Block off open cavities along the line of the thermal/pressure boundary



3. Air seal around blocking material



4. Cut batts to size for each individual cavity, ensuring no gaps remain, locating kraft-paper toward conditioned space



5. For batt insulation, cover installed batts with backing. For blown-in, attach netting to framing members, cut holes in netting and blow in insulation to 3.5 pounds per cubic inch



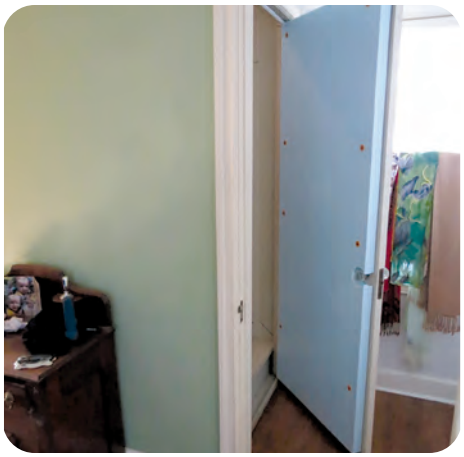
6. If walls are enclosed from attic side, drill holes in stairway's walls

Photo credit: Home Insulation of Syracuse – after, steps 8, 11 and 12

6-3 INSULATE AN ATTIC STAIRWAY



7. Dense pack stairway walls



8. Weatherstrip and insulate door



9. Insulate under stairway using insulation indicated by work order



10. Seal off insulation from conditioned space in home



11. If backside of stairs is already sealed, blow insulation into cavity behind stairs



12. Plug access holes for blown insulation

NOTES

Two part spray foam is not approved for use in Kansas.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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7-1 PREPARE A MANUFACTURED HOME CEILING FOR INSULATION

Aligns with SWS 4.0103.6, 4.0103.9, 4.0103.10, 4.0103.11, 4.0103.12





BEFORE YOU BEGIN

Make any repairs and preparation as noted from assessment, as well as fixing any new issues that could cause the ceiling to be compromised with the additional weight of insulation

AFTER

FINAL CHECKLIST

- ✓ Vents all terminate to outside and are properly sealed
- ✓ Flues are dammed properly
- ✓ Ceiling is in good condition to hold weight

TOOLS

- Measuring Tape
- Utility Knife
- Zip Tie Tensioner

MATERIALS

- R-8 minimum Flex Duct insulation
- Duct Insulation with Vapor Retarder
- Water Heater Blanket with Vapor Retarder
- Zip Ties
- Twine
- Spray Adhesive
- Mastic
- UL-Listed Fiberglass Mesh Tape

PPE



*if working with mold **weather dependent ***if cutting lumber

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-1 PREPARE A MANUFACTURED HOME CEILING FOR INSULATION



1. Ensure plumbing and exhaust vents terminate outside



2. Dam around high temperature flues (note: flue in image is in need of work)



3. Encapsulate non-IC rated can light fixture where possible and replace with airtight IC-rated fixtures, if attic cavity does not allow access before insulating



4. Repair roof leaks or other damage, as possible, or defer job if necessary

NOTES

Check with your state program to find out deferral thresholds and procedures

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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DECK OF CARDS

7-2 MH INSULATION: GABLE END BLOW METHOD

Aligns with SWS 4.0103.9





BEFORE

✗ Manfactured housing often does not meet regional standards for insulation

AFTER

✓ Fill entire cavity and reseal gable ends

TOOLS

- Drill
- Utility Knife
- Hole Saw or Saws-All
- Caulk Gun

MATERIALS

- Fiberglass Loose Insulation
- Mechanical Fasteners
- Caulk/Sealant

Cellulose insulation is NOT allowed for use in manufactured homes. Fiberglass insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.

NOTES

PPE



** if cutting lumber*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-2 MH INSULATION: GABLE END BLOW METHOD



1. Verify integrity of ceiling to hold weight of insulation



2. Ground blower hose to reduce chance of electrical build-up



3. Remove or fold up gable end to access attic



4. Insert blower hose as far as possible and then retract slowly to fill cavity entirely, on each side of marriage wall



5. Fill cavity and leave appropriate documentation



6. Reseal gable end or install gable vent at peak that has no more than 1/2 inch mesh screen. Repeat all steps from other end, if needed.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-3 MH INSULATION: EDGE BLOW METHOD

Aligns with SWS 4.0103.10





BEFORE

✗ Manufactured housing often does not meet regional standards for insulation

AFTER

✓ Verify reinstallation and proper sealing of edge of roof to ensure no water or pest intrusion

Cellulose insulation is NOT allowed for use in manufactured homes. Fiberglass insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.

PPE



** if cutting lumber ** situation dependent *** if cutting lumber*

TOOLS

- Drill
- Utility Knife
- Insulation Machine

MATERIALS

- Fiberglass Loose Insulation
- Blocking Material
- Butyl Tape

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-3 MH INSULATION: EDGE BLOW METHOD



1. Verify integrity of ceiling to hold weight of insulation



2. Prepare stable work area to access roof edge



3. Unfasten and remove J channel from edge of roof



4. Clean old butyl tape or putty from J channel and store J channel somewhere safe until it can be reinstalled



5. Remove staples holding down edge of roof



6. Insert blocks to hold roof edge up approximately 6 inches

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

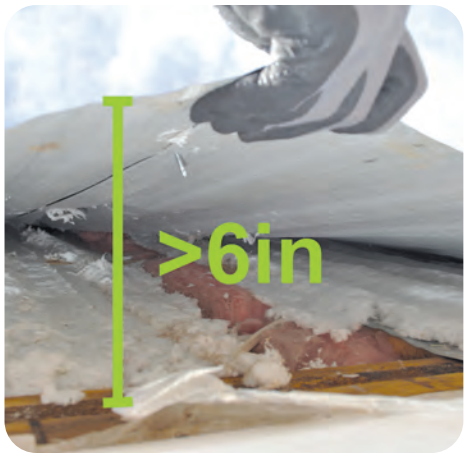
7-3 MH INSULATION: EDGE BLOW METHOD



7. Ground fill hose to reduce chance of electrical build-up



8. Insert blower hose as far as possible into cavity and retract slowly while filling space between trusses



9. Work down the edge of the roof until entire cavity is full



10. Remove blocks and reattach edge of roofing over exterior sidewall paneling



11. Replace butyl tape on J channel



12. Reattach J channel, lapping over edge of roof. Repeat entire process for other side, if necessary

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-4 MH INSULATION: RIDGE BLOW METHOD

Aligns with SWS 4.0103.11





BEFORE

✗ Manufactured housing commonly is underinsulated, particularly older models

AFTER

✓ After accessing from ridge, ridge cap can be installed or a series of vent caps

Cellulose insulation is NOT allowed for use in manufactured homes. Fiberglass insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.

PPE



TOOLS

- Drill
- Saw
- Insulation Machine
- Caulk Gun
- Metal Sheers

MATERIALS

- Loose Fiberglass Insulation
- Sealant
- 26-Gauge Metal Sheeting
- Vent Caps
- Mechanical Fasteners
- Elastomeric Coating

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-4 MH INSULATION: RIDGE BLOW METHOD



1. Remove ridge cap or cut access holes at ridge, leaving one side attached to put back in place



2. Insert blower hose



3. Fill all accessible areas



4. If not installing ridge or cap vents, replace flaps, patch over with metal, and seal with elastomeric sealant

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-5 MH INSULATION: INTERIOR BLOW METHOD

Aligns with SWS 4.0103.12





1. Drill holes in ceiling to fill each ceiling joist cavity

2. Blow insulation into ceiling cavity to appropriate R-value for region

NOTE - Equidistant holes will be drilled in a straight row parallel to the longitudinal exterior wall of the ceiling. There will be a minimum of one hole between each roof truss.

Cellulose insulation is NOT allowed for use in manufactured homes. Fiberglass insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.

TOOLS

- Hole Saw
- Vacuum
- Insulation Machine
- Caulk Gun

MATERIALS

- Fiberglass Loose Insulation
- Plugs
- Sealant

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-5 MH INSULATION: INTERIOR BLOW METHOD



3. Continue throughout house to ensure even coverage and no gaps



4. Seal all holes securely

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-6 MH INSULATION: TOP FILL BLOW METHOD

Aligns with SWS 4.0103.11





BEFORE

✗ Attics in older manufactured housing are often underinsulated or poorly insulated

AFTER

FINAL CHECKLIST

✓ Provide a continuous and safe thermal barrier

✓ Protect integrity of roof

Cellulose insulation is NOT allowed for use in manufactured homes. Fiberglass insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot.

PPE



TOOLS

- Saw
- Insulation Machine
- Caulk Gun
- Paint Brush
- Drill

MATERIALS

- Fiberglass Loose Insulation
- All-Weather Adhesive
- Sheet Metal
- Mechanical Fasteners
- Elastomeric Paint

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

7-6 MH INSULATION: TOP FILL BLOW METHOD



1. Drill or cut uniform access holes in the roof adequately spaced to access the entire roof cavity



2. Blow insulation into attic cavity to capacity



3. Run a continuous bead of flexible and durable all-weather adhesive around the access hole



4. Install a durable metal patch of equal or greater gauge than the roof material that overlaps the opening at least 2 inches on all sides, and fastening in place every 2 inches along perimeter



5. Apply elastomeric paint over patch that laps at least 6 inches on all sides to create a continuous seal

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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8-1 AIR SEAL ABOVE THE KNEE WALL

Aligns with SWS 3.0101.1, 3.0102.11





BEFORE

✗ Knee walls are part of the thermal and pressure boundary

AFTER

✓ Air sealing from above continues the pressure boundary while supporting future insulation

NOTES

R-board can be substituted for EPS or XPS.

PPE



** if cutting lumber ** situation dependent*

TOOLS

- Measuring Tape
- Utility Knife
- Saw
- Drill
- Caulk Gun
- Spray Foam Gun

MATERIALS

- Extruded Polystyrene (XPS)
- Plywood
- Gypsum Board
- Lumber
- Mechanical Fasteners
- Caulk
- Spray Foam
- Mastic

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

8-1 AIR SEAL ABOVE THE KNEE WALL



1. After clearing away debris, measure gap above knee wall in line with pressure boundary



2. Cut blocking material (XPS, wood, gypsum board) to fit gap



3. Securely fit infill or blocking material in place



4. Ensure blocking material is located in line with preferred pressure boundary



5. Secure in place with mechanical fasteners or adhesive as necessary to prevent movement when insulation is installed



6. Seal continuously around blocking material to preserve pressure boundary

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

8-2 AIR SEAL BENEATH THE KNEE WALL

Aligns with SWS 3.0101.1





BEFORE

✗ Knee walls are part of the thermal and pressure boundary

AFTER

✓ Air sealing from below allows areas of the attic floor to be treated separately according to whether they fall in or out of the pressure boundary

R-board can be substituted for EPS or XPS.



** if cutting lumber ** situation dependent*

TOOLS

- Measuring Tape
- Utility Knife
- Saw
- Drill
- Caulk Gun
- Spray Foam Gun

MATERIALS

- Extruded Polystyrene (XPS)
- Plywood
- Gypsum Board
- Lumber
- Mechanical Fasteners
- Caulk
- Spray Foam
- Mastic

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

8-2 AIR SEAL BENEATH THE KNEE WALL



1. After clearing away debris, measure gap below knee wall in line with pressure boundary



2. Cut blocking material (XPS, wood, gypsum board) to fit gap



3. Securely fit infill or blocking material in place



4. Ensure blocking material is located in line with preferred pressure boundary



5. Seal continuously around blocking material to preserve pressure boundary

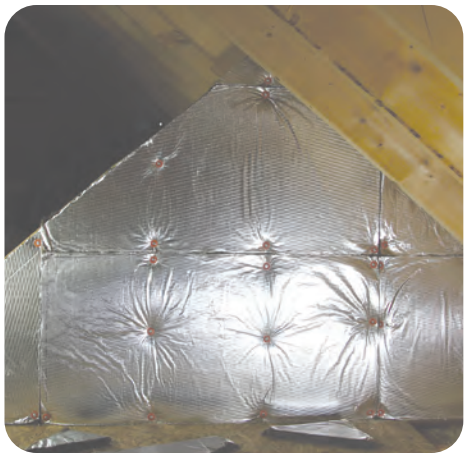
NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

8-3 INSULATE AN ATTIC KNEE WALL WITH BATTS

Aligns with SWS 4.0104.2, 4.0104.3





BEFORE

✗ Air sealed knee walls are ready for insulation

AFTER

✓ Once insulated, this knee wall provides a continuous, contiguous, safe, and compliant thermal boundary that prevents air movement

TOOLS

- Measuring Tape
- Utility Knife
- Staple Gun

MATERIALS

- Fiberglass Batts
- Staples
- Nylon Strap
- Mechanical Fasteners
- House Wrap
- Radiant Barrier

PPE



** situation dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

8-3 INSULATE AN ATTIC KNEE WALL WITH BATTS



1. Measure cavities



2. Cut batts for exact fit



3. Install batts with minimal compression



4. Install air-tight vapor-permeable backing material in contact with insulation

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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8-5 INSULATE AN ATTIC KNEE WALL WITH BLOWN INSULATION

Aligns with SWS 4.0104.1





BEFORE

✗ Air sealed knee walls are ready for insulation

AFTER

✓ Once insulated, this knee wall provides a continuous, contiguous, safe, and compliant thermal boundary that prevents air movement

R-board can be substituted for EPS or XPS.

PPE



** situation dependent*

TOOLS

- Measuring Tape
- Utility Knife
- Drill
- Staple Gun
- Hole Saw
- Insulation Machine

MATERIALS

- Extruded Polystyrene (XPS)
- Gypsum Board
- House Wrap
- Radiant Barrier
- Mechanical Fasteners
- Furring Strips
- Loose Insulation

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

8-5 INSULATE AN ATTIC KNEE WALL WITH BLOWN INSULATION



1. Securely install backing material over entire knee wall



2. Cut holes in backing material to allow access to all cavities



3. Blow insulation into cavities to meet dense-pack standards



4. Fill all cavities



5. Replace access hole plugs in backing material, if possible



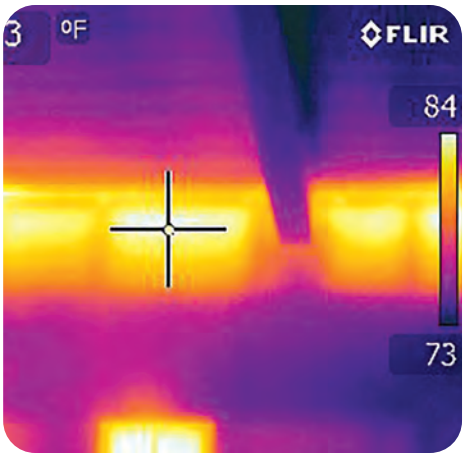
6. Seal access holes permanently and completely

NOTES

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9-1 DENSE-PACK A SIDEWALL VIA EXTERIOR BLOW

Aligns with SWS 4.0202.1





BEFORE

✗ Walls that are missing insulation or underinsulated are an opportunity for energy savings

AFTER

✓ When properly insulated, walls will allow minimal heat and air transfer

TOOLS

- Measuring Tape
- Utility Knife
- Pry-Bar
- Siding Remover
- Hole Saw
- Drill
- Insulation Machine

MATERIALS

- Plastic Sheeting
- Painters Tape
- Loose Cellulose or Fiberglass Insulation
- Plugs
- Caulk
- Spray Foam
- Mechanical Fasteners

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

9-1 DENSE-PACK A SIDEWALL VIA EXTERIOR BLOW



1. Protect work area from debris and dirt



2. Ensure balloon-framed walls are blocked at top and bottom



3. Ensure wall integrity is complete (no holes)



4. Remove siding as needed



5. Drill holes as required based on building frame design and exterior materials



6. Fill cavities completely and to proper density

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

9-1 DENSE-PACK A SIDEWALL VIA EXTERIOR BLOW



7. If possible, ensure all cavities are filled before completing job



8. Patch holes



9. Replace and/or repair siding

NOTES

Adding sidewall insulation is not allowable if live knob and tube wiring is present in the cavity to be insulated.

Exterior sidewall work must not result in any visible work areas nor plugs.

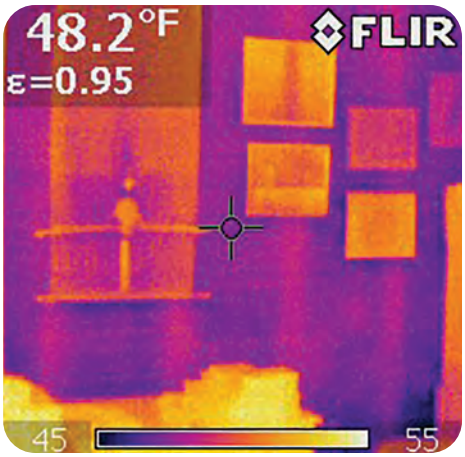
Plastic plugs will be allowed in garage walls and ceiling, CAZ closets, and other unfinished areas.

Plugs are allowed for manufactured home ceilings and paneling, with written permission from the owner.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

9-2 DENSE-PACK A SIDEWALL VIA INTERIOR BLOW

Aligns with SWS 4.0202.1





BEFORE

✗ Older houses often are lacking in insulation

AFTER

✓ Inconspicuous capped, patched, or covered holes are the ideal

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Hole Saw
- Drill
- Insulation Machine
- Infrared Camera

MATERIALS

- Plastic Sheeting
- Loose Cellulose or Fiberglass Insulation
- Gypsum Board
- Joint Compound
- Caulk
- Mechanical Fasteners
- Chair Rail
- Plugs
- Painters Tape

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

9-2 DENSE-PACK A SIDEWALL VIA INTERIOR BLOW



1. Protect work area from debris and dust



2. Ensure balloon-framed walls are blocked at top and bottom



3. Ensure wall integrity is complete (no holes)

NOTES

Interior sidewall work should strive for the highest quality of finished product. Clients shall be informed and agree to the type of sidewall patching performed. Sheetrock and lath and plaster holes should be finished to provide a smooth nearly paint ready surface. Minimal or no necessary sanding is the expectation. Finished chair rail, to cover the holes, is also acceptable.

