RETROFITTING OKLAHOMA

STANDARD WORK SPECIFICATION-ALIGNED FIELD GUIDE
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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

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 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 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.
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

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

---

**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.*
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.
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
2-1 AIR SEAL TOP PLATES IN ATTIC
Aligns with SWS 3.0101.1, 3.0102.11

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

**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

**NOTES**

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

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

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

Aligns with SWS 3.0101.1, 3.0102.9

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**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.

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**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.

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**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
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

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 3.0101.1

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

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

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.
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
2-4 AIR SEAL BALLOON FRAMING FROM ATTIC

Aligns with SWS 3.0101.1

**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

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

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.
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 thermal boundary is maintained

TOOLS
• Caulk Gun

MATERIALS
• Caulk

NOTES

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

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

TOOLS

• Caulk Gun
• Spray Foam Gun
• Utility Knife

MATERIALS

• Caulk • Spray Foam • 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

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

BEFORE
✗ Check floor joist cavities for blocking material and penetrations

AFTER
✓ Air seal cracks and penetrations in floored attic spaces

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

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

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, and air seal to hold insulation in place

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 – Step 1 and Step 2
3-1 SEAL AROUND CHIMNEYS AND FLUES
Aligns with SWS 3.0102.2

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

**BEFORE**

✗ Even high-temperature sites need air sealing

**AFTER**

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

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</table>
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

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

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

**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.

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

With the help of a licensed electrician, there is also the option of replacing old can lights with airtight units or LED retrofit inserts. Check program requirements.
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

✓ Cover junction boxes and attach flag for visibility

TOOLS

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

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, if needed. Ensure 2 inches of gap for airflow

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

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

NOTES

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

### 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 (optional)

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 foam tape

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 (the maximum R-value structurally allowable, up to the final insulation level of surrounding attic)

6. Trim is air-sealed with appropriate material

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

NOTES

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

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

TOOLS

- Measuring Tape
- Utility Knife
- Saw
- Caulk Gun
- Spray Foam Gun
- Drill
- Spray Adhesive
- Caulk Adhesive
- Foil Tape
- Mechanical Fasteners

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 appropriate R-value

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’

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

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

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

**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

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

Photo credit: Home Insulation of Syracuse – After
6-3 INSULATE AN ATTIC STAIRWAY

Aligns with SWS 4.0104.1, 4.0104.2, 4.0104.3, 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

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

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 stairways walls

Photo credit: Home Insulation of Syracuse – after, steps 8, 11 and 12
6-3 INSULATE AN ATTIC STAIRWAY

- Dense pack stairway walls
- Weatherstrip and insulate door
- Insulate under stairway using insulation indicated by work order
- Seal off insulation from conditioned space in home
- If backside of stairs is sealed, blow insulation into cavity behind stairs
- Plug access holes from blown insulation

NOTES
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 181 Fiberglass Mesh Tape

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. Replace non-IC rated can lights with IC-rated cans

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.
7-2 MH INSULATION: GABLE END BLOW METHOD

Aligns with SWS 4.0103.9

**BEFORE**

✗ Manufactured 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 or Cellulose Loose Insulation
- Mechanical Fasteners
- Caulk/Sealant

**NOTES**

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

**TOOLS**
- Drill
- Utility Knife
- Insulation Machine

**MATERIALS**
- Fiberglass or Cellulose Loose Insulation
- Blocking Material
- Butyl Tape

**NOTES**

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

**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
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 the 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

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

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

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

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

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

4. Seal all holes securely

*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

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

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

TOOLS
• Saw
• Insulation Machine
• Caulk Gun
• Paint Brush
• Drill

MATERIALS
• Cellulose or Fiberglass Loose Insulation
• All-Weather Adhesive
• Sheet Metal
• Mechanical Fasteners
• Elastomeric Paint
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

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
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

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.

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

**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

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

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 backing material

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
8-4 INSULATE AN ATTIC KNEE WALL WITH 2-PART SPRAY FOAM

Aligns with SWS 4.0104.5, 4.0104.6

BEFORE

✗ Air seal before applying spray foam to prevent foam from leaking into conditioned space

AFTER

✓ Spray walls as evenly as possible

TOOLS

- Spray Foam Gun
- Fit-Tested Respirator or PAPR
- Measuring Tape
- Utility Knife
- Drill

MATERIALS

- 2-Part Spray Foam
- Low-Perm Paint
- Polyisocyanurate
- Expanded Polystyrene (EPS)
- Gypsum Board
- Mechanical Fasteners
- Joint Tape
- Joint Compound

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
Ensure proper PPE when installing 2-Part Spray Foam

