



ENERGY EFFICIENCY PROGRAMS

Building Envelope Field Guide

Standard Work Specifications for Single-Family Homes

7.9.18

This document is intended to summarize best practices and published guidance for residential contractors and home performance professionals' safe and effective completion of work within Ameren Illinois Energy Efficiency Programs. It references the National Renewable Energy Laboratory's Standard Work Specifications Tool. This document does not provide incentive eligibility guidelines. Incentive eligibility guidelines and requirements are available in documentation available at AmerenIllinoisSavings.com

Guidelines for Home Energy Professionals: Standard Work Specifications for Single-Family Home Energy Upgrades. U.S. Department of Energy Weatherization Assistance Program/National Renewable Energy Laboratory. <http://sws.nrel.gov>, accessed 12/14/2017.

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3 Air Sealing

3.1 Attics

3.1.1 Penetrations and Chases

3.1.1.1 - Penetrations and Chases General

Desired Outcome:

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

A listing of approved material types to be used based upon location and combustibility requirements.

The materials in this section apply to all air sealing efforts.

3.1.1.1.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a chase

Repairs will be completed before work

Objective(s):

Repair moisture-related issues

3.1.1.1.2 – Backers, Barriers, and Infill

Specification(s):

Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole

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

Barrier Materials for Exposed Use in Attic and Crawl Spaces:

- Foil faced polyisocyanurate (e.g. ESR-1864 TSX8500, NER 681 Thermax or similar)
- Extruded polystyrene insulation boards (e.g. ESR 2142 Dow Styrofoam or similar)
- Foil faced bubble wrap (flame spread 25X)
- Radiator reflector board
- House wraps when supported (Flame spread 25: ESR 2375 Tyvek or similar)

Barrier Materials with Allowed Interior Exposure and To Cover Chases to Interior:

- Rigid duct board with Flame Spread 25 facing
- Gypsum board
- Plywood
- Oriented strand board (OSB)

Non-combustible Barriers:

- Galvanized sheet metal
- Cement board

Non-combustible Backers:

- Galvanized sheet metal
- Mineral Wool

Backers for other Sealants:

- Glass or mineral fiber insulation
- Backer rod (foam rope)

Moisture Resistant Backers:

- Polyethylene (6 mil at the minimum)

- Rigid Foam Board Insulation
- Backer Rod (foam rope)
- Foil-faced polyisocyanurate

Objective(s):

Minimize hole-size to ensure successful use of sealant

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

Ensure sealant does not fall out

3.1.1.1.3 - Sealant selection

Specification(s):

Sealants shall be rated for a minimum 20-year life

Sealants visible to the interior of the residence shall be paintable

Caulking and sealant materials for specific locations and uses will be governed by the cost-effectiveness

Siliconized acrylics should only be used in interior locations or where paint compatibility is important

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

- Pure silicone will be used anywhere that sealants are needed between wood and metal, wood and concrete, or other materials that expand and contract at different rates as moisture and temperature vary, or where greater flexibility is needed

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

Duct Mastic and Sealants include:

- Water based duct sealant UL 181A-M, UL 181B-M
- Acrylic sealant meeting ASTM C 834
- Silicone, urethane, other elastomeric sealants meeting ASTM C-920

Sealant foams that meet ICC ES 377 and ASTM C1642-07 include:

- One component foam
- Two component sealant foam (kit)

Non-Fireproof Sealants include:

- 1-part urethane foam
- 1-part urethane fire block foam rated for sealing gaps in wood framing
- 2-part urethane foam kits
- Siliconized latex sealants meeting ASTM C834
- Silicone urethane and other elastomeric sealants meeting ASTM C920
- Water-based duct sealant meeting UL181A-M, UL181B-M
- Spray applied latex based sealants

Objective(s):

Select permanent sealant

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

3.1.1.1.4 - High temperature application

Specification(s):

Sealants will be rated for a minimum 20-year life

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

Local codes will be referenced

Non-combustible Sealants include:

- Furnace cement
- Fireblock sealant meeting ASTM E 136 (all chimneys)
- For gas vents only: 600F RTV silicone

Objective(s):

Prevent a fire hazard

3.1.1.2 - Chase Capping

Desired Outcome:

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

3.1.1.2.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a chase

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

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

Specification(s):