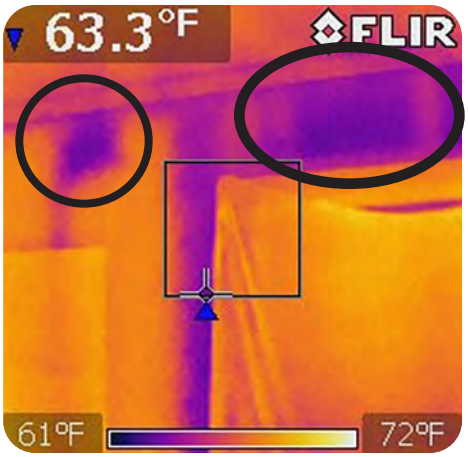


4. Drill holes as required based on building design

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

9-2 DENSE-PACK A SIDEWALL VIA INTERIOR BLOW







5. Fill cavities completely and to proper density

6. If possible, ensure all cavities are filled before completing job (note: dark areas were missed)

7. Patch/coat interior holes to match original surface or cover with trim. Use chair rail if preferred.

NOTES

Sidewall dense pack insulation is not allowable if live knob and tube wiring is present in the cavity to be insulated.

Follow all applicable KDHE regulations.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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10-2 INSULATE MANUFACTURED HOME SIDEWALLS WITH BLOWN INSULATION

Aligns with SWS 4.0202.4, 4.0202.5





BEFORE

✗ Older manufactured housing is often lacking insulation since it did not have to be built to a particular jurisdiction's codes

AFTER

✓ When properly insulated, siding will not bulge or be dented from installation

TOOLS

- Drill
- Insulation Machine

MATERIALS

- Loose Fiberglass Insulation
- Mechanical Fasteners

PPE



** situation dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

10-2 INSULATE MANUFACTURED HOME SIDEWALLS WITH BLOWN INSULATION



1. Ensure the integrity of the wall to be insulated, both from exterior and interior



2. Remove siding as needed, from the bottom



3. Fill cavity with blown insulation, ensuring to get past belt rails and electrical



4. Reinstall siding



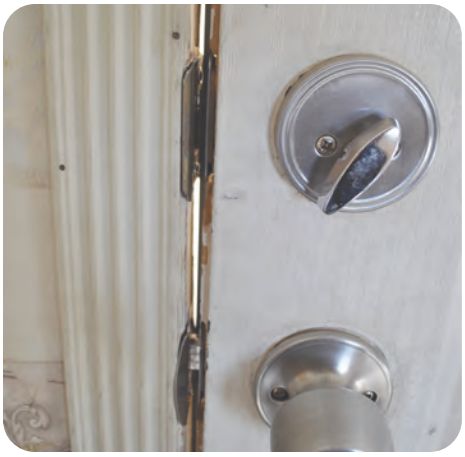
5. Be prepared to adapt insulation strategy dependent upon exterior materials

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

11-1 INSTALL WEATHERSTRIPPING ON AN EXTERIOR DOOR

Aligns with SWS 3.0202.1





BEFORE

✗ Daylight visible around an exterior door indicates air infiltration

AFTER

FINAL CHECKLIST

✓ Door closes and opens easily

✓ Weatherstrip makes a good seal with the door

✓ Weatherstrip does not get flattened in a way that will lead to damage when used

PPE



TOOLS

- Tape Measure
- Snips
- Drill with Appropriate Bits

MATERIALS

- Weatherstripping

Q Lon type weatherstripping required.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

11-1 INSTALL WEATHERSTRIPPING ON AN EXTERIOR DOOR



1. Measure doorway for weatherstripping



2. Measure door top or bottom as well for weatherstripping and potential door bottom or sweep



3. Notch upper ends of side weatherstripping to allow for top piece



4. Fit weatherstripping snugly into rabbet, if one exists, and against other pieces



5. Fasten weatherstripping securely when no rabbet exists

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

11-2 INSTALL A DOOR SWEEP OR DOOR BOTTOM ON AN EXTERIOR DOOR

Aligns with SWS 3.0202.1





BEFORE

✗ Air and water can come in under doors when there is no door bottom or sweep

AFTER

FINAL CHECKLIST

✓ Ensure a good seal to prevent air infiltration

✓ Ensure unimpeded door operation

MATERIALS

- Mechanical Fasteners
- Caulk

PPE

TOOLS

- Measuring Tape
- Metal Snips
- Saw
- Drill
- Caulk Gun

NOTES

Door bottoms commonly are installed on new doors, those that have wooden thresholds, or to replace older existing door bottoms.

For houses with a rubber threshold, door sweeps are more common.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

11-2 INSTALL A DOOR SWEEP OR DOOR BOTTOM ON AN EXTERIOR DOOR

STEPS 1-3: FOR DOOR SWEEP AND DOOR BOTTOM



1. Measure width of door and ensure that door sweep is appropriate length



2. Adjust threshold to ensure that it is seated tightly



3. Apply caulk to threshold at floor on interior, and exterior if possible, to minimize water intrusion

STEPS 4-6: FOR DOOR SWEEP



4. Install door sweep on interior face of door, centering on door face



5. Attach door sweep using mechanical fasteners



6. Evenly place mechanical fasteners along entire length of door sweep

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

11-2 INSTALL A DOOR SWEEP OR DOOR BOTTOM ON AN EXTERIOR DOOR

STEPS 4-8: FOR DOOR BOTTOM



4. With threshold adjusted, measure door opening height



5. Remove door from opening if height of door needs to be shortened to make room for door bottom



6. Trim door, if possible, to ensure good fit of door bottom



7. Trim sweep to match width of door



8. Ensure that door bottom sits tight against the door and reinstall door

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

12-1 AIR SEAL SILL PLATE AND RIM JOIST

Aligns with SWS 3.0104.1





BEFORE

✗ Air movement around sill plates and near rim joists needs to be addressed before insulating

AFTER

✓ Once air sealed, the cavity is ready for insulation

TOOLS

- Spray Foam Gun
- Caulk Gun

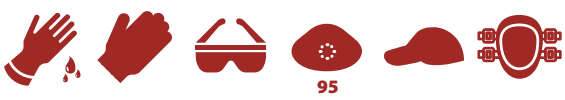
NOTES

Tube sealant or caulking may be a more reliable choice than expanding foam for gaps 1/4" or less

MATERIALS

- 1-Part Spray Foam
- Backer Rod
- Machine Mesh
- Steel Wool
- Caulk

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

12-1 AIR SEAL SILL PLATE AND RIM JOIST



1. For exterior holes larger than 1/4 inch, steel wool or other pest blocking material before sealing



2. Cut backing material to fill space



3. Seal over to hold backing material in place and air seal



4. Seal penetrations on subfloor as well, looking out not only for current electrical and plumbing, but also vacated holes



5. Push sealant into seams where framing members meet



6. Create a continuous seal on all seams

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

12-2 INSULATE RIM JOIST

Aligns with SWS 4.0401.1, 4.0401.2, 4.0401.3





BEFORE

✗ Basement and crawlspace rim joists must be addressed when part of the thermal boundary

AFTER

✓ Foam products require a thermal barrier or coating, such as 1/2-inch gypsum board, to separate them from permanently habitable spaces

NOTE: The thermal barrier is not required if the foam product is less than 3.25" thick and the space is not permanently habitable.

R-board can be substituted for EPS or XPS.

PPE



** if using two-part*

TOOLS

- Measuring Tape
- Utility Knife
- Spray Foam Gun
- Caulk Gun
- Drill

MATERIALS

- Polyisocyanurate Foam Board
- Extruded Polystyrene (XPS)
- 1-Part Spray Foam
- Gypsum Board
- Mechanical Fasteners
- Caulk

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

12-2 INSULATE RIM JOIST



1. Measure each individual cavity to be insulated and take note of obstacles for insulation



2. Cut insulation, either rigid foam board or wrapped batts, for each individual cavity



3. Ensure space is filled with no gaps or misalignment, and insulation is in full contact with the rim joist

NOTES

As long as foam is not over 3.25 inches thick and space is not permanently habitable, insulation does not need to be covered by thermal barrier.



4. Ensure insulation is secured in place and will not move over time

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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12-3 INSULATE BASEMENT WALLS IN CONDITIONED SPACE

Aligns with SWS 4.0402.4, 4.0402.5





BEFORE

✗ An uninsulated wall in a "conditioned" space allows the loss of conditioned air

AFTER

✓ A sealed continuous air barrier finishes off an insulated basement wall, providing air sealing and thermal comfort

TOOLS

- Caulk Gun
- Spray Foam Gun
- Metal Snips
- Measuring Tape
- Utility Knife
- Drill
- Staple Gun
- Taping Knife
- Mudding Trowel

MATERIALS

- Backer Rod
- Metal Lath
- Spray Foam
- Caulk
- Fiberglass Kraft-Faced Batts
- Extruded Polystyrene (XPS)
- Staples
- Gypsum Board
- Luan
- Mechanical Fasteners
- Joint Compound
- Joint Tape

R-board can be substituted for EPS or XPS.

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

12-3 INSULATE BASEMENT WALLS IN CONDITIONED SPACE



1. Check wall for penetrations and seal as needed



2. Check wall for water intrusion that needs to be mitigated first. All bulk sources of moisture should be directed away from the foundation walls



3. If insulation has vapor retarder on only one side, install it facing the conditioned space



4. Install insulation to prescribed R-value in full contact with the entire perimeter of foundation wall from ceiling to floor



5. Install a sealed air barrier on the conditioned side of the insulation. When using foam, gypsum board must be at least 1/2 inch to meet building codes for an ignition barrier

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

12-4 INSULATE CONDITIONED CRAWLSPACE WALL

Aligns with SWS 4.0402.2, 4.0402.3





BEFORE

✗ Unvented crawlspaces are sometimes considered to be part of the conditioned space, so the walls need insulation

AFTER

FINAL CHECKLIST

✓ Insulation is or has class II vapor retarder

✓ Vapor retarder faces conditioned space

✓ Insulation laps underneath ground vapor retarder at foundation wall

TOOLS

- Measuring Tape
- Utility Knife
- Drill
- Spray Foam Gun

MATERIALS

- Polyisocyanurate Foam Board
- Nylon Fasteners

R-board

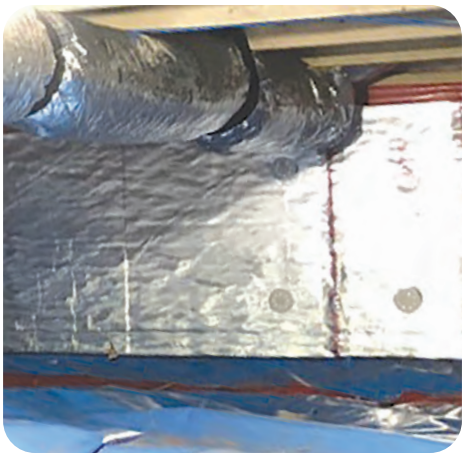
PPE



** if using two-part*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

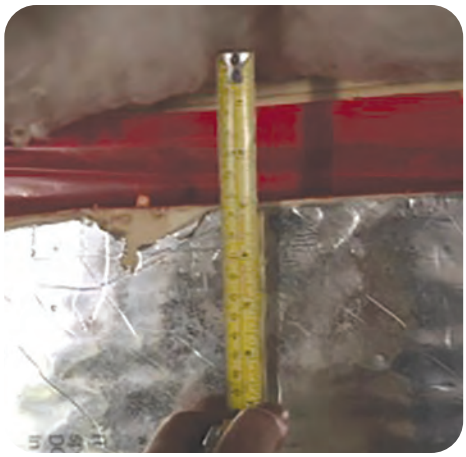
12-4 INSULATE CONDITIONED CRAWLSPACE WALL



1. Use a fire-safe and hydrophobic material



2. Attach insulation in a durable manner



3. Leave a 3-inch termite inspection gap between the bottom of the sill plate at the top of the insulation, if needed

NOTES

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

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

R-19 fiberglass batt insulation may also be used. R-19 vinyl-faced, metal building insulation or wall batt insulation may be used. Insulation should be attached to the entire wall surface with appropriate fasteners. Install insulation with no significant voids or edge gaps. Foundation insulation will only be used in conjunction with a ground moisture barrier. Draped insulation shall extend down the wall and extend 1 foot from the wall along the ground.

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

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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13-1 AIR SEAL SMALL PENETRATIONS IN A SUBFLOOR

Aligns with SWS 3.0101.1, 3.0104.1



Many types of caulks and sealants will easily span and seal a 1/4-inch gap



One-part spray foams can also span up to 3 inches to create an air seal

High temp sealants and foams must be utilized when installed adjacent to heat sources.

TOOLS

- Caulk Gun
- Spray Foam Gun
- Utility Knife

MATERIALS

- Caulk Sealant
- One-Part Spray Foam
- Backer Rod

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

13-1 AIR SEAL SMALL PENETRATIONS IN A SUBFLOOR



1. For small penetrations, caulk or sealant is often enough to seal the gap



2. Use a backer rod or other infill material when sealing a gap larger than 1/4 inch with caulk



3. Seal over the backer rod to establish the air seal



4. Spray foam can also be used in areas with slightly larger penetrations

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

13-2 AIR SEAL LARGE PENETRATIONS IN A SUBFLOOR

Aligns with SWS 3.0101.1, 3.0104.1





BEFORE

✗ Larger penetrations in the subfloor, especially plumbing chases, need to be air sealed

AFTER

✓ Depending on the size of the gap, one-part spray foam or a combination of infill material and foam or caulk can be used

R-board can be substituted for EPS or XPS.

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Drill
- Spray Foam Gun
- Caulk Gun

MATERIALS

- One-Part Spray Foam
- Two-Part Spray Foam
- Caulk
- Extruded Polystyrene (XPS)
- Mechanical Fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

13-2 AIR SEAL LARGE PENETRATIONS IN A SUBFLOOR



1. One-part spray foam expands to fill large holes, but needs support for holes over 5 inches



2. For larger holes, rigid infill material is needed



3. Cut rigid infill with attention to locations of pipes and electrical



4. Secure rigid infill in place and seal smaller gaps around infill with appropriate materials



5. Use appropriate materials for high-temperature locations, such as around flues and chimneys

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

13-3 AIR SEAL BALLOON FRAMING AT SUBFLOOR

Aligns with SWS 3.0101.1, 3.0102.4, 3.0104.1





BEFORE

✗ Balloon-framed walls have an open cavity that runs from the basement to the attic, allowing for large amounts of air flow via stack effect

AFTER

✓ Securely sealing off these cavities prevents air movement, as well as providing a barrier to hold in insulation and providing fire blocking

R-board can be substituted for XPS or EPS.

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Saw
- Drill
- Spray Foam Gun
- Caulk Gun
- Chip Brush

MATERIALS

- Extruded Polystyrene (XPS)
- Expanded Polystyrene (EPS)
- Gypsum Board
- Lumber
- Mechanical Fasteners
- 1-Part Spray Foam
- 2-Part Spray Foam
- Caulk
- Mastic

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

13-3 AIR SEAL BALLOON FRAMING AT SUBFLOOR



1. Measure opening



2. Cut blocking material to fit



3. Seal all edges with caulk, foam or mastic

NOTES

Spray foam will not be used in spaces that will be exposed to habitable living space.

Installations and air sealing must be professional in appearance.

Photo credit: InterNACHI – Before

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14-1 INSULATE A SUBFLOOR WITH BATTS ABOVE UNCONDITIONED SPACE

Aligns with SWS 4.0301.1, 4.0301.6, 4.0302.1





BEFORE

✗ Uninsulated, unconditioned spaces drive down the energy efficiency of HVAC systems

AFTER

FINAL CHECKLIST

✓ Vapor retarder faces warm side of floor

✓ Consistent cover across subfloor

R-board can be substituted for EPS or XPS.

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Drill

MATERIALS

- Kraft-Faced Fiberglass Batts
- Strapping
- Netting
- Rigid Barrier Such as Extruded Polystyrene (XPS)
- Mechanical Fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

14-1 INSULATE A SUBFLOOR WITH BATTS ABOVE UNCONDITIONED SPACE



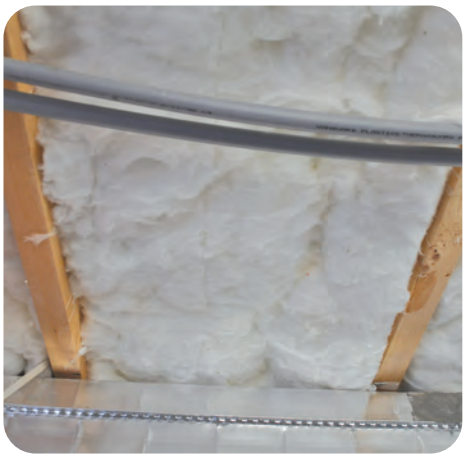
1. Ensure air sealing is complete



2. Insulation R-value matches work order



3. Batt vapor retarder faces warm side of floor



4. Batts installed with no gaps

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

14-1 INSULATE A SUBFLOOR WITH BATTS ABOVE UNCONDITIONED SPACE







5. Batts are in good contact with subfloor

6. Batts held in place with physical fasteners, with minimal compression

7. In areas where exposure to outside elements or vermin may be a concern, such as cantilevered or exposed floors, a rigid barrier is an extra layer of protection

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

SFCC ENERGY SMART ACADEMY DECK OF CARDS

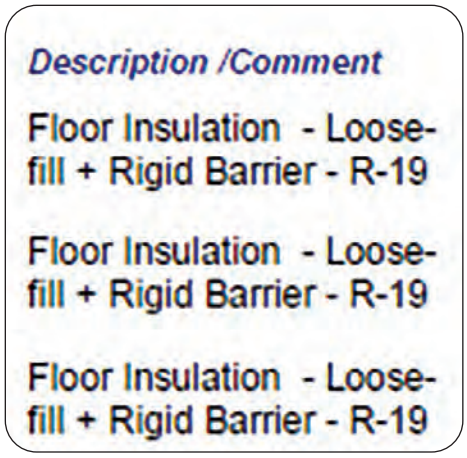
14-2 INSULATE A SUBFLOOR WITH BLOWN INSULATION ABOVE UNCONDITIONED SPACE

Aligns with SWS 4.0301.2, 4.0301.3, 4.0301.4, 4.0302.2, 4.0302.3

BEFORE YOU BEGIN



Uninsulated, unconditioned spaces drive down the energy efficiency of HVAC systems



✓ Review work order to verify if dense-pack or loose fill is required. Netting a subfloor will mean loose fill, but a rigid barrier can mean either.

R-board can be substituted for EPS or XPS.