For climate zones 5-8, install foam to a thickness of at least a class II vapor retarder or install a class II vapor retarder, such as fiber-faced polyiso, unfaced EPS or low-perm paint

If space is used for utility access, storage, or permanently habitable, separate foam from the subspace with a suitable thermal barrier covering, such as 1/2-inch gypsum board

Photo credit: Tracy Helgeson – third photo from left
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

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 Fiberglass Insulation

Tools and materials listed are only recommendations and may not include everything needed to complete the job. “After” photo credit: Home Insulation of Syracuse
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
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

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
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

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

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

### BEFORE

✗ Older houses often are lacking in insulation

### AFTER

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

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<th>TOOLS</th>
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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)

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)


Notes

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
10-1 INSULATE MANUFACTURED HOME SIDEWALLS WITH BATTs

Aligns with SWS 4.0202.3

BEFORE
× Manufactured housing sidewalls present a unique challenge when it comes to insulation

AFTER
✓ Properly installed insulation will have no gaps and compressed as little as possible

BEFORE YOU BEGIN

Prepare insulation stuffer, if necessary

TOOLS
- Drill
- Measuring Tape
- Utility Knife
- Batt Stuffer

MATERIALS
- Wrapped Fiberglass Batts
- Mechanical Fasteners

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
10-1 INSULATE MANUFACTURED HOME SIDEWALLS WITH BATTs

1. Remove siding as needed, starting from bottom and taking note of any obstacles that may compress insulation.

2. Measure cavity size.

3. Plastic-wrapped fiberglass batts provide both insulation value and vapor retarder for unsealed cavities.

4. Cut batt to length for cavity.

5. Fold batt over end of insulation stuffer.

6. Insert batt into cavity, sliding under top belt rail to top of cavity, and ease stuffer back out to allow batt to fill in space.

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
10-1 INSULATE MANUFACTURED HOME SIDEWALLS WITH BATTs

7. Gently tug batt into place and tuck remaining batt under lower belt rail and fit down to bottom of cavity with minimal compression

8. Reinstall siding

9. Reattach mechanical fasteners

NOTES

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

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
11-1 INSTALL WEATHERSTRIPPPING ON AN EXTERIOR DOOR
Aligns with SWS 3.0202.1

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

BEFORE
✗ Daylight visible around an exterior door indicates air infiltration

AFTER
✓ 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

FINAL CHECKLIST

TOOLS
• Tape Measure
• Snips
• Drill with Appropriate Bits

MATERIALS
• Weatherstripping

Weatherization Works
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
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**

✓ Ensure a good seal to prevent air infiltration
✓ Ensure unimpeded door operation

**FINAL CHECKLIST**

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

**MATERIALS**
- Mechanical Fasteners
- Caulk

**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 Applicator
- Spray Foam Gun
- Caulk Gun

### MATERIALS

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

---

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

---

**TOOLS**

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

**MATERIALS**

- Polyisocyanurate Foam Board
- Plastic-Wrapped Fiberglass Batts
- Extruded Polystyrene (XPS)
- 2-Part Spray Foam
- 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 tight to rim joist

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

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.
5. If foam insulation is over 3.25 inches thick or space is permanently habitable, insulation needs to be covered by a thermal barrier, such as gypsum board.

6. When using wrapped or faced batts, ensure facing is to the conditioned side of the cavity and that batt is uncompressed.

7. Seal edges of the wrap or facing to surrounding surface to ensure a continuous barrier.

8. 2-part sprayfoam can also be used as rim joist insulation.

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

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

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

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 a thermal barrier

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**

✓ Insulation is or has class II vapor retarder
✓ Vapor retarder faces conditioned space
✓ Insulation laps underneath ground vapor retarder at foundation wall

**FINAL CHECKLIST**

**TOOLS**
- Measuring Tape
- Utility Knife
- Drill
- Spray Foam Gun
- Half- or Full-Face Respirator

**MATERIALS**
- Polyisocyanurate Foam Board
- Nylon Fasteners
- 2-Part Spray Foam

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-rated 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

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
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

TOOLS
- Caulk Gun
- Spray Foam Gun
- Utility Knife

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

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.

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

**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

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

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

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

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.
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.

Photo credit: InterNACHI – Before
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

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

✓ Vapor retarder faces warm side of floor
✓ Consistent cover across subfloor

FINAL CHECKLIST

TOOLS

• Measuring Tape
• Utility Knife
• Drill

MATERIALS

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

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.
14-2 INSULATE A SUBFLOOR WITH BLOWN INSULATION ABOVE UNCONDITIONED SPACE
Aligns with SWS 4.0301.2, 4.0301.3, 4.0301.4, 4.302.2, 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.