Entire opening will be spanned with rigid material

Material will be cut to fit and fastened as required

Objective(s):

Reduce opening to what can be sealed with sealant

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

Specification(s):

Material will be used that can be exposed to the interior of the house and meet the flame and smoke spread indexes as required in IRC (Flame Spread 25)

Objective(s):

Prevent a fire hazard

3.1.1.2.4 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.1.2.5 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.1.2.6 - Adjacent framing

Specification(s):

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

Objective(s):

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

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

Desired Outcome:

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

3.1.1.3.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.1.3.2 - Sealing methods

Specification(s):

Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

Wall below openings will be dense packed

OR

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

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

Objective(s):

Prevent air leakage from wall cavity to attic

3.1.1.3.3 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.1.3.4 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.1.3.5 - Adjacent framing

Specification(s):

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

OR

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

Objective(s):

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

3.1.1.4 – Recessed Lighting (Non-Insulation Contact and Insulation Contact)

Desired Outcome:

Ensure safety from fire and prevent air leakage

3.1.1.4.1 - Air barrier system

Specification(s):

A fire-rated air barrier system (i.e. equivalent to 5/8 fire code gypsum wallboard) will be used to separate recessed lights from insulation, using one of the methods below:

A fire-rated airtight closure taller than surrounding attic insulation will be placed over recessed lights

OR

The light fixture will be replaced with an airtight and IC- rated fixture

OR

The fixture(s) may be replaced with surface mounted fixture and opening sealed

Objective(s):

Prevent a fire hazard

Prevent air leakage through fixture

3.1.1.4.2 - Enclosure top

Specification(s):

The top-fire rated enclosure material will have an R-value of 0.5 or less

The top of the enclosure may be insulated over

Objective(s):

Prevent heat build up

3.1.1.4.3 - Clearance

Specification(s):

The entire closure will maintain a 3" clearance between the closure and the fixture including wiring, box, and ballast

Objective(s):

Keep an air space around the fixture

3.1.1.4.4 - Sealants and weather stripping

Specification(s):

Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only (not the lighting fixture)

Objective(s):

To prevent air leakage, completely adhere the sealant to all surfaces to be sealed

3.1.2 Open Stairwells

3.1.2.1 - Interior with Sloped Ceiling

Desired Outcome:

Stairwells sealed to prevent air leakage and moisture movement between the attic and conditioned space

3.1.2.1.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell
Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.2.1.2 - Standard void over stairwell (15-minute fire-rated material; e.g., gypsum lined)

Specification(s):

Entire opening will be spanned with rigid material
Material will be cut to fit and fastened as required

Objective(s):

Prevent air leakage from wall to attic
Reduce opening to what can be sealed with sealant
Support load as required (e.g., wind, insulation)

3.1.2.1.3 - Non-standard void over stairwell (surfaces around void are not 15-minute fire-rated (e.g., bookcases, chest of drawers), or lined with paneling)

Specification(s):

Material will be used that can be an exposed barrier to the interior of the house

Objective(s):

Prevent a fire hazard

3.1.2.1.4 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.2.1.5 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.2.1.6 - Perimeter sealing

Specification(s):

Air barrier will be extended on all four sides from finished ceiling or existing framing to the new barrier
Access will be gained as needed (e.g., pull flooring)

Objective(s):

Create a continuous air barrier

3.1.2.2 - Stairwell to Attic—Door at Bottom with No Ceiling Above

Desired Outcome:

Stairwell sealed to prevent air leakage and moisture movement between the attic and the conditioned space

3.1.2.2.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell
Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.2.2.2 - Option 1: bring stairwell inside

Specification(s):

Materials will be installed in line with the ceiling level with an airtight and operable insulated panel weighing no more than 15 pounds, or a pre-fabricated kit may be used for repeated access

OR

Airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter
Access will be gained as needed (e.g., pull flooring)

Objective(s):

Prevent air leakage through stairwell between conditioned space and attic
Ensure the insulated panel is lightweight and easy for the occupant to use on an ongoing basis
Support insulation
Bring the stairwell inside of the thermal boundary
Ensure the new closure ties into the existing air barrier on all sides

3.1.2.2.3 - Option 2: keep stairwell outside

Specification(s):