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Scissors
- Caulk Gun
- Insulation Machine
- Pressure Gauge
- Hole Saw

MATERIALS

- Netting
- Rigid Barrier Such as Extruded Polystyrene (XPS)
- Staples
- Mechanical Fasteners
- Caulk
- Cellulose or Fiberglass Loose Insulation

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

14-2 INSULATE A SUBFLOOR WITH BLOWN INSULATION ABOVE UNCONDITIONED SPACE



1. Verify all air sealing and prep work is complete



2. Attach rigid barrier to cover entire cavity



3. Seal seams between sheets of rigid material to prevent air movement and insulation leakage



4. Cut an access hole into each cavity of the floor, large enough for fill tube



5. Use appropriate fill tube to correspond with work order requirements



6. Fill cavity completely to density required by work order

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

14-2 INSULATE A SUBFLOOR WITH BLOWN INSULATION ABOVE UNCONDITIONED SPACE



7. Plug access hole either with original material cut out or appropriate replacement



8. Seal around plug to keep it secure and air tight



9. For work orders that require netting, secure a smooth layer of netting across the bottom of floor joists

NOTES



10. Keep staples close together

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

14-2 INSULATE A SUBFLOOR WITH BLOWN INSULATION ABOVE UNCONDITIONED SPACE



11. Cover the entire cavity to ensure continuous insulation coverage and prevent insulation from blowing out the ends



12. Cut access hole for fill tube



13. Loose fill netting to required density



14. Ensure insulation coverage is even and continuous throughout floor cavities

NOTES

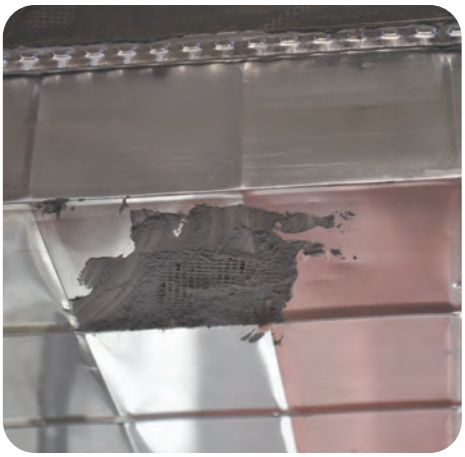
Tools and materials listed are only recommendations and may not include everything needed to complete the job.

SFCC ENERGY SMART ACADEMY
DECK OF CARDS

15-1 INSULATE A MANUFACTURED HOME BELLY

Aligns with SWS 4.0302.9, 4.0302.1, (3.0102.5, 3.0102.6, 3.0102.7)

BEFORE YOU BEGIN



CHECKLIST

- ✓ Air and duct sealing complete
- ✓ Electrical/plumbing issues fixed
- ✓ Belly board repaired/replaced

R-board can be substituted for EPS or XPS.

NOTE - SEE ADDENDUM A-12 FOR ADDITIONAL INFORMATION REGARDING SOFT BELLY VERSES HARD BELLY REQUIREMENTS

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Drill
- Insulation Machine
- Pressure Gauge
- Saw

MATERIALS

- Belly Wrap
- Belly Board
- Caulk
- Mechanical Fasteners
- Mastic
- Spray Foam
- Extruded Polystyrene (XPS)

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

15-1 INSULATE A MANUFACTURED HOME BELLY



1. Remove old insulation and make repairs as needed



2. Attach new belly wrap



3. Seal seams of belly wrap

NOTES

NOTE - SEE ADDENDUM A-12 FOR ADDITIONAL INFORMATION REGARDING SOFT BELLY VERSES HARD BELLY REQUIREMENTS

Cellulose will not be utilized in manufactured homes due to weight and moisture concerns.

Crossover ducts will be suspended with 1.5" or wider material, every 4' or less, without crimping.

Penetrations will be air sealed prior to insulation provided that there is adequate access.



4. Cut access holes to ensure entire cavity will receive continuous and consistent insulation

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

15-1 INSULATE A MANUFACTURED HOME BELLY



5. Fill entire belly cavity to prescribed R-value (KS maximum of R-30)



6. Apply waterproof, permanent adhesive to patch for belly wrap, with patch sized at least 3 inches larger than hole in barrier



7. Stitch staple every 2" to ensure permanent adhesion

NOTES

Manufactured housing with typical skirting will be considered an open crawlspace.

Manufactured housing with an enclosed, unvented area below the belly, typical of permanent foundations, will be modeled as an enclosed crawlspace or basement.

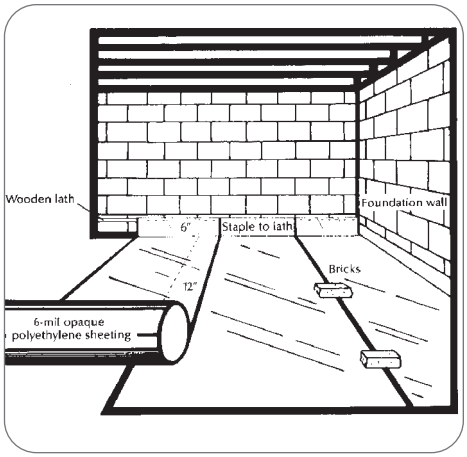
NOTE- See A-10 for additional details regarding soft belly repairs verses hard belly repairs.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

16-1 INSTALL A CRAWLSPACE VAPOR RETARDER

Aligns with SWS 2.0202.1, 2.0202.2, 2.0202.3, (3.0104.1)





BEFORE

✗ Moisture and resultant mold issues in crawlspaces can cause extensive damage to floor assemblies and foundations

AFTER

✓ A well-installed vapor retarder helps to minimize ground moisture vapor and soil gas, such as radon

TOOLS

- Utility Knife
- Measuring Tape
- Caulk Gun

MATERIALS

- 6 Mil Plastic Sheeting
- Durable Adhesive Tape
- Furring Strips
- Mechanical Fasteners
- Ballast
- Sealant

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

16-1 INSTALL A CRAWLSPACE VAPOR RETARDER



1. Clear out storage and debris



2. Select appropriate materials



3. Spread out plastic as flat as possible

NOTES

Ground moisture barrier shall extend a minimum of 6" up the foundation walls / pillars and must be mechanically fastened or sealed with bonding agents. Best practice is to extend the moisture barrier to a point above the exterior grade, without contactiong the sill or other wood structure. Barrier must be attached with a durable connection. Best practices include adhesive with mastic, or mechanically fastened. Wehn the moisture barrier is installed on sloping ground, it will be fastened to the ground with durable fasteners or ballast.



4. Extend plastic a minimum of 6 inches up walls, piers and columns

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

16-1 INSTALL A CRAWLSPACE VAPOR RETARDER



5. Use a minimum 12 inch reverse shingle overlap and tape seams



6. Plastic needs to be fastened in durable way: e.g. tape, sealant, screws



7. Use ballast to hold down vapor retarder

NOTES

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

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

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DECK OF CARDS

16-2 REPAIR AN EXISTING CRAWLSPACE VAPOR RETARDER

Aligns with SWS 2.0202.1, 2.0202.2, 2.0202.3, (3.0104.1)





BEFORE

✗ Improperly installed and damaged vapor retarders do not prevent moisture and resultant mold issues in crawlspace

AFTER

✓ A well-installed vapor retarder helps to minimize ground moisture vapor and soil gas, such as radon

PPE



TOOLS

- Utility Knife
- Measuring Tape
- Caulk Gun

MATERIALS

- 6-Mil Plastic Sheeting
- Durable Adhesive Tape
- Furring Strips
- Mechanical Fasteners
- Ballast
- Sealant

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

16-2 REPAIR AN EXISTING CRAWLSPACE VAPOR RETARDER



1. When repairing along the ground, ensure seams overlap uphill in a reverse shingle pattern



2. Overlap seams by at least 12 inches



3. Spread out plastic as flat as possible



4. Plastic needs to be fastened in durable way: e.g. tape, sealant



5. Ensure plastic extends a minimum of 6 inches up walls, piers and columns and is securely attached

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

17-1 VENT A CLOTHES DRYER

Aligns with SWS 6.0202.1, (6.0101.1, 6.0101.2)





BEFORE

✗ Dryer vents with long bumpy runs create a fire hazard

AFTER

✓ When properly vented, dryers run more efficiently, are safer, and last longer

An elbow may be necessary in some circumstances.

PPE

TOOLS

- Metal Snips or Grinder
- Flathead Screwdriver
- Utility Knife

MATERIALS

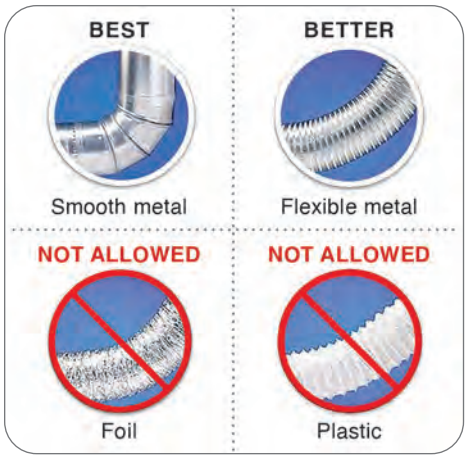
- 28-Gauge Rigid or Semi-Rigid Metal Ducting
- Worm-Drive Clamps
- Backdraft Damper
- Duct Insulation
- Foil Tape

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

17-1 VENT A CLOTHES DRYER



1. Keep duct run as short as possible to prevent backup of lint



2. Transition duct material is metal rigid or flexible duct must be labeled UL 2158A and no more than 8 feet in length without any joints, and shall not extend beyond the room in which the appliance is located



3. Correct fasteners are used (no screws penetrating into duct)



4. Duct terminates to outside, at a downward slope when possible

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

17-1 VENT A CLOTHES DRYER



5. Termination has backdraft damper and no cage



6. Duct in unconditioned space is insulated



7. If duct run must exceed 35 feet, install an exhaust power ventilator

NOTES

Insulate dryer ducts installed outside of the thermal boundary to a minimum of R-8.
Select primary dryer ducting material that is 28 gauge metal with a smooth interior.

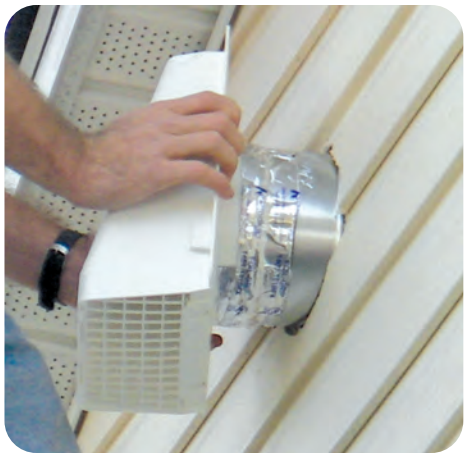
Foil, vinyl, or plastic dryer ducting is not allowable.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

18-1 INSTALL EXHAUST FAN FLEX DUCT (BATH FAN ONLY)

Aligns with SWS 6.0101.1, 6.0101.2, 6.0201.1





BEFORE

✗ Exhausting moisture from bath fans into the attic or crawlspace can cause mold and rot in building materials

AFTER

✓ Bath fans must exhaust to the exterior of the home

TOOLS

- Measuring Tape
- Utility Knife
- Zip Tie Tensioner
- Drill

MATERIALS

- Flex Ducting with R-8 Insulation (unless ducting will be buried in insulation)
- Zip Ties
- Support Strapping
- Mechanical Fasteners

PPE



** if going in attic*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

18-1 INSTALL EXHAUST FAN FLEX DUCT (BATH FAN ONLY)



1. Ensure proper connection of duct to bath fan



2. Ensure flex ducting runs smoothly with no kinks or u-turns



3. Create the shortest run possible to an exterior termination and provide adequate support as needed without compressing the duct

NOTES

See ASHRAE 62.2-2016 regulations regarding ductwork requirements regarding air sealing, being as straight as possible, being supported, and being insulated will apply to exhaust fans. When applicable, pitch duct to remove condensation to outdoors. Duct diameter will be equal to or greater than the exhaust fan outlet.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

18-2 INSTALL A HARD-DUCTED EXHAUST VENT

Aligns with SWS 6.0101.1, 6.0101.2, 6.0201.1, 6.0201.2



BEFORE

✗ Kitchens and bathrooms must be ventilated to control moisture, vapor, and combustion gases

TOOLS

- Measuring Tape
- Hole Saw
- Drill
- Caulk Gun

AFTER

KITCHEN CHECKLIST

✓ Located within 5 feet of primary cooking surface

✓ At least 100 cfm but not more than 3 sones

✓ Efficacy of 2.8 cfm/watt or more

BATHROOM CHECKLIST

✓ Located in center of room

✓ At least 50 cfm but not more than 2 sones

✓ Efficacy of 4 cfm/watt or more

NOTE - The above specifications are for spot ventilation only. Follow ASHRAE specifications for continuous.

MATERIALS

- Mastic
- Brush
- Foil Tape
- Duct Insulation
- 28-Gauge Ducting
- Vent Termination
- Caulk

PPE



** if going in attic **weather dependent if going in attic*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

18-2 INSTALL A HARD-DUCTED EXHAUST VENT



1. Fasten rigid duct using three equally spaced screws



2. Keep duct run as short as possible with few turns, and run to exterior – either via roof or sidewall



3. Seal all joints with mesh and mastic or foil tape

NOTES

Best practice is to wire ASHRAE fans located in the bath for spot and continuous operation.

Doing so provides options in the event that air sealing results exceed the initial expectation.

Follow manufacturer recommendations regarding installation.



4. Completely seal joints

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

18-2 INSTALL A HARD-DUCTED EXHAUST VENT



5. Locate exterior vent based on duct run and size hole less than 1/2 inch larger than duct



6. Chose appropriate exterior termination to match size of duct while minimizing water intrusion and pest infestation. Seal around exterior termination as needed



7. Ducting that runs through unconditioned space will be insulated to R-8

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

SFCC
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19-1 SEAL DUCTS WITH MASTIC

Aligns with SWS 5.0106.1, 6.0101.2, 6.0101.3, (5.0105.1, 5.0105.2, 5.0105.3)



CHECKLIST

- ✓ Ensure ducts are properly connected
- ✓ Ensure ducts are properly supported

TOOLS

- Drill
- Zip Tie Tensioner
- Caulk Gun

MATERIALS

- Mastic
- Fiberglass Mesh Tape
- Chip Brush
- Mechanical Fasteners
- 26-Gauge Metal Sheeting
- Duct or Electrical Tape (for temporary use)
- Flexible Caulking
- Butyl Tape

NOTES

Mastic alone can be used for gaps <1/8-inch, when gap is located more than 10 inches from air handler and static pressure is less than 1 iwc.

PPE

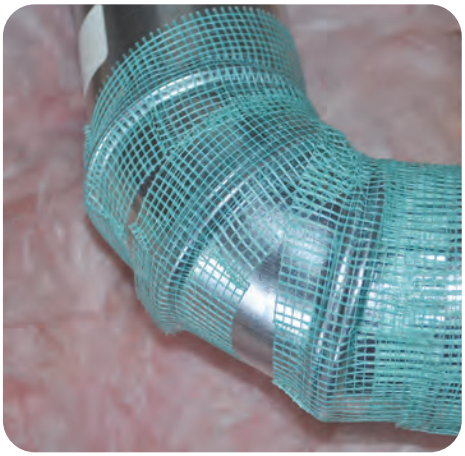


** location dependent **weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

19-1 SEAL DUCTS WITH MASTIC

METHOD A – FOR SMALL GAPS (LESS THAN 1/4 INCH) INCLUDING ALL JOINTS, SEAMS, AND CRACKS IN DUCT SYSTEM



A-1. Apply fiberglass mesh tape over all gaps, seams, joints, etc.



A-2. Apply mastic over all mesh tape and all gaps, seams, joints, etc.

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

19-1 SEAL DUCTS WITH MASTIC

METHOD B – FOR MEDIUM GAPS (1/4-3/4 INCH) SUCH AS MINOR HOLES AND PENETRATIONS IN DUCT SYSTEM



B-1. Small holes and penetrations require one additional step



B-2. Apply temporary tape as a backer to hold mastic



B-3. Apply mastic over the tape



B-4. Push fiberglass mesh into the mastic



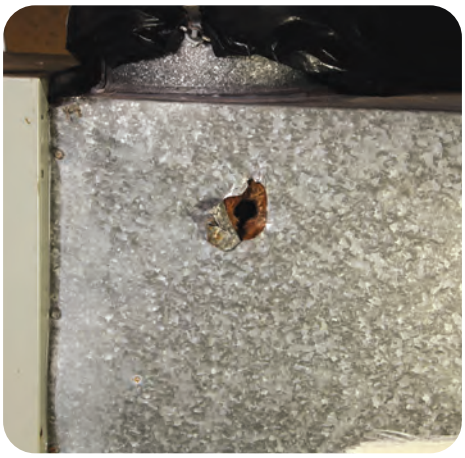
B-5. Apply additional mastic over mesh and tape, extending at least 1 inch past edges of tape in all directions

NOTES

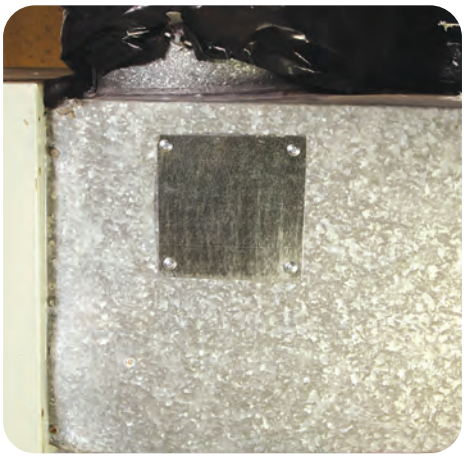
Tools and materials listed are only recommendations and may not include everything needed to complete the job.