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

10. Keep staples close together

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

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
13. Loose fill netting to required density

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

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

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
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.
5. Fill entire belly cavity to prescribed R-value

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 patch to ensure permanent adhesion

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

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
4. Extend plastic a minimum of 6" 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" 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

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

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

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

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 6.0101.1, 6.0101.2, 6.0202.1

BEFORE

✗ Dryer vents with long bumpy runs create a fire hazard

AFTER

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

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. Duct material is metal rigid or semi-rigid

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.
5. Termination has backdraft damper and no cage

6. Duct in uninsulated space is insulated

7. If duct run must exceed 35 feet, install booster fan

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

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**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

---

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

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

MATERIALS

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

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
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

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

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

*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)

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<td>Cut patch that will extend over entire gap or hole and affix with mechanical fasteners.</td>
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<td>Apply mastic over edges and fasteners of patch and push fiberglass mesh into it.</td>
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<tr>
<td>C-4.</td>
<td>Apply additional mastic over mesh, extending at least 1 inch past tape and seam in all directions.</td>
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**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

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

TOOLS
• Measuring Tape
• Utility Knife

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

MATERIALS
• Duct Insulation (min R-8) with Exterior Vapor Retarder
• UL-181 Tape
• Twine
• Zip Ties

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

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-181 Tape
- Twine
- Zip Ties

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

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

Exposured 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 181 Fiberglass Mesh Tape

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
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.
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
• Extruded Polystyrene
• Gypsum Board
• Mastic
• UL-181 Mesh Tape
• Butyl Tape

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)

4. Prepare plenum by removing any residue from old insulation

NOTES

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

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

7. To ensure a complete vapor barrier, trim insulation from vapor barrier to create overlap flap for seams, or tape seams with UL-181 tape

8. Ensure clean surface for adhesion at overlap seam

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
20-4 INSULATE PLENUM

9. Spray adhesive over area where piece will be installed

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 adhered to the lower layer to maintain complete vapor barrier, or tape seams with UL-181 tape

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

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
✓ Window opens and closes properly
✓ All exterior edges are air-sealed
✓ Water will flow away from window

FINAL CHECKLIST

TOOLS
• Measuring Tape
• Utility Knife
• Drill
• Spray Foam Gun
• Vacuum

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.
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
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

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

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
21-2 DOOR INSTALLATION

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

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 window pane, size pane 1/8-3/16 inches less than RO

4. Run interior bead of caulk

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
5. Install new glass, using tempered where code requires, that meets or exceeds previous glazing

6. Hold new pane with tape or stops

7. Caulk all edges
23-1 INSULATE AN ELECTRIC DOMESTIC HOT 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

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
23-1 INSULATE AN ELECTRIC DOMESTIC HOT 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
23-2 INSULATE A GAS DOMESTIC HOT 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

Tools and materials listed are only recommendations and may not include everything needed to complete the job.
23-2 INSULATE A GAS DOMESTIC HOT WATER HEATER

1. Insulate tank with minimum R-10 or better

2. Ensure a continuous vapor barrier with no gaps

3. Cut insulation to allow 6-inch space to draft diverter and flue pipe

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

NOTES
23-2 INSULATE A GAS DOMESTIC HOT 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

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

TOOLS
- Utility Knife
- Measuring Tape

MATERIALS
- Pipe Insulation
- Tape or Tie Straps

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.

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.

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.
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

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

MATERIALS

• Vent with Collar
• Caulk
• Mechanical Fasteners
• Joint Tape
• Mastic

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

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 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 (Note: pictured stacks are too close to one another)

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

NOTES
**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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A-2 Specialized Field-Work Tasks

**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 720

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 720 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.

**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 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.

**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.

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.

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).
IF replacing existing refrigerator, through-wall or window unit always:

- 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

**Refrigerator and Freezer Replacement**
Aligns with 7.0101.1

Electrical receptacle meets the requirements of NFPA 70 (Article 440)

Select an ENERGY STAR® qualified appliance, equivalent or better

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

Install appliance according to manufacturer specifications and applicable code

Where applicable, ensure appliance is accessible as required by the Federal Fair Housing Act and ICC A117.1

The appliance shall not reduce required maneuvering clearances in the kitchen to less than that permitted by local, state, or federal guidelines

**Install a Through-Wall or Window Unit**
Aligns with 5.0301.1

Verify unit meets physical size of through-wall or window opening and that electrical receptacle meets requirements of NFPA 70 (Article 440)

Select new unit that: matches available voltage and does not exceed available amperage of existing circuit, is sized based on manufacturer specifications for the space conditioned, is ENERGY STAR® qualified with Energy Saver Mode or better, does not use electric resistance heat as the primary heat source (i.e., select Heat Pump units).