An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors

OR

All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs)

Door will be weather-stripped and insulated

OR

A combination of the above methods can be used

Objective(s):

Prevent air leakage
Provide continuous thermal boundary Maximize thermal performance

3.1.2.2.4 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.2.2.5 - Joint seal

Specification(s):

Continuous, airtight seals will be provided around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.2.2.6 - Perimeter sealing

Specification(s):

Air barrier will be extended on all four sides from finished ceiling or from existing framing to the new barrier

Access will be gained as needed (e.g., pull flooring)

Objective(s):

Create a continuous air barrier

3.1.2.3 - Stairwell to Attic—Door at Top with Finished Ceiling Above

Desired Outcome:

Stairwell is sealed to prevent air leakage and moisture movement between the attic and conditioned space

3.1.2.3.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.2.3.2 - Option 1: bring stairwell inside

Specification(s):

An airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter

Access will be gained as needed (e.g., pull flooring)

OR

An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors

OR

All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs)

Door will be weather-stripped and insulated

OR

A combination of the above methods can be used

Objective(s):

Reduce air leakage

Provide continuous thermal boundary Maximize thermal performance

3.1.2.3.3 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.2.3.4 - Joint seal

Specification(s):

Continuous, airtight seals will be provided around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.2.3.5 - Perimeter sealing

Specification(s):

Air barrier will be extended on all four sides from finished ceiling or existing framing to the new barrier

Access will be gained as needed (e.g., pull flooring)

Objective(s):

Create a continuous air barrier

3.1.3 Dropped Ceilings and Soffits

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

Desired Outcome:

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

3.1.3.1.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.3.1.2 - Sealing methods

Specification(s):

Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

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

OR

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with SPF

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

Objective(s):

Prevent air leakage from dropped ceiling to attic

3.1.3.1.3 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.3.1.4 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.3.1.5 - Adjacent framing

Specification(s):

All remaining gaps will be sealed at the top of the dropped ceiling

OR

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

Objective(s):

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

3.1.3.2 - Ceiling Leaks Not Repairable—No Air Barrier Above

Desired Outcome:

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

3.1.3.2.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.3.2.2 - Sealing methods

Specification(s):

Ceiling or roof and wall air and thermal barriers will be connected with a rigid airtight connection around the perimeter

OR

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

OR

Intermediate framing will be used to support air and thermal barrier

OR

Rigid airtight thermal barrier will be installed at the roof sheathing

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

Objective(s):

Prevent air leakage from dropped ceiling to attic

3.1.3.2.3 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.3.2.4 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.3.2.5 - Adjacent framing

Specification(s):

All remaining gaps will be sealed at the top of the dropped ceiling

OR

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

Objective(s):

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

3.1.3.3 - Above Closets and Tubs

Desired Outcome:

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

3.1.3.3.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.3.3.2 - Above closets and tubs

Specification(s):

Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

OR

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

OR

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with SPF

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

Objective(s):

Prevent air leakage from dropped ceiling to attic

3.1.3.3.3 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.3.3.4 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

3.1.3.3.5 - Adjacent framing

Specification(s):

All remaining gaps at the top of the dropped ceiling will be sealed

Objective(s):

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

3.1.3.4 - Dropped Ceilings

Desired Outcome:

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

3.1.3.4.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.3.4.2 - Sealing methods

Specification(s):

Entire opening will be spanned with rigid material installed in line with the ceiling level

Material will be cut to fit and fastened as required

OR

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

OR

Wall below openings will be dense packed

OR

Wall below openings will be bridged and sealed with SPF

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

Objective(s):

Prevent air leakage from dropped ceiling to attic

3.1.3.4.3 - Support

Specification(s):

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

Objective(s):

Ensure seal stays in place and does not sag

3.1.3.4.4 - Joint seal

Specification(s):

Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections
Pre-fabricated units may be used when meeting the desired outcome

Objective(s):

Provide airtight, durable seal that does not move, bend or sag

3.1.3.4.5 - Adjacent framing

Specification(s):

All remaining gaps will be sealed at the top of the dropped ceiling

OR

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

Objective(s):

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

3.1.3.5 - Dropped Ceiling with Light Boxes and Fixtures

Desired Outcome:

Sealed light boxes safely prevent air leakage and moisture movement between the attic and conditioned space