19-1 SEAL DUCTS WITH MASTIC

METHOD C – FOR LARGER GAPS OR HOLES (OVER 3/4 INCH)



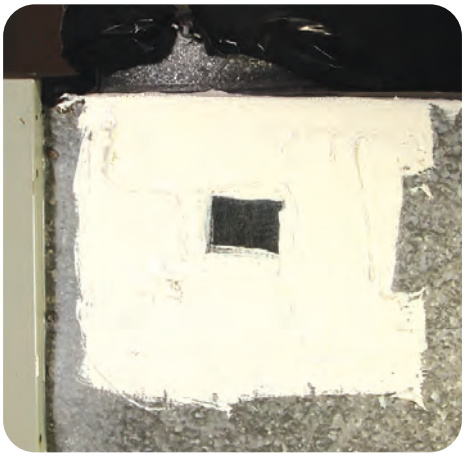
C-1. Larger holes require a different process



C-2. Cut patch that will extend over entire gap or hole and affix with mechanical fasteners



C-3. Apply mastic over edges and fasteners of patch and push fiberglass mesh into it



C-4. Apply additional mastic over mesh, extending at least 1 inch past tape and seam in all directions

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

19-1 SEAL DUCTS WITH MASTIC

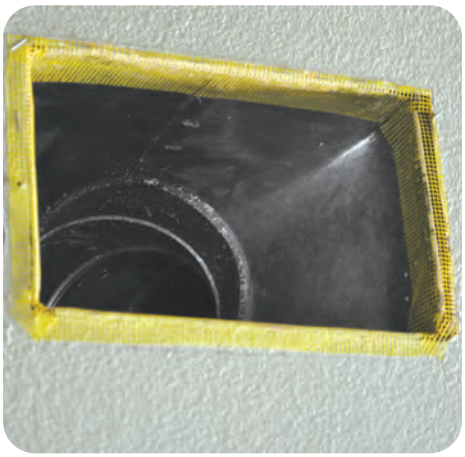
METHOD D – FOR CONNECTIONS BETWEEN DUCT BOOT AND SURFACE



D-1. Often, holes for duct boots are cut too large and leave gaps around the boot as a path for air leakage



D-2. Clean the area around the duct boot to allow for better adhesion of fiberglass mesh tape



D-3. Apply fiberglass mesh tape bridging from duct boot interior to surface, taking care not to extend past what will be covered by register



D-4. Apply mastic over mesh tape and allow to dry completely before reinstalling register

NOTES

19-1 SEAL DUCTS WITH MASTIC

METHOD E – AT THE AIR HANDLER



E-1. Ensure that filter slot cover is removable so that occupant can change filter as needed, but does not allow for bypass air around air filter



E-2. Seal unnecessary holes in air handler cabinet with butyl tape

NOTES

NEW FURNACE INSTALLATION NOTES

1. Install thermostat where it accurately reflects the temperature and humidity of the zone which it controls

2. Seal penetrations for control wiring with a durable sealant that complies with applicable fire safety code

3. Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information.

4. Install a filter slot cover.

5. See A-5 Condensate

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-1 INSULATE HARD PIPE DUCTS

Aligns with SWS 5.0107.1, 5.0105.2, (6.0202.1)





BEFORE YOU BEGIN

VERIFY DUCTS ARE:

- ✓ Connected properly
- ✓ Supported properly
- ✓ Air-sealed properly

AFTER

Well-supported and uniformly-insulated ducts perform at higher efficiency

TOOLS

- Measuring Tape
- Utility Knife

MATERIALS

- Duct Insulation (min R-8) with Exterior Vapor Retarder
- UL-Listed Tape
- Twine
- Zip Ties

PPE



** location dependent **weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-1 INSULATE HARD PIPE DUCTS



1. Layer insulation around duct, fitting between duct and construction members as necessary and able



2. Tape joints to secure insulation in place



3. Insulation will not be compressed



4. Tape around circumference of duct at regular intervals



5. Twine or zip ties can also be used to offer additional support for insulation – but need not to cause compression on the insulation

NOTES

Ductwork will be sealed before being insulated. Sealing and insulating ductwork is considered an ECM and should be considered whenever the ductwork is outside of the conditioned volume of the home. Ductwork is generally not insulated inside conditioned area.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-2 INSULATE FLEX DUCTS

Aligns with SWS 5.0107.1, 5.0105.2





BEFORE YOU BEGIN

VERIFY DUCTS ARE:

- ✓ Connected properly
- ✓ Supported properly
- ✓ Air-sealed properly

AFTER

Ducts in unconditioned spaces require a minimum R-8 insulation. If exposed to the exterior, R-12.

TOOLS

- Measuring Tape
- Utility Knife
- Zip Tie Tensioner

MATERIALS

- Duct Insulation (min R-8) with Exterior Vapor Retarder
- UL-Listed Tape
- Twine
- Zip Ties

PPE



** location dependent **weather dependent*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-2 INSULATE FLEX DUCTS



1. Secure duct liner to hard connections with zip tie and tensioner tool



2. Pull insulation over hard connections as needed



3. Secure vapor retarder layer at boots



4. Seal new joints

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-3 INSULATE SUPPLY BOOTS

Aligns with SWS 5.0107.1, 5.0107.2





✗ Exposed duct boots are a prime location for energy loss

BEFORE YOU BEGIN

Ensure ducts are:

- ✓ Properly connected
- ✓ Properly supported
- ✓ Properly air-sealed

TOOLS

- Measuring Tape
- Utility Knife
- Zip Tie Tensioner

MATERIALS

- R-8 Minimum Flex Duct insulation
- Duct Insulation with Vapor Retarder
- Water Heater Blanket with Vapor Retarder
- Zip Ties
- Twine
- Spray Adhesive
- Mastic
- UL-Listed Fiberglass Mesh Tape

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-3 INSULATE SUPPLY BOOTS



1. Insulate all exposed metal of the boot



2. Ensure a complete vapor barrier by sealing all seams with mastic

NOTES

- R-8 minimum for ducts in unconditioned spaces.
- R-12 minimum for ducts exposed to outside elements.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-4 INSULATE PLENUM

Aligns with SWS 5.0107.1





BEFORE

✗ Return and supply plenums left uninsulated with contact to unconditioned spaces allow for energy loss

AFTER

FINAL CHECKLIST

✓ Ducts are connected properly

✓ Ducts are supported properly

✓ Ducts are air-sealed properly

TOOLS

- Measuring Tape
- Utility Knife

MATERIALS

- R-8 Minimum Duct Insulation
- Spray Adhesive
- Twine
- Mechanical Fasteners
- R Board
- Gypsum Board
- Mastic
- UL-Listed Mesh Tape
- Butyl Tape

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-4 INSULATE PLENUM



1. Cover any unnecessary holes in the air handler cabinet



2. Check return cavities inside building envelope to ensure they are sealed off from unconditioned spaces



3. Patch holes in ducts and plenum with appropriate materials (see 19-1 Seal Ducts with Mastic)

NOTES

Expanded Polystyrene (EPS) is not appropriate for use in high-temperature areas -- particularly inside framed return platforms.



4. Prepare plenum by removing any residue from old insulation

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-4 INSULATE PLENUM



5. Measure insulation to take maximum advantage of large sheets of duct insulation



6. Cut to size for area to be covered. Insulate all exposed metal of the plenum

NOTES



7. To ensure a complete vapor barrier, trim insulation from vapor barrier to create overlap flap for seams, or tape seams with UL-Listed tape



8. Ensure clean surface for adhesion at overlap seam



9. Spray adhesive over area where piece will be installed

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

20-4 INSULATE PLENUM



10. Ensure smooth and unrippled adhesion of insulation to metal of plenum



11. Spray adhesive along vapor retarder at seam to seal closed



12. Ensure overlapping flap securely adhesed to the lower layer to maintain complete vapor barrier, or tape seams with UL-Listed tape



13. Support insulation to prevent movement over time, securing in place without puncturing vapor retarder

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

21-1 WINDOW INSTALLATION

Aligns with SWS 3.0201.9





BEFORE

✗ Single pane aluminum-frame windows offer little to no thermal break from outdoors

AFTER

FINAL CHECKLIST

✓ Window opens and closes properly

✓ All exterior edges are air-sealed

✓ Water will flow away from window

NOTES

Determine if SHPO approval is required prior to installation. Follow all KDHE requirements if the date of construction was pre-1978. Paint/seal all surfaces to prevent moisture intrusion. **SEE APPENDIX A-9 for additional information**

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Drill
- Spray Foam Gun
- Vaccuum

MATERIALS

- Plastic Sheeting
- Shims
- Flashing Tape
- Mechanical Fasteners
- Backer Rod
- Spray Foam

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

21-1 WINDOW INSTALLATION



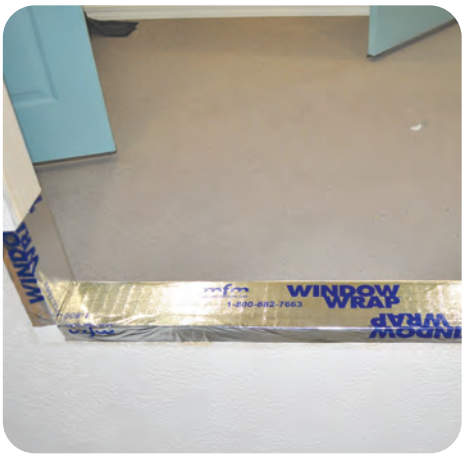
1. Measure window to be replaced



2. Remove existing window



3. Clean up sash or jam and repair any issues



4. Replace flashing as needed



5. Dry fit window



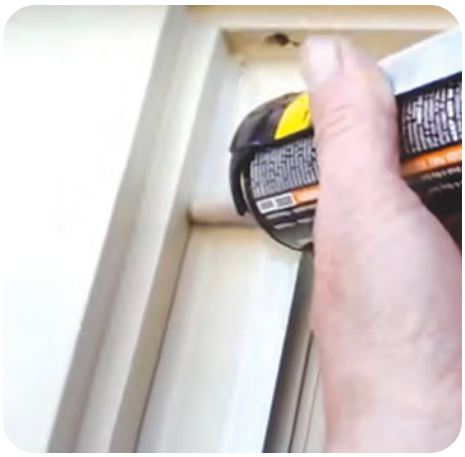
6. Level the window using shims and secure with mechanical fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

21-1 WINDOW INSTALLATION



7. Ensure window is operational



8. Caulk all exterior edges



9. Insulate and seal rough opening with backer rod and/or spray foam



10. Replace trim

NOTES

See appendix A-9 for window insert process verses replacing the entire window and jamb.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

21-2 DOOR INSTALLATION

Aligns with SWS 3.0202.2





BEFORE

✗ In rare cases, doors are too damaged to be retrofitted and must be replaced

AFTER

FINAL CHECKLIST

✓ Weatherstrip and door bottom installed

✓ Door opens and closes properly

✓ All exterior trim is caulked

✓ Water will flow away from the door

PPE



TOOLS

- Measuring Tape
- Utility Knife
- Saw
- Drill
- Level
- Caulk Gun
- Spray Foam Gun
- Jamb Saw

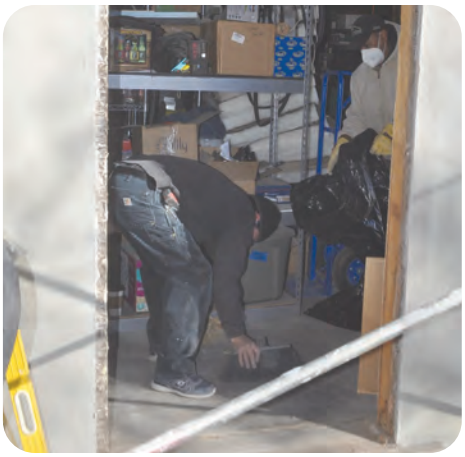
MATERIALS

- Lumber
- Shims
- Mechanical Fasteners
- Adhesive
- Spray Foam
- Caulk
- Insulation
- Weatherstrip
- Door Bottom
- Lock set

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

21-2 DOOR INSTALLATION

(Complete Door and jamb replacement)



1. Remove old door and clear away debris



2. Measure opening and ensure that the door on location is the proper size



3. Prepare opening by ensuring that jacks are plumb and threshold is level



4. Frame in and adjust opening as necessary to accommodate new door



5. Attach flashing, if necessary, to protect any new materials from water intrusion



6. Using shims, locate door in frame, adjusting for level and plumb, and attach securely

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

21-2 DOOR INSTALLATION



7. Ensure door is fully operational and lock set is aligned



8. Insulate gaps between door jamb and frame



9. Seal rough opening, to prevent both air and water intrusion



10. Replace trim



11. Seal along threshold, ensuring water will flow away from door

NOTES

Check file for age of house and complete any required lead testing before work begins.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

22-1 WINDOW GLASS REPLACEMENT

Aligns with SWS 3.0201.1, 3.0201.4





BEFORE

✗ Broken, cracked or missing glass breaks the pressure and thermal boundary

AFTER

✓ Newly installed glass is sealed to prevent air and water infiltration

NOTES

Check file for age of house and complete any required lead testing before work begins.

PPE

TOOLS

- Heavy Work Gloves
- Glass Cutter
- Scraping Tool

MATERIALS

- Cleaning Solution
- New Window Pane
- Silicone Caulk
- Window Glazing
- Tape

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

22-1 WINDOW GLASS REPLACEMENT



1. Remove all broken glass



2. Clean all debris, caulk, etc., from sash



3. Measure rough opening for pane, size pane 1/8-3/16 inches less than RO

NOTES



4. Run interior bead of caulk

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

22-1 WINDOW GLASS REPLACEMENT



5. Install new glass, using tempered where code requires, that meets or exceeds previous glazing



6. Hold new pane with push points.



7. Caulk all edges

NOTES

Photo 7 incorrectly shows silicone sealant. Glazing compound is the expected product.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-1 INSULATE AN ELECTRIC DOMESTIC WATER HEATER

Aligns with SWS 7.0301.2





BEFORE YOU BEGIN

Check data plate on water heater to find existing insulation level (if any) and verify additional insulation is not prohibited

AFTER

✓ A properly insulated water heater safely reduces standby losses

PPE



TOOLS

- Utility Knife

MATERIALS

- Water Heater Insulation Blanket
- Foil Tape
- Tie Strap
- Wire
- Twine

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-1 INSULATE AN ELECTRIC DOMESTIC WATER HEATER



1. Insulate tank with minimum R-10 or better



2. Ensure a continuous vapor barrier with no gaps



3. Do not obstruct temperature and pressure relief valve (T&P)



4. Tape all seams and edges airtight



5. Cut flaps at access plates, tape them shut and then label from the exterior



6. Secure seams with tie strap, wire or twine and minimal compression

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-2 INSULATE A GAS DOMESTIC WATER HEATER

Aligns with SWS 7.0301.2





BEFORE YOU BEGIN

Check data plate on water heater to find existing insulation level (if any) and verify additional insulation is not prohibited

AFTER

✓ A properly insulated water heater safely reduces standby losses

TOOLS

- Utility Knife

MATERIALS

- Water Heater Insulation Blanket
- Foil Tape
- Tie Strap
- Wire
- Twine

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-2 INSULATE A GAS DOMESTIC WATER HEATER



1. Insulate tank with minimum R-10 or better



2. Ensure a continuous vapor barrier with no gaps



3. Maintain a minimum clearance of 6" or as required by manufacturer

NOTES



4. Do not obstruct burner access plate or combustion air intake

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-2 INSULATE A GAS DOMESTIC WATER HEATER



5. Do not obstruct temperature and pressure relief valve (T&P)



6. Tape all seams and edges airtight



7. Cut flaps at access plates, tape them shut and then label from the exterior



8. Secure seams with tie strap, wire or twine and minimal compression

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-3 INSULATE DOMESTIC HOT WATER (DHW) PIPES

Aligns with SWS 7.0301.1



Insulate pipes to a minimum R-3 at least 6 feet from DHW on both hot and cold lines



Insulation should be continuous with no gaps, corners mitered and secured

TOOLS

- Utility Knife
- Measuring Tape

MATERIALS

- Pipe Insulation
- Tape or Tie Straps

PPE



Tools and materials listed are only recommendations and may not include everything needed to complete the job.

23-3 INSULATE DOMESTIC HOT WATER (DHW) PIPES



Keep insulation back at least 6 inches from draft diverter and single wall pipe



Do not rely on manufactured adhesive seam seal to hold closed



Secure seams with tape



When path is partially obstructed or curved, shape insulation to the location to eliminate gaps

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

24-1 INSTALL A LOW-FLOW SHOWERHEAD

Aligns with SWS 7.0201.1





BEFORE

✗ Higher flow showerheads waste water and cause water heaters to run more than necessary

AFTER

✓ Low-flow showerheads must be 2.5 gallon per minute (gpm) or less flow rate, to reduce heating load and encourage lower water use.