Install unit per manufacturer specifications and in accord with applicable codes (e.g., no extension cord used)

Where applicable, unit controls and thermostat must comply with the operable parts provisions of ICC A117.1 when the dwelling unit is required to be accessible per ADA

Where required, maintain egress requirements in accordance with ANSI/NFPA 101 and local laws

Install unit according to manufacturer specifications so that it is stable, secure, and will not pose a risk to occupant safety

Before installing through-wall unit, seal all adjacent framing. Provide a sealed, sleeved opening After installation, seal the perimeter with suitable materials (e.g., ASTM C1193)
A-3 Electrical Contractor Tasks

Install Hardwired (Interconnected) Smoke Alarms
Aligns with 2.0101.1, NFPA 72

Select hardwired (interconnected) smoke alarms that are listed and labeled in accordance with UL 217

Install hardwired (interconnected) smoke alarms in the locations required by Authority Having Jurisdiction

Install hardwired (interconnected) smoke alarms in accordance with the manufacturer’s instructions

Provide occupants the manufacturer’s written instructions

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

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

Seal penetrations for control wiring with a durable sealant (e.g., caulk, silicone) that complies with applicable fire safety code

Provide occupants/owners with user’s manual, warranty information, installation instructions and installer contact information
A-4 HVAC/R Contractor Tasks

Domestic Hot Water

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)
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 shut-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 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 ENERGY STAR® certified, equivalent, 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.
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-off 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)

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
Heating and Cooling

**Install a Through-Wall or Window Unit**
Aligns with 5.0301.1

Verify unit meets physical size of through-wall or window opening and that electrical receptacle meets requirements of NFPA 70 (Article 440)

Select new unit that: matches available voltage and does not exceed available amperage of existing circuit, is sized based on manufacturer specifications for the space conditioned, is ENERGY STAR® qualified with Energy Saver Mode or better, does not use electric resistance heat as the primary heat source (i.e., select Heat Pump units).

Install unit per manufacturer specifications and in accord with applicable codes (e.g., no extension cord used)

Where applicable, unit controls and thermostat must comply with the operable parts provisions of ICC A117.1 when the dwelling unit is required to be accessible per ADA

Where required, maintain egress requirements in accordance with ANSI/NFPA 101 and local laws

Install unit according to manufacturer specifications so that it is stable, secure, and will not pose a risk to occupant safety

Before installing through-wall unit, seal all adjacent framing and provide a sealed and sleeved opening

After installation, seal the perimeter with suitable materials (e.g., ASTM C1193)

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

**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

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

Seal penetrations for control wiring with a durable sealant (e.g., caulk, silicone) that complies with applicable fire safety code

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

**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.

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 in the primary and secondary drain pan 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 23-3), 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".

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**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 rod 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 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

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-5 Chart 1: Duct Fastening

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metal to Metal</strong></td>
<td>3 equally-spaced galvanized or stainless steel mechanical fasteners</td>
</tr>
<tr>
<td><strong>Flex to Metal</strong></td>
<td>UL-181 approved tie bands using a tie band tensioning tool</td>
</tr>
<tr>
<td><strong>Flex to Flex</strong></td>
<td>Rigid metal coupling of the same size at the flex duct between the two sections. Fasten both joints with UL 181 approved tie bands using a tied band tensioning tool</td>
</tr>
<tr>
<td><strong>Duct Board to Duct Board</strong></td>
<td>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</td>
</tr>
<tr>
<td><strong>Duct Board to Flexible Duct</strong></td>
<td>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 181 approved tie bands using a tie band tensioning tool</td>
</tr>
<tr>
<td><strong>Duct Board to Metal</strong></td>
<td>Fasten duct board to metal duct using metal channel and mechanical fasteners spaced evenly on all sides. Cover connection 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</td>
</tr>
<tr>
<td><strong>Duct Board Plenum to Air Handler Cabinet</strong></td>
<td>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</td>
</tr>
<tr>
<td><strong>Duct Boot to Subfloor</strong></td>
<td>Minimum of 1 stainless steel or galvanized fastener per side</td>
</tr>
<tr>
<td><strong>Duct Boot to Gypsum</strong></td>
<td>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 181 rated fiber tape and mastic</td>
</tr>
<tr>
<td><strong>Metal Plenum to Air Handler Cabinet</strong></td>
<td>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</td>
</tr>
</tbody>
</table>

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**Note:** The above chart outlines various methods for fastening ducts in different scenarios, ensuring proper durability and safety in HVAC systems.