3.1.3.5.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.3.5.2 - Light boxes (e.g., fluorescent lights)

Specification(s):

An airtight seal will be provided around perimeter between light box enclosure and interior ceiling

All seams and penetrations of the enclosure will be sealed

Access will be gained as needed (e.g., pull flooring)

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

Objective(s):

Prevent air leakage

3.1.3.5.3 - Recessed lights (Insulation Contact and Non-Insulation Contact)

Specification(s):

Insulation will be kept at least 3 inches away from the top and side of any fixtures

If dropped ceiling is to be filled with insulation, then a sealed rigid barrier enclosure will be installed to maintain a 3 inches clearance on all sides

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

Objective(s):

Prevent light fixture from overheating

Bring light fixture inside of the air barrier

3.1.3.6 - Dropped Soffits

Desired Outcome:

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

3.1.3.6.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.3.6.2 - Soffit general

Specification(s):

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

Objective(s):

Provide continuous air barrier across soffit openings

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

Specification(s):

Entire opening will be spanned with rigid material in line with the ceiling level

Material will be cut to fit and fastened as required

Objective(s):

Prevent air leakage from wall to attic

Reduce opening to what can be sealed with sealant

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

Bring soffit into thermal boundary

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

Specification(s):

Each stud bay will be spanned with rigid material will be cut to fit and fastened as required

OR

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

OR

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

OR

A sealed rigid barrier will be installed at all transitions

Objective(s):

Prevent air leakage from wall to soffit

Reduce opening to what can be sealed with sealant

Ensure soffit is outside of the thermal boundary

3.1.3.6.5 - Soffits containing recessed lights

Specification(s):

Insulation will be kept at least 3" away from the top and side of any fixtures

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

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

perm rating and R-value)

Objective(s):

Prevent light fixture from overheating

Bring light fixture inside of the air barrier

3.1.4 Cathedralized Attic Ceilings

3.1.4.1 - Cathedralized Attic Air Sealing (Insulation Installed at Roof Deck)

Desired Outcome:

Cathedralized attics sealed to prevent air leakage

3.1.4.1.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a cathedralized ceiling

Repairs will be completed before work begins

Objective(s):

Repair moisture-related issues

3.1.4.1.2 - Backing and infill

Specification(s):

Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space

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

Objective(s):

Minimize hole-size to ensure successful use of sealant

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

Ensure sealant does not fall out

3.1.4.1.3 - Sealant selection

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

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

Objective(s):

Select permanent sealant

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

3.1.5 Other Ceiling Materials

3.1.5.1 - Tongue and Groove Ceilings

Desired Outcome:

Tongue and groove ceilings sealed to prevent air leakage and moisture movement between the attic and conditioned space

3.1.5.1.1 - Pre-inspection

Specification(s):

An inspection will be conducted for mold, water leaks, and water damage before sealing a tongue and groove ceiling

Repairs will be completed before work

Objective(s):

Repair moisture-related issues

3.1.5.1.2 - Backing

Specification(s):

Backing will be installed behind tongue and groove ceilings

Objective(s):

Prevent air leakage and allow for sealants

3.1.5.1.3 - Sealant selection

Specification(s):

Sealants will be compatible with their intended surfaces

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

No sealant will be allowed to be visible in the living space

Objective(s):

Select permanent sealant

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

Ensure ceiling remains aesthetically pleasing

3.2 Windows and Doors

3.2.1 Maintenance, Repair, and Sealing

3.2.1.1 - Double-Hung Wood Windows

Desired Outcome:

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

3.2.1.1.1 - Lead paint assessment

Specification(s):

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

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

Objective(s):

Protect worker and occupant from potential lead hazards

3.2.1.1.2 - Weather stripping

Specification(s):

Existing weather stripping and sash sealant will be removed Surface where the sill meets the sash will be cleaned

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

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

Objective(s):

Form a complete seal from the outer edge of the sash to the jamb

Maintain operability of the window

3.2.1.1.3 - Sash locks

Specification(s):

Locks will be installed so that the rails of the upper and lower sashes are flush and in full contact

No gaps will be visible between the two sashes

Locks will be installed to achieve compression of the two sashes

Objective(s):