PPE

TOOLS

- Adjustable Wrench
- Pipe Wrench
- Channel Locks
- Buffer Material
- Rag
- Toothbrush/Wire brush

MATERIALS

- Thread Tape
- New Showerhead

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

24-1 INSTALL A LOW-FLOW SHOWERHEAD



1. Carefully remove old showerhead with adjustable wrench, taking care not to loosen shower arm



2. If old showerhead does not have flat sides at connection, wrap with buffer material, such as a piece of rubber



3. Then use pipe wrench or channel locks to loosen connection at shower arm



4. Clean threads of shower arm well to remove old residue



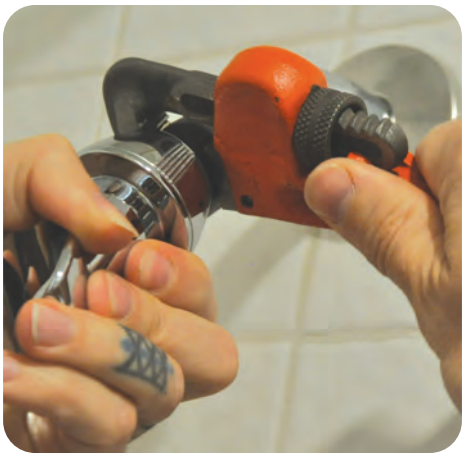
5. Wrap new thread tape around threads



6. Install new showerhead according to occupant needs, such as hand-held, shutoff or swivel

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

24-1 INSTALL A LOW-FLOW SHOWERHEAD



7. Ensure that connections will not leak while preventing damage by using buffer material



8. Use thread tape at all connections



9. Verify proper water flow and that there are no leaks

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

24-2 INSTALL A LOW-FLOW FAUCET AERATOR

Aligns with SWS 7.0201.1





BEFORE

✗ Faucets without aerators produce excess flow and old aerators can impinge flow or cause leakage

AFTER

✓ Low-flow faucet aerators limit flow to 2.2 gpm or less and reduce heating load by encouraging lower water use

PPE

TOOLS

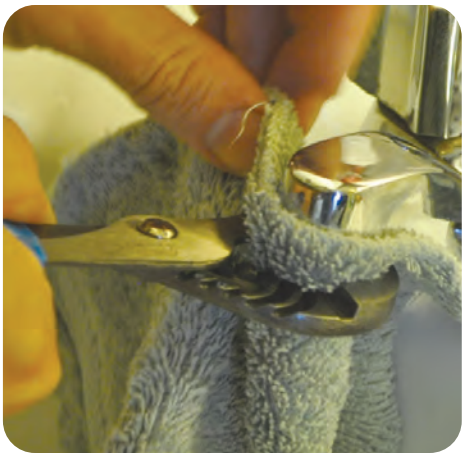
- Adjustable Wrench/Aerator Wrenches
- Soft Rag

MATERIALS

- Thread Tape
- WaterSense Aerator

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

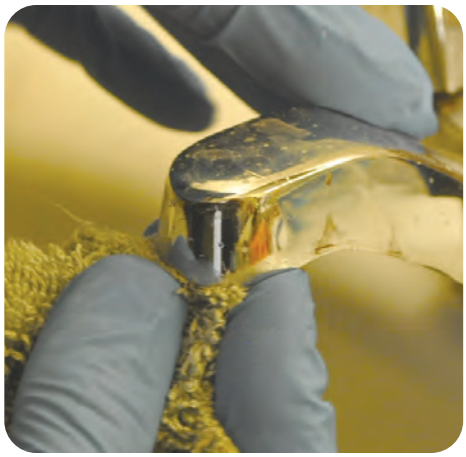
24-2 INSTALL A LOW-FLOW FAUCET AERATOR



1. Using adjustable wrench or aerator wrench, gently remove old aerator, taking care not to damage faucet



2. Once loose, continue removal by hand



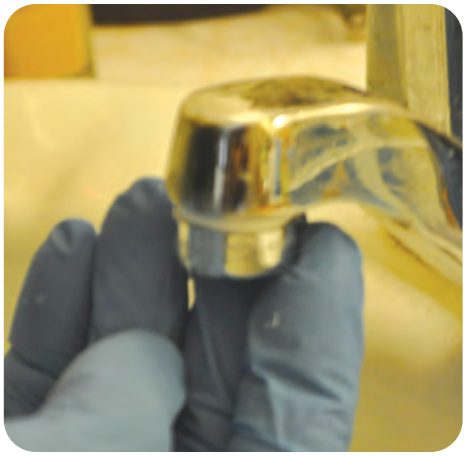
3. Clean threads of the faucet with a soft rag to remove any debris



4. Verify size and type of aerator will work with faucet



5. Wrap thread tape around new aerator if male, or faucet threads if it takes a female aerator



6. Carefully install new aerator, ensuring any necessary rubber washers are in place and taking care not to cross-thread

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

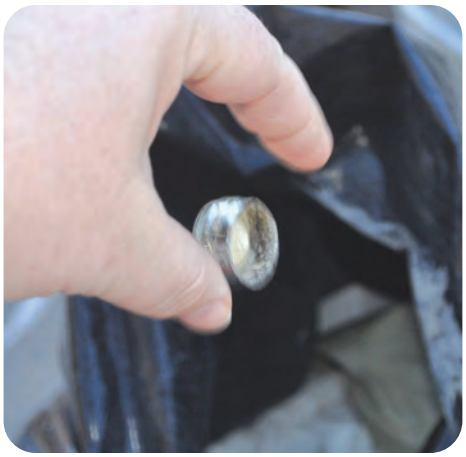
24-2 INSTALL A LOW-FLOW FAUCET AERATOR



7. Do not overtighten aerator



8. Run water through new aerator to verify it is not cross-threaded and no water is leaking around sides



9. Remove old aerator from property and permanently dispose of it

NOTES

For kitchen sinks, 1.0-1.5 gpm save water without affecting performance. For lavatory sinks, as low as 0.5 gpm is adequate.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

25-1 INSTALL ROOF VENT

Aligns with SWS 6.0101.2, 6.0201.1, 6.0201.2, 4.0188.2



BEFORE

✗ Kitchens, bathrooms, and attics all have requirements for ventilation to the exterior, as well as dryer and combustion exhaust venting



AFTER

✓ A properly installed vent preserves the integrity of the roof

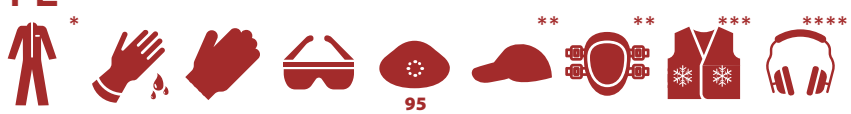
TOOLS

- Measuring Tape
- Drill
- Hole Saw
- Caulk Gun
- Utility Knife
- Mastic Brush
- Reciprocating Saw

MATERIALS

- Vent with Collar
- Caulk
- Mechanical Fasteners
- Joint Tape
- Mastic
- UL-181 AP Listed Tape

PPE



** if going in attic **location dependent ***weather dependent ****if using power tools*

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

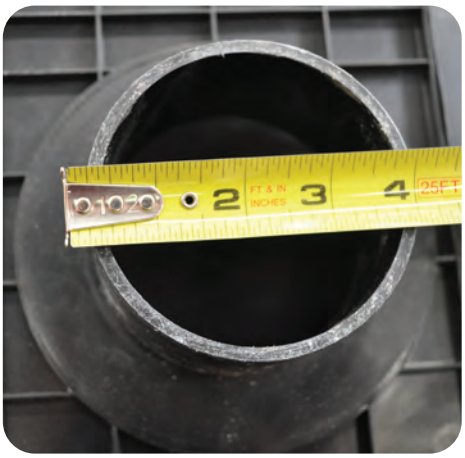
25-1 INSTALL ROOF VENT





1. Determine the appropriate vent dependent on its use – attic ventilation, kitchen hood, bath fan, dryer exhaust (these should ideally be lower), or combustion exhaust

2. Locate ideal hole location from attic side of roof deck and drill center hole





3. Mark out size and location of hole on roof deck, verifying size of termination collar

NOTES

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

25-1 INSTALL ROOF VENT







4. From roof side, cut hole slightly larger than termination collar. If shingle roof, cut just below one layer of shingles in order to preserve overlap

5. Run sealant around perimeter of vent and tuck under any surrounding uphill shingles. Seal uphill shingles over vent







6. Collar should extend down through roof into attic

7. Slide vent ducting to collar, sized to match the duct diameter, and attach with mechanical fasteners

8. Seal duct joints with mesh and mastic or UL-181 AP listed tape to complete vent installation. Insulate as required

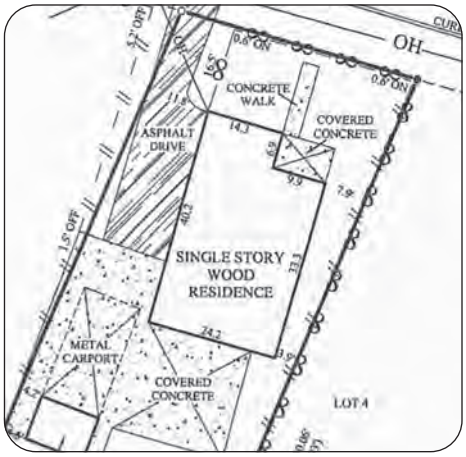
Tools and materials listed are only recommendations and may not include everything needed to complete the job.

25-2 LOCATE AN EXTERIOR TERMINATION

Aligns with SWS 6.0101.2

CHECKLIST

✓ Locate all exhaust terminations to the outside – not attics and crawlspaces – and:



✓ At least 3 feet from the property line



✓ At least 3 feet from all operable openings



✓ At least 10 feet from a mechanical intake



✓ If near soffit, no open soffit venting for at least 6 feet on each side

NOTES

See these Job Aids for PPE for appropriate termination installations

17-1 Vent a Clothes Dryer

18-1 Install Exhaust Fan Flex Duct (Bath Fan Only)

18-2 Install a Hard-Ducted Exhaust Vent

25-1 Install Roof Vent

Tools and materials listed are only recommendations and may not include everything needed to complete the job.

A-1 Index of Standard Work Specifications Referenced in Field Guide:

**Note: Inclusion on this list does not imply that every Specification within the cited Detail is addressed in the Field Guide. Job Aids in parentheses ( ) presume referenced SWS has been followed.

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Useful Acronyms in this Guide:

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers, https://www.ashrae.org

EPS: Expanded Polystyrene – lightweight insulation board composed of foam beads, will absorb water

gpm: Gallons per Minute, measurement of water flow at a fixture

LED: Light-Emitting Diode, increasingly cost-effective and efficient lighting technology

IESNA: Illuminating Engineering Society of North America, https://www.ies.org

NECA: National Electrical Contractors Association, https://necaonline.com

NEMA: National Electrical Manufacturers Association, https://www.nema.org/Standards

NFPA: National Fire Protection Association, https://www.nfpa.org

OSB: Oriented Strand Board, wood by-product pressed into sheets, similar to particle board but with larger pieces compressed together with adhesives

SWS: Standard Work Specification, https://sws.nrel.gov

UL: Underwriters Laboratories, https://ul.org

XPS: Extruded Polystyrene – lightweight insulation board characterized by smooth uniform foam appearance, often in pastel colors indicating manufacturer

A-2 Safety Measures

Smoke Alarm Installation

Aligns with 2.0101.1, 2.0101.2, NFPA 72

Smoke alarms, either battery-operated or hardwired (interconnected), will be listed and labeled in accordance with UL 217

Battery-operated smoke alarms will have sealed, non-replaceable 10-year batteries

Smoke alarms, either battery-operated or hardwired (interconnected), will be installed in the locations required by Authority Having Jurisdiction

NFPA 72 states that smoke alarms will be installed:

- Inside each bedroom
- Outside each sleeping area
- On every level of the home, including the basement
    - If a level does not have a bedroom, install in the living room or near the stairway to the upper level, or both locations
    - In the basement, install on the ceiling at the bottom of the stairs leading to the next level
- On walls at a height not more than 12 inches away from the ceiling (to the top of the alarm) or on the ceiling
- At least 10 feet from any cooking appliance
- Away from windows, doors, or ducts where drafts might interfere with their operation
- For pitched ceilings, install alarm within 3 feet of the peak, but not in the apex (within four inches of the peak)

Install smoke alarms in accordance with the manufacturer's instructions

Provide occupants the manufacturer's written instructions

Carbon Monoxide (CO) Detection and Warning Equipment

Aligns with 2.0102.1, NFPA 72

Select CO alarms that are listed and labeled in accordance with UL 2034, or approved by the authority having jurisdiction, have a minimum of 10-year manufacturer's warranty and contain internal, non-replaceable batteries

Install CO alarms in the locations required by the Authority Having Jurisdiction

NFPA 72 states that carbon monoxide alarms will be installed:

- In each sleeping area, within 10 feet of each bedroom door
- On every level of the home, including the basement
- More than 15 feet from heating or cooking appliances
- NOT in or near very humid areas, such as bathrooms

In addition, the International Association of Fire Chiefs recommends installing a CO detector near or over any attached garage.

Install CO alarms in accordance with the manufacturer's instructions, taking note of instructions for placement and height, as this can vary significantly by manufacturer

Provide occupants the manufacturer's written instructions

A-3 Baseload Lighting Measures

FOR ALL BASELOAD LIGHTING MEASURES:
Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Permanently remove uninstalled equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Lighting Replacement

Aligns with 7.0103.1

Discuss the lighting schedule with the client, which lamps are on the most often or for the longest period of time.

Educate client about incandescent lamp use, including using these lamps as little as possible.

Select replacement lighting that is appropriate for the intended application (e.g., enclosed, dimmable, potential for breakage, indoor vs. outdoor).

LEDs rated 2700-3000 K have similar color to incandescent bulbs.

Provide lighting level quality required for the intended application (e.g., task lighting, hazards lighting, nightlights) and approximate the lumen rating of incandescent lamp being replaced (see chart at right), except in circumstances where Lighting Reduction may be put into place (see Article below).

LED/Incandescent Lamp Equivalency Chart		
LED	**Incandescent**	**Lumens**
6 – 9 W	40 W	450 lm
8 – 12 W	60 W	800 lm
9 – 13 W	75 W	1100 lm
16 – 20 W	100 W	1600 lm
25 – 28 W	150 W	2600 lm

All replacement lamps are the highest level of efficiency within a technology (e.g., LED bulbs) and are ENERGY STAR® qualified, equivalent or better, and UL approved.

New fixtures or lamps facilitate upgrade to future lighting technologies

New lamps are rated no more than the rated wattage of fixture.

Install lighting in accordance with manufacturer specifications and applicable code (i.e., NFPA 70, NFPA 101, NECA/IESNA 500)

If applicable, clean lens and reflector before installing new bulb

Install all electrical wiring according to applicable code (i.e., NFPA 70)

Lighting Reduction

Aligns with 7.0103.2, 7.0103.7

Replace or maneuver window coverings (e.g., blinds, shades, movable insulation) to maximize useful daylight where appropriate

Follow IESNA protocols for appropriate light levels for certain tasks when designing delamping procedure

Ensure final lighting levels are in accordance with ASHRAE 90.1 or 90.2

Ensure final egress lighting levels are in accordance with NFPA 70 and 101

Ensure that delamping does not impact required egress lighting, as required by ANSI/NFPA 101

De-energize circuit and lock out power before work begins

Remove bulbs or fixtures per plan ensuring that no open connections will remain after work is finished

Terminate all unused electrical connections in appropriate covered junction box per NFPA 70

Seal any penetrations created by removal as per ANSI/NFPA/ICC Fire Code

If removed bulbs or fixtures meet retrofit standards and are operational, store them in a dry location for reuse

Fixture Replacement

Aligns with 7.0103.3, 7.0103.4, 7.0103.5, 7.0103.6

For all fixture installations:

De-energize circuit and lock-out power before work begins

Locate and install new fixtures in accordance with appropriate code (e.g., NFPA 101, NFPA 70, NECA/IESNA 500)

Ballast Replacement

Select pulse start, high-efficiency, electronic ballasts that meet the appropriate nationally recognized product standards (ANSI C82.1, ANSI C82.2, UL 924, UL 1029, NEMA) and have a ballast factor of 0.85 or greater

Select ballasts that match the input and output voltage of the existing fixture, that fit within the existing enclosure, and will support the necessary wattage of the bulbs

Install ballasts in accordance with manufacturer specifications

Clean the lens and reflector once installation is complete

Exit Sign Replacement

Select exit signs from the NEMA Premium Exit Sign List and that meet all applicable codes (UL 924, NFPA 70, and/or IBC and IFC, as appropriate)

Signs that include battery-backups that can maintain the total load for a minimum period of 1-1/2 hours and indicate system failure with visual and audible alarm

Signs that are able to be attached to the existing outlet box

Signs that are rated for a maximum of 5 watts per illuminated side

Signs with at least a 1-year warranty

Emergency Lighting Replacement

Select emergency light fixtures that are UL approved for location installed (i.e., indoor, outdoor, wet location)

Emergency light fixture has battery-backup that can maintain the total load for a minimum period of 1-1/2 hours, in accordance with section 700.12 of NFPA 70

Security Lighting

Select security light fixtures that are UL approved for location installed (i.e., indoor, outdoor, wet location)

Security light fixtures provide the required lighting conditions with the lowest possible energy-use, are vandal-proof, are dark-sky approved and are ENERGY STAR® qualified, equivalent or better

Aim light fixtures to minimize light emitted above the horizontal, beyond the perimeter of the property, and not directly into any window of a residence

Clean the lens and reflector once installation is complete

Install both photo and motion sensors and configure to only activate when sun is down and to switch off within 5 minutes if no motion is detected

Lighting Controls

Aligns with 7.0104.1, 7.0104.2, 7.0104.3, 7.0104.4, 7.0104.5

For all control installations:

Select controls that are compatible with the existing wiring and lighting fixture, and are UL approved and listed for the installed location

Install control in accordance with NFPA 70 and manufacturer specifications, in a secure location, and in location appropriate enclosure (e.g., weatherproof) or protected from physical damage

Occupancy Sensors

Do not install occupancy sensors in areas accessed for electrical and mechanical maintenance

Set controls to match the intended use of the space (i.e., time off setting not too short or too long)

Stand-Alone Timers

Select timer that has at least 10 hours of battery backup time, has at least two programmable schedules, and has an appropriate manual override

Do not install timers for egress lighting required by NFPA 101

Set timer to turn off exterior fixtures when there is sufficient daylight (civil twilight) or when lighting is no longer needed at night per ASHRAE 90.1 or 90.2

Set timer to turn off interior fixtures when light is no longer needed in the space

Motion Control Sensors
Select sensor that is location- and climate-appropriate (e.g., outdoor weatherproof fixture)

Locate sensor where it will minimize false starts

Set controls of motion sensor based on anticipated occupant usage or security needs

Set control to turn off lighting if no motion is detected for a maximum of 15 minutes

Outdoor Photo Sensors
Select sensor that is UL approved and listed for the installed location (e.g., UL 60730-1) and is location- and climate-appropriate (e.g., outdoor weatherproof fixture)

Select fixture that allows for replacement of photo sensor independently

Position sensor to properly sense natural light, but shielded from artificial light sources (e.g., other outdoor lighting)

Bi-Level Controls
Select control that has an appropriate manual override

Affix permanent labels near the switch location to indicate light level and fixture control

A-4 Specialized Field-Work Tasks

Refrigerator Replacements

Aligns with 7.0101.1

Select an ENERGY STAR® qualified appliance.

Select appliance with a minimum one-year warranty that provides a replacement appliance if repeated issues relating to health, safety, or performance occur.

Ensure new appliance will not block access to light switches, cabinets, etc. and will fit through the smallest opening between the outside and installation location.

All refrigerators in the household will be inspected and have model numbers and other necessary information recorded on the inspection form. All refrigerators in the home will be modeled in the REM energy audit with corresponding energy usage. Refrigerators are eligible upgrade items and should be proposed on the Improvement Analysis, unless rejected by the client. Multiple units per home are eligible.

Replacements should be of like model, size, configuration, and features (top mount, side by side, ice maker, etc.). Client education will be provided to encourage the removal of unnecessary or infrequently used secondary units.

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information.

Permanently remove old appliance from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990).

Air Sealing

Aligns with 3.01 and 3.02

Sealant Selection

Select sealants that are compatible with their intended surfaces,
allow for differential expansion and contraction between dissimilar materials,
meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and for use inside the pressure boundary select low volatile organic compound (VOC) sealants that meet independent testing and verification protocols.

Material Selection

Select materials that adequately support applied load and are permanent air barriers, meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and for use inside the pressure boundary select low volatile organic compound (VOC) materials that meet independent testing and verification protocols.