Form a secure connection between the two sashes

3.2.1.1.4 - Replacement sills

Specification(s):

Beveled sill will be flush with interior wall and sloped to the exterior

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

Sill will be water-sealed and primed

Objective(s):

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

Maintain operability of the window

Allow for drainage to the exterior

3.2.1.1.5 - Sash replacement

Specification(s):

Lower sash will have the same bevel on the bottom rail as the sill

Sash will be water-sealed and primed

Objective(s):

Ensure sash remains in a fixed position when open or partially open

Maintain operability of the window

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

3.2.1.1.6 - Adjust stops

Specification(s):

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

Objective(s):

Form a complete seal between the jamb, sash, and stop

Maintain operability of the window

3.2.1.1.7 - Replace stops

Specification(s):

Stops will be installed to keep the window securely in place

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

Objective(s):

Form a complete seal between the jamb, sash, and stop

Maintain operability of the window

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

Desired Outcome:

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

3.2.1.2.1 - Lead paint assessment

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule ([40 CFR Part 745](#)) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards

Objective(s):

Protect worker and occupant from potential lead hazards

3.2.1.2.2 - Operable windows

Specification(s):

All egress windows will be operable as required by local codes

Objective(s):

Maintain operability of egress windows

3.2.1.2.3 - Air infiltration

Specification(s):

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

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

Objective(s):

Reduce air infiltration

3.2.1.2.4 - Water infiltration

Specification(s):

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

Objective(s):

Reduce water infiltration

3.2.1.2.5 - Occupant education and maintenance

Specification(s):

Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window

Objective(s):

Ensure long-term weather tightness

3.2.1.3 - Exterior Doors

Desired Outcome:

Doors operable and weather tight

3.2.1.3.1 - Lead paint assessment

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule ([40 CFR Part 745](#)) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards

Objective(s):

Protect worker and occupant from potential lead hazards

3.2.1.3.2 - Door operation and fit

Specification(s):

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

Objective(s):

Ensure proper operation of the door

3.2.1.3.3 - Air infiltration

Specification(s):

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

Objective(s):

Reduce air infiltration

3.2.1.3.4 - Water infiltration

Specification(s):

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

Objective(s):

Reduce water infiltration

3.2.1.3.5 - Occupant education and maintenance

Specification(s):

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

Objective(s):

Ensure long-term weather tightness

3.2.1.4 - Pocket Door

Desired Outcome:

Pocket door sealed top and back to prevent leakage

3.2.1.4.1 - Backing and infill

Specification(s):

Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole

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

Objective(s):

Minimize hole-size to ensure successful use of sealant

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

Ensure sealant does not fall out

3.2.1.4.2 - Sealant selection

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction
Sealant will be used in accordance with OSHA/manufacturer safety protocol for worker and occupant safety

Manufacturer SDS sheet will be followed for worker safety

Objective(s):

Select permanent sealant

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

3.2.2 Repairing/Replacing Cracked and Broken Glass

3.2.2.1 - Fixed Frame with Wood Sash—Older House

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

3.2.2.1.1 - Lead paint assessment

Specification(s):

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

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

Objective(s):

Protect worker and occupant from potential lead hazards

3.2.2.1.2 - Broken glass removal

Specification(s):

Putty and push points will be removed Broken or cracked glass will be removed

Objective(s):

Safely remove old glass

Glass complete and intact; improved energy efficiency performance of fenestration

3.2.2.1.3 - Sash preparation

Specification(s):

Opening will be cleaned

Objective(s):

Prepare opening for new glass

3.2.2.1.4 - New glass installation

Specification(s):

Glass will be sized 1/8" to 3/16" smaller than opening to allow for movement of frame

Safety glass will be installed in accordance with local codes

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

Glazing compound will be added in accordance with manufacturer specifications

Objective(s):

Ensure glazing compound will adhere to sash Install, seal, and secure new glass in place

Allow glazing compound to harden to ensure secure installation

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

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

3.2.2.2.1 - Lead paint assessment

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule ([40 CFR Part 745](#)) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards

Objective(s):

Protect worker and occupant from potential lead hazards

3.2.2.2.2 - Broken glass removal

Specification(s):

Window stops and damaged glass will be removed

Objective(s):

Safely remove old glass

3.2.2.2.3 - Opening preparation

Specification(s):