Backing, Infill, and Support

If backing or infill is installed, it will not bend, sag, or move once installed, and will adequately support any insulation installed on the surface. For small holes (less than 1/4"): if using, install backing or infill material at least 1/8" below the surface where sealant is applied. For medium holes (1/4" to 3"): Install backing or infill in or over all holes to be sealed. For large holes (greater than 3"): Install rigid backing or infill in or over all holes to be sealed. Install support material for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation). Support material installed for any walking/working surface (attics or floors) will support the weight of a worker and any insulation applied in the area. Mechanically fasten backing or infill materials sufficient to prevent movement.

Surface Preparation

Remove any material from the sealing area that will prevent full adhesion of the selected sealant.

Sealant Application

Apply a continuous seal at all seams, cracks joints, edges, penetrations, and connections in sealing surface while applying sufficient pressure to push the sealant into any gaps or cracks and contact any backing or infill material required.

High-Temperature Application

Install only noncombustible materials and sealants with an ASTM E136 listing in contact with any device producing 200 degrees F or more (e.g. chimneys, vents, flues, etc.).

Sealing Dropped Ceilings

Sealant Selection

Select sealants that are compatible with their intended surfaces, allow for differential expansion and contraction between dissimilar materials, meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and for use inside the pressure boundary select low volatile organic compound (VOC) sealants that meet independent testing and verification protocols.

Material Selection

Select materials that adequately support applied load and are permanent air barriers, meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and for use inside the pressure boundary select low volatile organic compound (VOC) materials that meet independent testing and verification protocols.

Support

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

Support material installed for any walking/working surface (attics or floors) will support the weight of a worker and any insulation applied in the area.

Support Preparation

Remove any material from the sealing area that will prevent full adhesion of the selected sealant.

Install Air Barrier

Install a permanent air barrier either above or below the existing ceiling material that will structurally support the final insulation level. Gypsum board recommended.

Sealant Application

Apply a continuous seal at all seams, cracks, joints, edges, penetrations, and connections of the pressure boundary while applying sufficient pressure to push sealant into any gaps or cracks and contact any backing or infill material required.

High-Temperature Application

Install only noncombustible materials and sealants with an ASTM E136 listing in contact with any device producing 200 degrees F or more (chimneys, vents, flues, etc.).

Unconditioned Attic Ventilation

Aligns with 4.0188.2

Pre-work Qualifications

Verify the presence of an effective air barrier and thermal boundary between the attic and living space.

Vent Selection

Attic vent types will be consistent with requirements for their specific location (e.g., exterior soffit, gable end, roof) and material and intended use (e.g., metal vent on metal roof). Install only passive ventilation, no powered ventilators may be installed.

Vent Location

Install between 40 and 50 percent of attic ventilation within 3 feet of the highest point in the ventilated space. Install attic vents in locations that prevent entry of wind-driven precipitation.

Ventilation Screens

All attic ventilation sources with holes greater than 1/4" will have corrosion-resistant wire mesh screens installed with openings of 1/16" to 1/4". Existing vents that are not screened will be covered with corrosion-resistant wire mesh with openings of 1/16" to 1/4".

Ventilation Baffles

If soffit venting is installed, mechanically fasten baffles (i.e., soffit chutes) in each truss bay that terminate at least 6" above final insulation level and provide a minimum of 2" clearance between insulation and roof deck material.

Guidance of Attic Ventilation

Many of the homes weatherization will encounter will have inadequate attic ventilation. The requirement for attic ventilation is a building code requirement and inadequate attic ventilation would be considered an existing code compliance issue. Weatherization has no requirement and is not equipped to correct existing code compliance issues. However, if and where the local code is triggered and requires code compliance because of a weatherization activity, weatherization will install attic ventilation to become code compliant. When the roof venting requirement is triggered, agencies shall document in the client file the actual code that was triggered and what weatherization activity triggered the code/permit.

Storm Windows

Aligns with 3.0201

Surface Preparation

Remove any material from the sealing area that will prevent full adhesion of the selected sealant.

Installation

Install new storm window in compliance with the manufacturer's instructions. Installation must be substantially airtight when closed.

Sealing

Apply a continuous bead of sealant under the top and side flanges of frame before installation. Do not seal the lower flange or designed drainage openings (i.e. weep holes).

Safety

Verify safe operation and size of egress windows as required by local codes. Do not install fixed storm windows in required egress locations.

Install a Chimney Liner

Aligns with 5.0503.1

Select and install chimney liners in accordance with applicable code (i.e., NFPA 54, NFPA 31, IFGC) and manufacturer specifications. If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Kansas State Technical Standards state the following:

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

Chimney Liner Installation Step-by-Step:



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



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



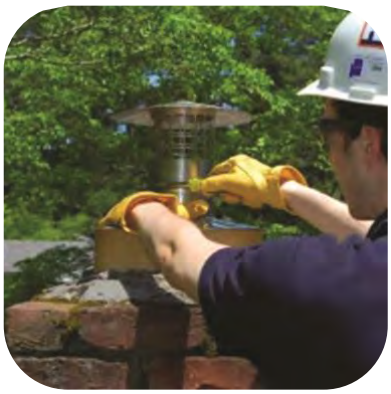
3. Measure and mark the flexible chimney liner at 4 inches above the chimney.



4. Cut the flexible chimney liner to length.



5. Install top plate over opening and attach it to the liner.



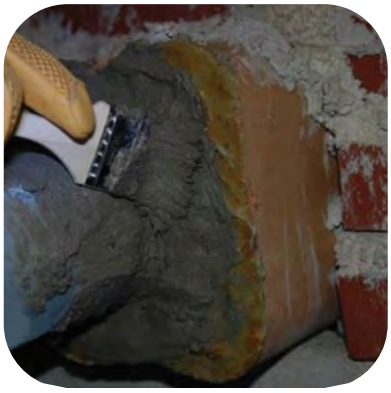
6. Fasten the rain cap to the chimney liner.



7. Seal around penetrations in chimney with refractory (furnace) cement.



8. Connect appliance vent to the chimney liner.



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

Install a Sump Cover

Aligns with 2.0401.2

Cover sump pump wells or pits with an airtight cover that allows all necessary penetrations to be sealed tightly. The cover must support human weight.

Install sump pump covers to allow bulk moisture to drain from above the cover utilizing trapped or one-way ball valve fittings, or equivalent.

Pedestal sump pumps are eligible for replacement with a submerged pump as a health and safety cost.

Two examples of acceptable sump covers:





A-5 Electrical Contractor Tasks

Enclose Junctions and Splices

Aligns with 2.0301.1

Cover all junction boxes with a location-appropriate (e.g. wet-location, outdoor, indoor, etc.) UL listed cover per NEC

Enclose all wiring splices inside a location-appropriate (e.g. wet-location, outdoor, indoor, etc.) UL listed electrical enclosure per the NEC

Replace the Thermostat on a Forced Air System

Aligns with 5.0101.1

Verify that sufficient number of thermostat wires is available to meet the needs of the replacement unit and the existing system

Select a double-setback programmable thermostat that allows for full functionality of the installed system (supplementary heat, emergency heat, fan only, ventilation control, etc.)

Install thermostat where is accurately reflects the temperature and humidity of the zone which it controls (i.e., not exposed to extreme temperatures, radiant heat sources, warm/cold walls, or drafts)

Connect supplementary heat to second-stage heating terminal in accordance with manufacturer specifications

For heat pumps, install and connect outdoor temperature sensor that is compatible with the thermostat in accordance with manufacturer specifications

Calculate and select an optimum thermal balance point for supplementary heat operation in accordance with ANSI/ACCA Manual S and manufacturer specifications

Program the thermostat to match the equipment and control board settings per manufacturer specifications

Set time delay for fan start in accordance with manufacturer specifications and as appropriate for the climate zone (e.g., no time delay for hot humid climates, longer time delay for cold climates)

Program the thermostat setbacks to a schedule that accommodates the occupant and reduces overall run time

Provide occupants/owners with user's manual, warranty information, installation instructions and installer contact information

A-6 Domestic Hot Water Tasks

Install a Temperature and Pressure Relief Valve

Aligns with 2.0103.1

Verify that T&P Valve meets IRC and ANSI Z21.22 requirements

Install in compliance with IRC, HUD code and according to manufacturer specifications

Install discharge tube such that it discharges to a readily observable location that is either 6 inches or less from the floor, 6 inches or less from an overflow pan OR to the outdoors

Locate discharge termination such that when it discharges it will not cause personal injury or structural damage

Ensure discharge tube flows by gravity and has no trap

Ensure drainage tube is not directly connected to dwelling drainage system

Ensure that drainage tube does not contain any valves or tees, nor ends with a threaded connection

Install an Electric Storage Tank Water Heater

Aligns with 7.0302.1

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Select a water heater that: has an Energy Factor (EF) of 0.93 or better, fits in the installation space with required clearances, and provides sufficient hot water for the home and occupants

Install appliance where it is protected from freezing and accessible for service

Install appliance in compliance with appliance code (e.g., NFPA 70, IRC, IBC, IMC) and manufacturer specifications

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Provide a level working space not less than 30” in length and 30” in width in front of the control side of the appliance

Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping and components, other than what requires repair/replacement

Ensure that anode rod is accessible for replacement

Install a Temperature and Pressure Relief Valve per IRC and manufacturer specifications (See article “Install a Temperature and Pressure Relief Valve” above)

Pipe the valve 6" or less from the floor or drain pan or to the outdoors and must terminate in an observable location

Select piping material based on IRC requirements

If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to the requirements of the IRC

Drain pan to the exterior of the building

Include a separate water cut-ff valve for both the hot and cold-water lines

Install an expansion tank anytime a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer

Connect the tank to the cold-water supply line at a point that is downstream of all check valves, pressure reducing valves and backflow preventers

Size thermal expansion tanks in accordance with the tank's manufacturer instructions and applicable code (e.g., IRC, IBC)

Install dielectric unions when connecting copper to galvanized steel piping in accordance with the IRC and manufacturer specifications

Install heat traps on the inlet and outlet piping where not provided by manufacturer

Set discharge temperature to not exceed 120 degrees or as prescribed by local code

In multi-tank systems, install valves to isolate each tank from water heating system and install bypass piping

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Install a Fuel-Fired Storage Tank Water Heater

Aligns with 7.0302.2

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Select a system that: is rated 0.70 UEF or better, includes a low nitrogen oxide burner, fits in the installation space with required clearances, and provides sufficient hot water for the home and occupants

For Manufactured Housing Only: Select a system that is listed and labeled for installation in manufactured homes, drafts all of its combustion air from outside the dwelling, fits in the installation space with required clearances, and provides sufficient hot water for the home and its occupants

Install appliance where it is protected from freezing and accessible for service

Install appliance in compliance with appliance code (e.g., NFPA 31, NFPA 54, IRC) and manufacturer specifications. If conflict exists between code and manufacturer specifications, apply the more restrictive requirement.

Provide a level working space not less than 30” in length and 30” in width in front of the control side of the appliance

Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping and components, other than what requires repair/replacement

Ensure that anode rod is accessible for replacement

Install fuel supply components per NFPA 31 (for oil) and NFPA 54 (for gas) and manufacturer specifications. If conflict exists between code and manufacturer specifications, apply the more restrictive requirement.

Install an emergency fuel cut-ff switch within reach of the water heater

If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to the requirements of the IRC

Drain pan to the exterior of the building

Include a separate water cut-off valve for both the hot and cold-water lines

Install an expansion tank anytime a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer

Connect the tank to the cold-water supply line at a point that is downstream of all check valves, pressure reducing valves and backflow preventers

Size thermal expansion tanks in accordance with the tank’s manufacturer instructions and applicable code (e.g., IRC, IBC)

Install a Temperature and Pressure Relief Valve per IRC and manufacturer specifications (See article “Install a Temperature and Pressure Relief Valve” above)

Pipe the valve 6" or less from the floor or drain pan or to the outdoors and must terminate in an observable location

Select piping material based on IRC requirements

Install dielectric unions when connecting copper to galvanized steel piping in accordance with the IRC and manufacturer specifications

Install heat traps on the inlet and outlet piping where not provided by manufacturer

Set discharge temperature to not exceed 120 degrees or as prescribed by local code

In multi-tank systems, install valves to isolate each tank from water heating system and install bypass piping

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Install a Heat Pump Storage Tank Water Heater

Aligns with 7.0302.3

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Select a water heater that is ENERGY STAR® certified, equivalent, or better fits in the installation space with required clearances provides sufficient hot water for the home and occupants

Install appliance where it is in a location above the minimum temperature specified by the manufacturer is accessible for service has sufficient volume of air per manufacturer specifications will not affect indoor thermostat readings or blow directly on occupants

Install water heater in compliance with applicable code (e.g., *NFPA* 70, *IRC*, *IBC*, *IMC*) and manufacturer specifications

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Provide a level working space not less than 30" in length and 30" in width in front of the control side of the appliance

Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping, and components, other than what requires repair/replacement

Ensure that anode rod is accessible for replacement

Install a Temperature and Pressure (TandP) relief valve per the *IRC* and manufacturer specifications

Pipe the valve 6" or less from the floor or drain pan or to the outdoors and must terminate in an observable location

Select piping material based on *IRC* requirements

If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to the requirements of the *IRC*

Drain pan to the exterior of the building

Install a separate water cut-off valve for both the hot and cold-water lines

Install an expansion tank anytime a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer

Connect the tank to the cold-water supply line at a point that is downstream of all check valves, pressure reducing valves and backflow preventers

Size thermal expansion tanks in accordance with the tank manufacturer's instructions and applicable code (e.g., *IRC*, *IBC*)

Install dielectric unions when connecting copper to galvanized steel piping in accordance with the *IRC* and manufacturer specifications

Install heat traps on the inlet and outlet piping where not provided by manufacturer

Set discharge temperature to not exceed 120 degrees or as prescribed by local code

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., *EPA* Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

A-5 Electrical Contractor Tasks

Enclose Junctions and Splices

Aligns with 2.0301.1

Cover all junction boxes with a location-appropriate (e.g. wet-location, outdoor, indoor, etc.) UL listed cover per NEC

Enclose all wiring splices inside a location-appropriate (e.g. wet-location, outdoor, indoor, etc.) UL listed electrical enclosure per the NEC

Replace the Thermostat on a Forced Air System

Aligns with 5.0101.1

Verify that sufficient number of thermostat wires is available to meet the needs of the replacement unit and the existing system

Select an appropriate programmable thermostat (per state variance) that allows for full functionality of the installed system (supplementary heat, emergency heat, fan only, ventilation control, etc.)

Install thermostat where is accurately reflects the temperature and humidity of the zone which it controls (i.e., not exposed to extreme temperatures, radiant heat sources, warm/cold walls, or drafts)

Connect supplementary heat to second-stage heating terminal in accordance with manufacturer specifications

For heat pumps, install and connect outdoor temperature sensor that is compatible with the thermostat in accordance with manufacturer specifications

Per state variance, calculate and select an optimum thermal balance point for supplementary heat operation based on manufacturer specifications and HVAC contractor input, taking into account planned infiltration, insulation, and overall ending U-factors for the unit

Program the thermostat to match the equipment and control board settings per manufacturer specifications

Set time delay for fan start in accordance with manufacturer specifications and as appropriate for the climate zone (e.g., no time delay for hot humid climates, longer time delay for cold climates)

Program the thermostat setbacks to a schedule that accommodates the occupant and reduces overall run time

Provide occupants/owners with user's manual, warranty information, installation instructions and installer contact information

A-6 Domestic Hot Water Tasks

Install a Temperature and Pressure Relief Valve

Aligns with 2.0103.1

Verify that T&P Valve meets IRC and ANSI Z21.22 requirements

Install in compliance with IRC, HUD code and according to manufacturer specifications

Install discharge tube such that it discharges to a readily observable location that is either 6 inches or less from the floor, 6 inches or less from an overflow pan OR to the outdoors

Locate discharge termination such that when it discharges it will not cause personal injury or structural damage

Ensure discharge tube flows by gravity and has no trap

Ensure drainage tube is not directly connected to dwelling drainage system

Ensure that drainage tube does not contain any valves or tees, nor ends with a threaded connection

Install an Electric Storage Tank Water Heater

Aligns with 7.0302.1

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Select a water heater that: has an Energy Factor (EF) of 0.93 or better, fits in the installation space with required clearances, and provides sufficient hot water for the home and occupants

Install appliance where it is protected from freezing and accessible for service

Install appliance in compliance with appliance code (e.g., NFPA 70, IRC, IBC, IMC) and manufacturer specifications

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Provide a level working space not less than 30” in length and 30” in width in front of the control side of the appliance

Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping and components, other than what requires repair/replacement

Ensure that anode rod is accessible for replacement

Install a Temperature and Pressure Relief Valve per IRC and manufacturer specifications (See article “Install a Temperature and Pressure Relief Valve” above)

Pipe the valve 6" or less from the floor or drain pan or to the outdoors and must terminate in an observable location

Select piping material based on IRC requirements

If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to the requirements of the IRC

Drain pan to the exterior of the building

Include a separate water cut-ff valve for both the hot and cold-water lines

Install an expansion tank anytime a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer

Connect the tank to the cold-water supply line at a point that is downstream of all check valves, pressure reducing valves and backflow preventers

Size thermal expansion tanks in accordance with the tank's manufacturer instructions and applicable code (e.g., IRC, IBC)

Install dielectric unions when connecting copper to galvanized steel piping in accordance with the IRC and manufacturer specifications

Install heat traps on the inlet and outlet piping where not provided by manufacturer

Set discharge temperature to not exceed 120 degrees or as prescribed by local code

In multi-tank systems, install valves to isolate each tank from water heating system and install bypass piping

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Install a Fuel-Fired Storage Tank Water Heater

Aligns with 7.0302.2

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Select a system that: is rated 0.58 UEF or better (per state variance), includes a low nitrogen oxide burner, fits in the installation space with required clearances, and provides sufficient hot water for the home and occupants

For Manufactured Housing Only: Select a system that is listed and labeled for installation in manufactured homes, drafts all of its combustion air from outside the dwelling, fits in the installation space with required clearances, and provides sufficient hot water for the home and its occupants

Install appliance where it is protected from freezing and accessible for service

Install appliance in compliance with appliance code (e.g., NFPA 31, NFPA 54, IRC) and manufacturer specifications. If conflict exists between code and manufacturer specifications, apply the more restrictive requirement.

Provide a level working space not less than 30” in length and 30” in width in front of the control side of the appliance

Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping and components, other than what requires repair/replacement

Ensure that anode rod is accessible for replacement

Install fuel supply components per NFPA 31 (for oil) and NFPA 54 (for gas) and manufacturer specifications. If conflict exists between code and manufacturer specifications, apply the more restrictive requirement.