Opening will be cleaned

Glazing tape will be removed or replaced

Objective(s):

Prepare opening for new glass

3.2.2.2.4 - New glass installation

Specification(s):

Replacement glass will be sized to original width, height, and depth Stops will be replaced or installed

Wood stops will be sealed to glass with appropriate sealant

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

Tempered glass will be installed as required by local codes

Glazing compound will be added in accordance with manufacturer specifications

Objective(s):

Install, seal, and secure new glass in place

Allow glazing compound to harden to ensure secure installation

3.2.3 Replacement

3.2.3.1 - Replacement Window in Existing Window Frame

Desired Outcome:

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

3.2.3.1.1 - Lead paint assessment

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise EPA's RRP Program Rule ([40 CFR Part 745](#)) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards

Objective(s):

Protect worker and occupant from potential lead hazards

3.2.3.1.2 - Opening preparation

Specification(s):

Interior stops, sashes, parting strips, and pulleys will be removed
Opening will be cleaned

Objective(s):

Provide a clean opening for replacement window unit

3.2.3.1.3 - Replacement window installation

Specification(s):

Replacement window will be installed in accordance with manufacturer specifications, ensuring that the exterior stops are caulked

Objective(s):

Ensure replacement window operates properly
Ensure replacement window has a weather tight fit

3.2.3.1.4 - Safety

Specification(s):

Egress windows and safety glass will be installed in accordance with local codes

Objective(s):

Meet all codes when replacing windows

3.2.3.1.5 - Occupant education and maintenance

Specification(s):

Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window

Objective(s):

Ensure long-term weather tightness

3.3 Basements and Crawl Spaces

3.3.1 Basements Connected to Crawl Spaces

3.3.1.1 - Basements Connected to Crawl Spaces—Sealing and Insulating

Desired Outcome:

Crawl spaces and basements separated using appropriate methods that define spaces and allow for treatment in accordance with specifications

3.3.1.1.1 - Conditioned basements with vented crawl spaces

Specification(s):

Crawl space will be separated from the conditioned basement with a continuous air barrier, ground moisture barrier, and thermal boundary

Objective(s):

Create separation and define spaces

Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency

3.3.1.1.2 - Conditioned basements with closed crawl spaces

Specification(s):

Crawl space will be separated from the conditioned basement with a continuous air barrier and ground moisture barrier

Objective(s):

Create separation and define spaces

Enable treatment of crawl spaces and basements by referenced specifications

Increase house durability and energy efficiency

3.3.1.1.3 - Unconditioned basements with vented crawl spaces**Specification(s):**

Vented crawl space will be separated from the unconditioned basement with a continuous air barrier and ground moisture barrier

Objective(s):

Create separation and define spaces

Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency

3.3.1.1.4 - Unconditioned basements with closed crawl spaces**Specification(s):**

Unconditioned basement will be treated as an extension of the closed crawl space

Objective(s):

Create separation and define spaces

Enable treatment of crawl spaces and basements by referenced specifications Increase house durability and energy efficiency

3.3.2 Crawl Spaces**3.3.2.1 - Crawl Spaces—Sealing Floor Penetrations****Desired Outcome:**

Air leakage prevented and indoor air quality protected

3.3.2.1.1 - Backing and infill**Specification(s):**

Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration

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

Objective(s):

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

Ensure sealant does not fall out

3.3.2.1.2 - Sealant selection**Specification(s):**

Sealants will be used to fill holes no larger than recommended by manufacturer specifications

Sealants will be compatible with their intended surfaces

Sealants will allow for differential expansion and contraction between dissimilar materials

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

Objective(s):

Create a permanent seal

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

3.3.2.1.3 - High temperature application**Specification(s):**

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

Objective(s):

Prevent a fire hazard

3.3.2.2 - Closed Crawl Spaces—Air Sealing Foundation Vents

Desired Outcome:

Air and moisture penetration through the existing vent into the crawl space blocked

3.3.2.2.1 - Vent closure

Specification(s):

Vent opening will be permanently closed and sealed

Objective(s):

Prevent air and moisture penetration

3.3.2.3 - Closed Crawl Spaces—Air Sealing Exterior Wall

Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

3.3.2.3.1 - Seal penetrations

Specification(s):