Install an emergency fuel cut-ff switch within reach of the water heater

If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to the requirements of the IRC

Drain pan to the exterior of the building

Include a separate water cut-off valve for both the hot and cold-water lines

Install an expansion tank anytime a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer

Connect the tank to the cold-water supply line at a point that is downstream of all check valves, pressure reducing valves and backflow preventers

Size thermal expansion tanks in accordance with the tank’s manufacturer instructions and applicable code (e.g., IRC, IBC)

Install a Temperature and Pressure Relief Valve per IRC and manufacturer specifications (See article “Install a Temperature and Pressure Relief Valve” above)

Pipe the valve 6" or less from the floor or drain pan or to the outdoors and must terminate in an observable location

Select piping material based on IRC requirements

Install dielectric unions when connecting copper to galvanized steel piping in accordance with the IRC and manufacturer specifications

Install heat traps on the inlet and outlet piping where not provided by manufacturer

Set discharge temperature to not exceed 120 degrees or as prescribed by local code

In multi-tank systems, install valves to isolate each tank from water heating system and install bypass piping

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Install a Heat Pump Storage Tank Water Heater

Aligns with 7.0302.3

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Select a water heater that is ENERGY STAR® certified, equivalent, or better fits in the installation space with required clearances provides sufficient hot water for the home and occupants

Install appliance where it is in a location above the minimum temperature specified by the manufacturer is accessible for service has sufficient volume of air per manufacturer specifications will not affect indoor thermostat readings or blow directly on occupants

Install water heater in compliance with applicable code (e.g., *NFPA* 70, *IRC*, *IBC*, *IMC*) and manufacturer specifications

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Provide a level working space not less than 30" in length and 30" in width in front of the control side of the appliance

Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping, and components, other than what requires repair/replacement

Ensure that anode rod is accessible for replacement

Install a Temperature and Pressure (TandP) relief valve per the *IRC* and manufacturer specifications

Pipe the valve 6" or less from the floor or drain pan or to the outdoors and must terminate in an observable location

Select piping material based on *IRC* requirements

If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to the requirements of the *IRC*

Drain pan to the exterior of the building

Install a separate water cut-off valve for both the hot and cold-water lines

Install an expansion tank anytime a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer

Connect the tank to the cold-water supply line at a point that is downstream of all check valves, pressure reducing valves and backflow preventers

Size thermal expansion tanks in accordance with the tank manufacturer's instructions and applicable code (e.g., *IRC*, *IBC*)

Install dielectric unions when connecting copper to galvanized steel piping in accordance with the *IRC* and manufacturer specifications

Install heat traps on the inlet and outlet piping where not provided by manufacturer

Set discharge temperature to not exceed 120 degrees or as prescribed by local code

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., *EPA* Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

A-7 Heating and Cooling

Install Condensate Drain

Aligns with 5.0102.1

Convey all condensate from all cooling coils, condensing furnaces, etc. to the exterior of the building, along condensate piping with not less than 1/8" per foot (1% slope) toward the termination point. Install condensate drain pumps when condensate cannot be drained by gravity.

When local code enforcement requires, condensate from condensing furnaces must first pass through a neutralizer if using waste lines for disposal

Seal all piping that conveys condensate

Install vents and traps on condensate drain lines in accordance with manufacturer specifications and applicable building code and in a manner that allows for cleaning of condensate lines without cutting the existing pipe

Install a secondary drain pan under all condensing appliances installed in or above conditioned space and where water damage may occur to the structure

Install an independent condensate drain for the secondary drain pan that drains to a visible termination location

Slope drain pan towards the condensate drain

Install a float switch that is interlocked with the system power circuit and will break the circuit when drainage fails to remove condensate

When there is potential for condensation or freezing of the drain line, insulate condensate drain lines to a minimum of R-4 with insulation that contains a Class II or greater vapor retarder

If termination of condensate drain is to the outdoors, direct it downward with an elbow fitting at the end of the exterior termination.

Provide Combustion Air for Fuel-Fired Appliances

Aligns with 5.0502.1

Calculate and provide combustion air needs in conformance with the applicable code (i.e. NFPA 54, IFGC, or NFPA 31) and manufacturer requirements

In instances where conflicts occur between the code and the manufacturer's installation instructions, the more restrictive provisions shall apply (i.e., more air rather than less)

The minimum required volume is 50 cubic feet per 1,000 BTU/h, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), then use alternative calculation from IFGC

Install Venting for a Fuel-Fired Appliance

Aligns with 5.0503.1

Design combustion appliance venting, select vent materials, and install venting, terminations, and chimney liners in accordance with applicable code (i.e., NFPA 54, NFPA 31, IFGC) and manufacturer specifications

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Isolate the Combustion Appliance Zone (CAZ)

Aligns with 5.0501.1, 3.0101.1, 5.0106.1 (See Job Aid 19-1), 5.0107.1 (See Job Aid 20-1 and 20-4), 5.0202.2 (See Job Aid 20-3), 5.0502.1 (See Article)

Air Sealing

Apply a continuous seal at all penetrations, gaps, cracks, etc. of the pressure boundary between the isolated room and conditioned space using sufficient pressure to push sealant into any gaps or cracks and contact any backing or infill material required

Select sealants that:

- Are compatible with their intended surfaces
- Allow for differential expansion and contraction between dissimilar materials
- Meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and
- For use inside the pressure boundary select low volatile organic compound (VOC) sealants that meet independent testing and verification protocols

Select materials that:

- Adequately support applied load and are permanent air barriers
- Meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and
- For use inside the pressure boundary select low volatile organic compound (VOC) materials that meet independent testing and verification protocols.

If backing or infill is installed, it will not bend, sag, or move once installed, and will adequately support any insulation installed on the surface

For small holes (less than 1/4"), if using backing or infill material, install at least 1/8" below the surface where sealant is applied.

For medium holes (1/4" to 3"), install backing or infill in or over all holes to be sealed

For large holes (greater than 3"), install rigid backing or infill in or over all holes to be sealed. Install support material for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)

Support material installed for any walking/working surface (attics or floors) will support the weight of a worker and any insulation applied in the area

Mechanically fasten backing or infill materials sufficient to prevent movement

Remove any material from the sealing area that will prevent full adhesion of the selected sealant

Install only noncombustible materials and sealants with an ASTM E136 listing in contact with any device producing 200 degrees F or more (chimneys, vents, flues, etc.)

Sealing Ductwork

Remove and seal register/grill openings of any return or supply ducting in the isolated room

Seal all ductwork in the CAZ (See Job Aid 19-1):

Select only UL 181 approved materials that are compatible with their intended surfaces, allow for differential expansion and contraction between dissimilar materials, and meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers)

Select low volatile organic compound (VOC) sealants for use inside the pressure boundary that meet independent testing and verification protocols

Clear surrounding insulation to expose joints being sealed, salvage for reuse if possible

If duct must be cut open to gain access, position the hole to make repair with appropriate materials feasible

Remove loose debris using a vacuum

Remove any substance that will prevent sealant adhesion (tape, oil, etc.) using appropriate solvent

Securely fasten all duct connections using appropriate mechanical fasteners according to Chart 1

Seal all accessible seams, cracks, joints, holes, and penetrations of duct system

Select method according to physical leak size:

Mastic alone is acceptable for holes less than 1/8" in size that are more than 10' from air handler if static operating pressure is less than 1" of Water Column (iwc)

Seal leaks less than 1/4" using fiberglass mesh and mastic

Seal leaks between 1/4" and 3/4" using a two stage process: Install temporary tape as a backing material, then seal with fiberglass mesh and mastic that extends at least 1" past the temporary tape on all sides

Repair leaks larger than 3/4" using a rigid duct patch. Mechanically fasten patch before applying mastic. Install fiberglass mesh and mastic over the seam, overlapping repair joint by at least 1" on all sides

Seal gaps between boot and surface connections using fiberglass mesh tape and mastic or appropriate flexible caulking. Ensure sealant is dry before reinstalling the register. Ensure the register can be removed and reinstalled by the dwelling occupant.

Seal any joints, cracks, and holes that are not gasketed or weatherstripped and are not needed for proper function or service of the unit using removable sealant (e.g., foil tape, gaskets, etc.)

Seal the filter slot with a durable, client removable filter slot cover (e.g., magnetic strip)

Duct Insulation:

Insulate all ductwork existing inside the isolated room (See also Job Aids 20-1 and 20-4):

Select insulation that includes an exterior vapor retarder layer and with a flame spread and smoke development index of 25/50 when tested in accordance with ASTM E84 or UL 723

Remove damaged or wet duct insulation from premises

Verify ductwork is sealed before insulating

Insulate all ducts outside the thermal boundary to a minimum of R-8

Insulate all ducts exposed to the exterior to a minimum of R-12

Secure blanket insulation in full contact with the duct surface using mechanical fasteners (e.g., stick pins, metal wire)

Secure reflective insulation to duct in compliance with manufacturer specifications including required air spaces

Seal all seams and connections of the duct insulation using UL 181 approved tape so that no gaps exist in the vapor retarder

Post a dated receipt signed by the installer that minimally includes: Installed insulation type, coverage area, installed thickness, and installed R-value

If reflective exterior insulation is used the documentation must include the number and width of included air spaces

Plumbing

Insulate all plumbing pipes in the CAZ (see also Job Aid 23-3):

Select insulation that is rated for the maximum operating temperature of the system, meets applicable fire safety code, and is R-3 or greater.

Install insulation over all distribution system components that allow insulation in a continuous manner without gaps

Seal all seams, joints, and connections of insulation with a durable sealant or mechanical fasteners (e.g., zip ties)

Install removable/reusable insulation over components that require regular maintenance

Post a dated receipt signed by the installer that minimally includes: Installed insulation type, coverage area, installed thickness, and installed R-value

Walls, Floors and Ceilings

Insulate all surfaces of the isolated room between the room and conditioned space to the applicable code minimum for the climate zone according to the IECC and applicable SWS

Provide outdoor combustion air to the isolated room according to article "Provide Combustion Air for Fuel-Fired Appliances"

Install an Air-to-Air Split System

Aligns with 5.0108.1, 5.0504.1, 5.0504.2, 5.0103.1, 5.0103.2, 5.0106.1, 5.0105.1

Load Calculation

Perform residential load calculation in accordance with the current version of ANSI/ACCA Manual J (Residential Load Calculation) or equivalent using interior design temperatures of 75 degrees for cooling and 70 degrees for heating

Perform commercial load calculation in accordance with the current version of ANSI/ACCA Manual N (Commercial Load Calculation) or equivalent using interior design temperatures of 75 degrees for cooling and 70 degrees for heating

Room by room load calculations will be performed when installing a new duct system or in retro-commissioning projects

Calculated loads based on post-retrofit dwelling characteristics

Equipment Selection

Select residential equipment in accordance with the current version of ANSI/ACCA Manual S (Residential Equipment Selection) or equivalent

Select commercial equipment in accordance with the current version of ANSI/ACCA Manual CS (Commercial Applications, Systems and Equipment) or equivalent

Select cooling equipment capable of meeting the sensible and latent load of the building that is not sized more than 115% of total load or next available size

Select heating equipment of the lowest capacity required to meet the design heating load and provide the air volume required by any air conditioning equipment installed

Select system that is ENERGY STAR® certified or equivalent

Select outdoor units that are corrosion-protected for marine climate zones

Unit Location and Installation

Locate outdoor unit to provide clearance on all sides and top according to manufacturer specifications and service access according to applicable code, on a non-wicking equipment pad, ensuring unit is level, stable and elevated a minimum of 6" above the ground

Locate indoor unit in a dry location and within conditioned space (when feasible) that provides adequate service access according to manufacturer specifications and applicable code

Install units according to manufacturer specifications and applicable building code (e.g., IRC, IMC, IBC) and ANSI/ACCA Standard 5 (HVAC Quality Installation Standard)

Fuel Delivery

For fuel delivery on indoor units, select approved pipe type in accordance with applicable code (e.g., NFPA 54/ANSI/ACCA Z223.1, NFPA 31, IMC) and capable of supporting the total connected load of all appliances.

Locate/route gas piping/train to create the least pressure drop possible and all fuel piping so as to not create a trip hazard and not be damaged by water

Support fuel piping in compliance with applicable code

All piping installations must contain at a minimum: a manual fuel shut off valve, union joint, and a sediment trap for each appliance

If installed, vent all gas pressure regulators requiring venting to outside the building with code-approved rigid pipe

Terminate pipe in a safe location without any thread, coupling, fitting etc. that would allow a plug to be easily fitted

Seal all gas piping in accordance with manufacturer specifications

Install a secondary liquid propane safety detector system (e.g., valve, exhaust fan, alarm light) for propane piping installed below grade

If a gas pressure booster is necessary, confirm compatibility with the gas-fired equipment and check low and high gas pressure switches for proper operation

If a fuel pump is required on oil systems, design it in accordance with manufacturer specifications based on fuel type, distance from tank and equipment size. Install a serviceable strainer in the pump supply side. Pump must be interlocked with appliance to cut off when appliance is not functioning.

Use connectors and filter fittings for oil systems that approved by applicable code (e.g. NFPA 31, IMC)

Support

Ensure unit is level, stable, secured to ductwork, properly braced to prevent movement (seismic bracing), and elevated as required by applicable building code

For Horizontal Flow Systems in an Attic, support equipment on a fireproof platform that is elevated above the insulation level or suspend with threaded rode in accordance with local codes and manufacturer specifications. Install vibration pads/isolators according to manufacturer specifications

For Horizontal Flow Systems in a Subspace, support equipment on a non-wicking, fireproof material or suspend with threaded rod in accordance with local codes and manufacturer specifications. Install vibration pads/isolators according to manufacturer specifications.

For Upflow Systems on a Platform, support equipment on a durable, fireproof platform capable of supporting the weight of the equipment. Install vibration pads/isolators according to manufacturer specifications

For Downflow Systems, support equipment on ductwork capable of supporting the weight of the equipment

Connections, Intakes/Terminations

Install equipment connections (e.g., electrical service, condensate drains, ductwork, fuel, venting, refrigerant lines) to allow for necessary service and repair access to all portions of the equipment

Locate all intakes/terminations in compliance with manufacturer specifications and applicable building code

Electrical Wiring

Install electrical wiring according to NFPA 70, and provide an electrical disconnect within site of the unit.

Install all high voltage wiring inside of protective conduit and approved junction boxes, no wiring connections (high or low voltage) will occur outside of appropriate junction box

Condensate Drainage

Install a secondary drain pan with a float switch interlocked to the cooling system power under all units that exist in or above conditioned space

Pipe condensate to a properly sized sanitary drain or the outdoors and provide with traps as specified by the manufacturer and applicable building code

When there is potential for condensation or freezing of the drain line, insulate condensate drain lines to a minimum of R-4 with insulation that contains a Class II or greater vapor retarder

Refrigerant Lines and Charge

When installing refrigerant piping:

- Select only manufacturer and code approved (e.g. IRC, IMC) refrigerant lines, fittings, etc., sized in accordance with manufacturer specifications for the installed equipment
- Install refrigerant lines without kinks, crimps, or excessive bends
- Route lines in a manner that protects it from damage by workers and occupants
- Join lines using manufacturer-approved method(s)
- Install proper filter dryer(s) on all systems
- Install P-traps on suction line risers that are greater than 10' in height
- Use manufacturer specifications to determine appropriate lengths and elevations of refrigerant lines between condensing units and indoor coils
- Insulate all suction lines to a minimum of R-4 with an insulation that is a class II or better vapor retarder
- Insulate all high pressure lines that pass through spaces where condensation may occur to a minimum of R-4 with an insulation that is a class II or better vapor retarder
- Seal all seams, joints, etc. of insulation using compatible material (e.g., tape)
- Install UV-resistant insulation on exterior lines or protected insulation from UV degradation

Secure and support refrigerant lines according to applicable code and in a manner that protects the line from damage by workers or occupants

If refrigerant lines are installed where they may be contacted by vehicles, people, tree limbs, etc., install a rigid sleeve or pipe duct over them that provides adequate impact protection

Install locking refrigerant caps on all refrigerant access ports

When installing refrigerant charge:

Before adjusting refrigerant to system verify that system is leak free, air flow of system is correct, and indoor and outdoor temperatures are within allowable range for refrigerant charge testing

Base refrigerant charge on manufacturer specifications for the equipment being serviced

Weigh in calculated refrigerant charge if outdoor conditions prevent accurate pressure measurements according to manufacturer specifications

Provide occupant/owner with refrigerant charge documentation according to ANSI/ACCA Standard 5 (HVAC Quality Installation)

Air Handler Sealing (see Job Aid 19-1)

Seal air handler and adjoining ductwork:

Select only UL 181 approved materials that are compatible with their intended surfaces, allow for differential expansion and contraction between dissimilar materials, and meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers)

Select low volatile organic compound (VOC) sealants for use inside the pressure boundary that meet independent testing and verification protocols

Clear surrounding insulation to expose joints being sealed, salvage for reuse if possible

If duct must be cut open to gain access, position the hole to make repair with appropriate materials feasible

Remove loose debris using a vacuum

Remove any substance that will prevent sealant adhesion (tape, oil, etc.) using appropriate solvent

Securely fasten all duct connections using appropriate mechanical fasteners according to Chart 1

Seal all accessible seams, cracks, joints, holes, and penetrations of duct system

Select method according to physical leak size:

Mastic alone is acceptable for holes less than 1/8" in size that are more than 10' from air handler if static operating pressure is less than 1" of Water Column (iwc)

Seal leaks less than 1/4" using fiberglass mesh and mastic

Seal leaks between 1/4" and 3/4" using a two stage process: Install temporary tape as a backing material, then seal with fiberglass mesh and mastic that extends at least 1" past the temporary tape on all sides

Repair leaks larger than 3/4" using a rigid duct patch. Mechanically fasten patch before applying mastic. Install fiberglass mesh and mastic over the seam, overlapping repair joint by at least 1" on all sides

Seal gaps between boot and surface connections using fiberglass mesh tape and mastic or appropriate flexible caulking. Ensure sealant is dry before reinstalling the register. Ensure the register can be removed and reinstalled by the dwelling occupant.

Seal any joints, cracks, and holes that are not gasketed or weatherstripped and are not needed for proper function or service of the unit using removable sealant (e.g., foil tape, gaskets, etc.)