Penetrations will be sealed with a durable material

Objective(s):

Prevent air and moisture penetration into crawl space

3.3.2.3.2 - Pest exclusion

Specification(s):

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

Objective(s):

Prevent pest entry

3.3.2.4 - Closed Crawl Spaces—Air Sealing Brick Curtain Wall with Piers

Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

3.3.2.4.1 - Seal penetrations

Specification(s):

Penetrations will be sealed with a durable material, including the following:

Sealing rain screen to crawl space connection

Re-venting exterior weep holes with wicking rope

Objective(s):

Reduce moisture vapor and water from entering the crawl space through the rain screen

Decrease probability of rot

3.3.2.4.2 - Pest exclusion

Specification(s):

If penetration is greater than ¼", a pest-proof material will be used to fill the penetration before sealing

Objective(s):

Prevent pest entry

3.3.2.5 - Closed Crawl Spaces—Attached Crawl Spaces under Unconditioned Spaces

Desired Outcome:

Closed, attached crawl spaces sealed but accessible

3.3.2.5.1 - Separate crawl spaces

Specification(s):

A continuous air and vapor barrier between the attached crawl space under unconditioned spaces and the closed crawl space will be maintained

Objective(s):

Prevent air and moisture penetration

3.3.2.5.2 - Entry point

Specification(s):

When adding access to a crawl space:

Access openings through the floor will be a minimum of 18 inches by 24 inches or as constrained by existing framing members

Openings through a perimeter wall will be not less than 16 inches by 24 inches or as constrained by existing framing members

When any portion of the through-wall access is below grade, an area way not less than 16 inches by 24 inches will be provided

Under-floor spaces containing appliances will be provided with an unobstructed access large enough to remove the largest appliance but not less than 30 inches high and 22 inches wide or more than 20 feet long measured along the center line of the passageway from the opening to the appliance

A level service space at least 30 inches deep and 30 inches wide will be present at the front or service side of the appliance

If the depth of the passageway or the service space exceeds 12 inches below the adjoining grade, the walls of the passageway will be lined with concrete or masonry extending 4 inches above the adjoining grade in accordance with [Chapter 4 IRC](#)

The rough-framed access opening dimensions will be a minimum of 22 inches by 30 inches and large enough to remove the largest appliance

Objective(s):

Provide access to attached crawl space for inspections

3.3.3 Special Considerations

3.3.3.1 - Skirting Post and Pier Foundations

Desired Outcome:

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

3.3.3.1.1 - Skirting

Specification(s):

Any materials making contact with the ground will be rated for ground contact

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

Objective(s):

Minimize pests, wind, water, and freezing of pipes under house

3.3.3.1.2 - Flashing

Specification(s):

Skirting will be flashed to prevent the entrance of water

Objective(s):

Prevent water from entering space under house

3.3.3.1.3 - Fastening

Specification(s):

Entire skirting will be mechanically fastened

Objective(s):

Ensure lasting upgrade

3.4 Attached Garages

3.4.1 Garage Openings

3.4.1.1 - Penetrations, Cracks, and Doors between Garage and House

Desired Outcome:

Openings from garage sealed to prevent leakage

3.4.1.1.1 - Penetrations

Specification(s):

All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations will be sealed

Objective(s):

Prevent air leakage and pollutant entry

3.4.1.1.2 - Ductwork

Specification(s):

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

Objective(s):

Prevent air leakage and pollutant entry

3.4.1.1.3 - Cracks

Specification(s):

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

All cracks in ceiling surfaces will be sealed

Objective(s):

Prevent air leakage and pollutant entry

3.4.1.1.4 - Garage to house door

Specification(s):

Weather stripping, door sweep, and threshold will be installed to stop air leakage

Objective(s):

Prevent air leakage and pollutant entry

3.4.1.1.5 - Glass

Specification(s):

Broken glass panes in doors will be replaced, pointed, and glazed where needed

Objective(s):

Prevent air leakage and pollutant entry

3.4.1.1.6 - Carbon monoxide (CO) alarm

Specification(s):

CO alarms should be installed in accordance with [ASHRAE 62.2](#), applicable codes and manufacturer specifications

Objective(s):

Warn occupants of CO exposure from attached garage

3.4.1.1.7 - Occupant education

Specification(s):