Seal the filter slot with a durable, client removable filter slot cover (e.g., magnetic strip)

If air handler is installed in a building cavity (i.e., closet), seal the cavity to eliminate any return air leaks from adjoining chases (See article "Isolate the Combustion Appliance Zone")

Occupant Safety and Documentation

Install smoke detectors inside the supply duct plenum of systems that move more than 2,500 cubic feet per minute (CFM) in accordance with the applicable building code

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Install a Furnace

Aligns with 5.0108.4, 5.0504.1, 5.0504.2, 5.0106.1

Load Calculation

Perform residential load calculation in accordance with the current version of ANSI/ACCA Manual J (Residential Load Calculation) or equivalent using interior design temperatures of 70 degrees for heating

Perform commercial load calculation in accordance with the current version of ANSI/ACCA Manual N (Commercial Load Calculation) or equivalent using interior design temperatures of 70 degrees for heating

Room by room load calculations will be performed when installing a new duct system or in retro-commissioning projects

Calculated loads based on post-retrofit dwelling characteristics

Equipment Selection

Select residential equipment in accordance with the current version of ANSI/ACCA Manual S (Residential Equipment Selection) or equivalent

Select commercial equipment in accordance with the current version of ANSI/ACCA Manual CS (Commercial Applications, Systems and Equipment) or equivalent

Select heating equipment of the lowest capacity required to meet the design heating load and provide the air volume required by any air conditioning equipment installed

Select system that is ENERGY STAR® certified or equivalent

Unit Location and Installation

Locate unit in a dry location and within conditioned space (when feasible) that provides adequate service access according to manufacturer specifications and applicable code

Install unit according to manufacturer specifications and applicable building code (e.g., IRC, IMC, IBC) and ANSI/ACCA Standard 5 (HVAC Quality Installation Standard)

Fuel Delivery

Select approved pipe type in accordance with applicable code (e.g., NFPA 54/ANSI/ACCA Z223.1, NFPA 31, IMC) and capable of supporting the total connected load of all appliances.

Locate/route gas piping/train to create the least pressure drop possible and all fuel piping so as to not create a trip hazard and not be damaged by water

Support fuel piping in compliance with applicable code

All piping installations must contain at a minimum: a manual fuel shut off valve, union joint, and a sediment trap for each appliance

If installed, vent all gas pressure regulators requiring venting to outside the building with code-approved rigid pipe. Terminate pipe in a safe location without any thread, coupling, fitting etc. that would allow a plug to be easily fitted

Seal all gas piping in accordance with manufacturer specifications

Install a secondary liquid propane safety detector system (e.g., valve, exhaust fan, alarm light) for propane piping installed below grade

If a gas pressure booster is necessary, confirm compatibility with the gas-fired equipment and check low and high gas pressure switches for proper operation

If a fuel pump is required on oil systems, design it in accordance with manufacturer specifications based on fuel type, distance from tank and equipment size. Install a serviceable strainer in the pump supply side. Pump must be interlocked with appliance to cut off when appliance is not functioning.

Use connectors and filter fittings for oil systems that approved by applicable code (e.g. NFPA 31, IMC)

Support

Ensure unit is level, stable, secured to ductwork, properly braced to prevent movement (seismic bracing), and elevated as required by applicable building code

For Horizontal Flow Systems in an Attic, support equipment on a fireproof platform that is elevated above the insulation level or suspend with threaded rode in accordance with local codes and manufacturer specifications. Install vibration pads/isolators according to manufacturer specifications

For Horizontal Flow Systems in a Subspace, support equipment on a non-wicking, fireproof material or suspend with threaded rod in accordance with local codes and manufacturer specifications. Install vibration pads/isolators according to manufacturer specifications.

For Upflow Systems on a Platform, support equipment on a durable, fireproof platform capable of supporting the weight of the equipment. Install vibration pads/isolators according to manufacturer specifications

For Downflow Systems, support equipment on ductwork capable of supporting the weight of the equipment.

Connections, Intakes and Terminations

Install equipment connections (e.g., electrical service, condensate drains, ductwork, fuel, venting, refrigerant lines) to allow for necessary service and repair access to all portions of the equipment

Locate all intakes/terminations in compliance with manufacturer specifications and applicable building code

Electrical Wiring

Install electrical wiring according to NFPA 70, and provide an electrical disconnect within site of the unit.

Install all high voltage wiring inside of protective conduit and approved junction boxes, no wiring connections (high or low voltage) will occur outside of appropriate junction box

Install combustion venting in compliance with manufacturer specifications and applicable building code (e.g., IRC, IMC, IBC)

Condensate Drainage

Install a float switch interlocked to the cooling system power under all units that exist in or above conditioned space

Pipe condensate to a properly sized sanitary drain or the outdoors and provide with traps as specified by the manufacturer and applicable building code

When there is potential for condensation or freezing of the drain line, insulate condensate drain lines to a minimum of R-4 with insulation that contains a Class II or greater vapor retarder

Air Handler Sealing (See Job Aid 19-1)

Seal air handler and adjoining ductwork:

- Select only UL 181 approved materials that are compatible with their intended surfaces, allow for differential expansion and contraction between dissimilar materials, and meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers)
- Select low volatile organic compound (VOC) sealants for use inside the pressure boundary that meet independent testing and verification protocols
- Clear surrounding insulation to expose joints being sealed, salvage for reuse if possible

If duct must be cut open to gain access, position the hole to make repair with appropriate materials feasible

Remove loose debris using a vacuum

Remove any substance that will prevent sealant adhesion (tape, oil, etc.) using appropriate solvent

Securely fasten all duct connections using appropriate mechanical fasteners according to Chart 1

Seal all accessible seams, cracks, joints, holes, and penetrations of duct system

Select method according to physical leak size:

Mastic alone is acceptable for holes less than 1/8" in size that are more than 10' from air handler if static operating pressure is less than 1" of Water Column

Seal leaks less than 1/4" using fiberglass mesh and mastic

Seal leaks between 1/4" and 3/4" using a two stage process: Install temporary tape as a backing material, then seal with fiberglass mesh and mastic that extends at least 1" past the temporary tape on all sides

Repair leaks larger than 3/4" using a rigid duct patch. Mechanically fasten patch before applying mastic. Install fiberglass mesh and mastic over the seam, overlapping repair joint by at least 1" on all sides

Seal gaps between boot and surface connections using fiberglass mesh tape and mastic or appropriate flexible caulking. Ensure sealant is dry before reinstalling the register. Ensure the register can be removed and reinstalled by the dwelling occupant.

Seal any joints, cracks, and holes that are not gasketed or weatherstripped and are not needed for proper function or service of the unit using removable sealant (e.g., foil tape, gaskets, etc.)

Seal the filter slot with a durable, client removable filter slot cover (e.g., magnetic strip)

If air handler is installed in a building cavity (i.e., closet), seal the cavity to eliminate any return air leaks from adjoining chases (See article "Isolate the Combustion Appliance Zone")

Occupant Safety and Documentation

Install smoke detectors inside the supply duct plenum of systems that move more than 2,500 cubic feet per minute (CFM) in accordance with the applicable building code

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

A-8 Duct Fastening

Metal to Metal	3 equally-spaced galvanized or stainless steel mechanical fasteners
Flex to Metal	UL-Listed approved tie bands using a tie band tensioning tool
Flex to Flex	Rigid metal coupling of the same size at the flex duct between the two sections. Fasten both joints with UL-listed approved tie bands using a tied band tensioning tool
Duct Board to Duct Board	Cut duct board edges to create an overlapping joint on all contact surfaces. Fasten joints with outward clinching (stitch) staples every 2 inches Cover joint with UL 181 rated mastic embedded fiber tape and additional mastic that laps at least 1" past the edges of the tape on all sides
Duct Board to Flexible Duct	Install a metal take-off collar on the duct board specifically designed for the thickness of the duct board Bend all finger tabs down securely so collar shank is firmly seated against the exterior surface Attach flexible duct to collar with UL listed tie bands using a tie band tensioning tool
Duct Board to Metal	Fasten duct board to metal duct using metal channel and mechanical fasteners spaced evenly on all sides Cover connection joint with UL-listed mastic embedded fiber tape and additional mastic that laps at least 1" past the edges of the tape on all sides
Duct Board Plenum to Air Handler Cabinet	Fasten using metal channel fastened with screws space a maximum of 6" with the duct board sandwiched between the channel flange In upflow air handler connections, install a flexible connection between supply plenum and unit that does not reduce the inside dimensions of the duct
Duct Boot to Subfloor	Minimum of 1 stainless steel or galvanized fastener per side
Duct Boot to Gypsum	If accessible, fasten a boot hanger to adjacent framing with mechanical fasteners, then connect boot to hanger with mechanical fasteners If inaccessible, fasten boot to gypsum with UL-listed fiber tape and mastic
Metal Plenum to Air Handler Cabinet	Install a flexible connection between plenum and unit that does not reduce the inside dimensions of the duct Fasten plenum on all sides with mechanical fasteners no more than every 6 inches

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES OFFICE



Building America Case Study:
Technology Solutions for Existing Homes

A Homeowner's Guide to Window Air Conditioner Installation for Efficiency and Comfort

PROJECT INFORMATION

Building Component: HVAC

Application: Retrofit; single and/or multi-family

Year Tested: 2012

Applicable Climate Zone(s): All

PERFORMANCE DATA

Cost of Window A/C unit: $150–$600

Cost of Materials for Improved Installation: $10–$15

Energy Savings: up to 7% cooling savings, or up to 280 kWh/year

Electricity Bill Savings: up to $31/year; enough to pay for the cost of the unit over its lifetime

FOR MORE INFORMATION

Read the full report, Laboratory Performance Testing of Residential Window Air Conditioners, NREL/TP-5500-57617, February 2013. *www.nrel.gov/docs/fy13osti/57617.pdf*

Watch the YouTube video: *http://www.youtube.com/watch?v=78AGFmGGjVY&feature=youtu.be*

Building America SM U.S. Department of Energy

Homeowners in the United States spend one out of every eight dollars of utility costs on cooling their living space. Window air conditioners (A/Cs) are an inexpensive alternative to central systems, and are sold in greater numbers each year than all other residential cooling systems. They are purchased to cool a specific room and are easy for anyone to install. In contrast to these benefits, window A/Cs come at a cost—they operate less efficiently (using more energy to do the same cooling) than most other residential A/C systems.

Researchers at the National Renewable Energy Laboratory (NREL) studied window A/Cs on behalf of the U.S. Department of Energy's Building America program, to understand how they perform and how they could be improved.

The study showed that window A/C installation resulted in significant air leakage—equivalent to having a 5-in^2 hole in the outside wall. All summer long, hot outdoor air flows into the home, as shown in the figure to the right, making the A/C run longer and use more energy. This outdoor air reduces comfort for occupants through increased heat and often carries humidity into the home.

A portion of the cool air leaving the A/C is recirculated back into the unit because the outlet and inlet are so close together. Thus, that cool air does not help cool off the home and is a secondary waste of energy. Also, the researchers verified the importance of appliance maintenance and cleaning.

> **"Air sealing around the window and the air conditioner is critical for best performance"**
>
> —Chuck Booten, Ph.D., Senior Engineer, NREL

Finally, NREL's team identified simple measures to improve both efficiency and comfort. Accessories provided by manufacturers can be replaced with inexpensive hardware store materials to improve a window A/C installation, increase efficiency, improve comfort, and lower utility bills with a payback of less than one year.



Typical air leakage pathways increase electricity use and decrease comfort. *Illustration by Marjorie Schott, NREL*











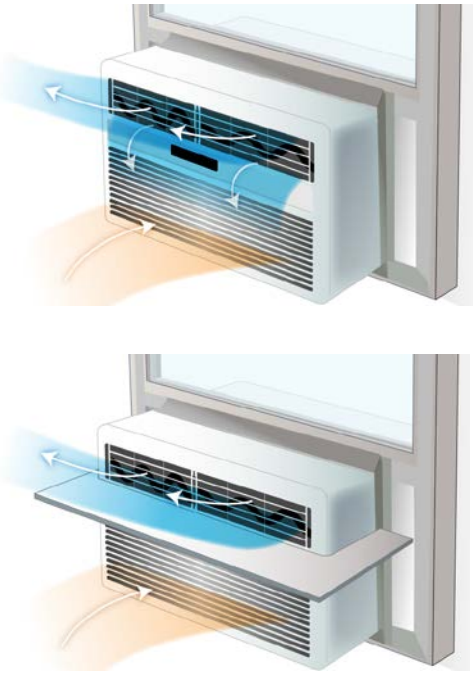
Five Easy Steps to Limit Window A/C Infiltration

1. Remove accordion panels. Typically, a sliding keeper can be removed. Pull the frame out, then remove another keeper from the side of the A/C. *(Do not remove top and bottom braces; they hold the unit in the window. Use manufacturer-supplied hardware to secure the window in place after replacing the unit.)*
2. Cut and install rigid foam panels to fill the spaces beside the A/C. Measure the thickness of the window sash to determine foam thickness; ¾–1½ in. thick will fit most window frame channels. Some foams have a skin to help protect the foam from weather. Exterior grade tape can be used to cover outside surface of foam for increased durability. If this is done, work from bottom to top and overlap tape so water will drain appropriately. (Cost of foam: $3–$10 for multiple windows.)
3. Foam strips provided by the manufacturer for sealing between sashes are prone to air leaks. Instead, use backer rod (closed cell cylindrical foam) between sashes. Measure gap thicknesses to select appropriate size. (Cost of backer rod: ~$4, enough for multiple windows.)
4. No matter what foam is used, it is important to also plug the top of the side channels.
5. Use tape to secure the foam panels and prevent air leaks around joints. Tape the foam panels to the window, window frame, and A/C; tape the top and bottom of the A/C. Different colors of tape are available. If window frames are painted, consider using tape with a less aggressive bond to prevent peeling. (Cost of one roll of duct tape: ~$6, enough for multiple windows.)

Go Further: Address Cool Air Recirculation

To further enhance performance, install a diverter between the cool air supply and room air return of the air conditioner. This reduces short-circuiting of air from the supply to the return and maximizes the amount of cool air that goes into the room, saving energy and money.

Diverters can be made from ¼-in. medium density fiberboard or similar material. (Cost for one sheet of fiberboard: ~$5.)



Installing a diverter (bottom) helps to maximize cool air flow from the A/C unit. *Illustration by Marjorie Schott, NREL*

The Bottom Line

- Air leakage wastes energy and costs money, but homeowners can reduce this leakage easily.
- Recirculation of air near the unit lowers efficiency and can be easily reduced.
- Periodic cleaning of intake and exhaust grills on both the indoor and outdoor portion of the unit can help maintain efficient performance.
- Remove unit from window or seal it up completely on the inside after cooling season is over; otherwise, air will leak through the unit itself.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

For more information, visit:
www.buildingamerica.gov

The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.

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A 10 Belly Repair Information

1. If necessary, remove/replace damaged or compromised insulation, and make other incidental repairs as needed.
2. Materials used for all hard belly repair and replacement must meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers), must create a continuous insulation layer when possible (i.e., rigid insulation board), must adequately support the applied load, and must provide a permanent air barrier.
3. All bottom board fabric must meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers), must adequately support the applied load, must provide a permanent air barrier, and must be used and installed in accordance with methods provided in the manufacturer's installation instructions. See Flex-mend, Mobile-Flex, or equivalent. House wrap, such as Tyvek, is not approved.
4. All bottom board tape must meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers), must be self-adhesive, must be used and installed in accordance with methods provided in the manufacturer's installation instructions. See Flex-mend, Mobile-Flex, or equivalent. House wrap, such as Tyvek, is not approved.
5. For hard belly replacement:
    a. In addition to rigid insulation board, a variety of other materials can be used, including plywood and reinforced polyethylene.
    b. Cover entire area with as few pieces of rigid belly material as possible, attaching it to sub-framing every 6" where possible with mechanical fasteners that penetrate sub-framing a minimum of 1-1/2".
    c. Use mechanical fasteners that incorporate washers/caps that prevent fasteners from being pulled through belly material.
    d. Install support material for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation).
    e. Cover the seams using bottom board tape and mastic.
    f. Cut or leave access holes to blow insulation.
    g. Fill entire belly cavity to ensure continuous and consistent insulation to the prescribed R-value.
    h. Cover access holes with bottom board tape.
    i. Seal bottom board tape with mastic.
6. For hard belly repair:
    a. Small holes can be patched using bottom board tape as required to cover the area, with the patch sized at least 3” larger than the hole in the belly material, with the edges covered with mastic.
    b. Patch any hole larger than 1 square foot with ridged patch material that laps over the sub-framing on at least two edges.
        i. Install rigid patching material over all holes lapping a minimum of 3" over the surrounding material.
        ii. Attach patches using mechanical fasteners spaced no more than 6" apart.

iii. Use mechanical fasteners that incorporate washers/caps that prevent fasteners from being pulled through belly material.
iv. Apply a continuous bead of sealant under the patch that creates an airtight seal.
v. Seal the patch edges using bottom board tape and mastic.

7. For soft belly replacement:
    a. Cut a piece of bottom board fabric large enough to span the entire section to be replaced.
    b. Attach bottom board fabric to rigid support material (wooden furring strips), wrapping it around a minimum of two times and mechanically fastening it every 6" with a divergent stapler.
    c. Attach the rigid support material to the belly at every joist, or at a maximum of every 2' with mechanical fasteners.
    d. Cover the bottom board fabric edges with bottom board tape.
    e. Cut or leave access holes to blow insulation.
    f. Fill entire belly cavity to ensure continuous and consistent insulation to the prescribed R-value.
    g. Cover access holes using bottom board tape, with the patch sized at least 3" larger than the hole in the belly material.
    h. Seal all bottom board tape edges with mastic.
8. For soft belly repairs:
    a. Small soft belly tears and holes can be patched using bottom board tape cut and placed as required to cover the area, with the patch sized at least 3" larger than the hole in the belly material, and the edges covered with mastic.
    b. For larger repairs, cut a piece of bottom board fabric sized at least 3" larger that the hole in the belly material.
        i. Apply bottom board tape and attach to the patch with fasteners installed with a divergent stapler.
        ii. Seal all bottom board tape edges with mastic.
9. Depending on the situation, mastic and/or spray foam may also be needed to ensure complete air sealing around HVAC, plumbing, and other penetrations.
10. Use of other materials may be allowed, providing they are appropriate for the job, installed per the manufacturer's installation instructions, and approved by KHRC in advance.