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

Objective(s):

Reduce risk of CO poisoning inside of garage and adjacent rooms

3.5 Ducts

3.5.1 Duct Preparation

3.5.1.1 - Preparation and Mechanical Fastening

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

3.5.1.1.1 - Preparation

Specification(s):

Type and R-value of existing duct insulation (e.g., fiberglass, stone wool, asbestos) will be identified as will the location of vapor retarders, if any

If asbestos insulation was used, it will not be disturbed; consult with an asbestos abatement expert for removal

Surrounding insulation will be cleared to expose joints being sealed

Duct surface to accept sealant will be cleaned

Insulation will be returned or replaced with equivalent R-value

Objective(s):

Gain access while maintaining insulation value

Achieve proper adhesion for airtight seal

3.5.1.1.2 - Metal to metal

Specification(s):

Round ducts will be mechanically fastened to maintain alignment

Other shaped ducts will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes

Objective(s):

Ensure durable joints

3.5.1.1.3 - Flex to metal

Specification(s):

Joints will be fastened with tie bands using a tie band tensioning tool

Objective(s):

Ensure durable joints

3.5.1.1.4 - Duct board to duct board

Specification(s):

Joints will be fastened with clinch stapler

Objective(s):

Ensure durable joints

3.5.1.1.5 - Flexible duct to duct board

Specification(s):

Metal take-off collar will be used and attached in accordance with IRC

Objective(s):

Ensure durable joints

3.5.1.1.6 - Metal plenum to air handler cabinet

Specification(s):

Plenum will be mechanically fastened

Objective(s):

Ensure durable joints

3.5.1.1.7 - Duct board plenum to air handler cabinet

Specification(s):

Termination bar or metal strip will be fastened with screws

Duct board will be installed between the screw and the termination bar

Objective(s):

Ensure durable joints

3.5.1.1.8 - Boot to wood

Specification(s):

Screws or nails will be used to fasten boot to wood

Objective(s):

Ensure durable joints

3.5.1.1.9 - Boot to gypsum

Specification(s):

Boot hanger will be fastened to adjacent framing with screws or nails Boot will be connected to boot hanger with screws

Integral snap boots will be installed

Objective(s):

Ensure durable joints

3.5.1.1.10 - Flex to duct board

Specification(s):

Take-offs will be in accordance with IRC and applicable local code

Objective(s):

Ensure durable joints

3.5.1.2 - Duct Preparation for SPF Application

Desired Outcome:

Condition of ductwork identified and necessary repairs made in preparation for spray polyurethane foam (SPF) application

3.5.1.2.1 - Inspection

Specification(s):

All exposed ductwork in unconditioned spaces (e.g., attics, basements, crawl spaces) will be inspected

Broken joints or large cracks, gaps, or holes will be identified

Type of ductwork (e.g., metal, duct board, flex duct) will be identified

Type and R-value of existing duct insulation (e.g., fiberglass, stone wool, asbestos) will be identified as will the location of vapor retarders, if any

If asbestos insulation was used, it will not be disturbed; consult with an asbestos abatement expert for removal

Loose fitting or damaged fiberglass or stone wool insulation will be removed using proper safety equipment

Necessary clearances for installation of SPF will be ensured

Objective(s):

Identify damaged ductwork in need of repair

Identify type and R-value of existing insulation

3.5.1.2.2 - Repair

Specification(s):

Broken or missing ductwork will be repaired or replaced

All cracks, gaps, or holes greater than ¼" will be taped or sealed as feasible

Dust, dirt, and grease will be removed from exterior surfaces of ducts

Objective(s):

Cover openings in ducts to prevent SPF from entering the interior of the duct

Ensure surfaces of duct are clean to promote proper adhesion of SPF

3.5.1.3 - Support

Desired Outcome:

Ducts and plenums properly supported

3.5.1.3.1 - Support (applies to all duct types)

Specification(s):

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

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

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

Objective(s):

Eliminate falling and sagging

3.5.2 Duct Sealing

3.5.2.1 - Air Sealing Duct System

Desired Outcome:

Ducts and plenums sealed to prevent leakage

3.5.2.1.1 - New component to new component sealant selection

Specification(s):

Any closure system used will be in accordance with [IRC Chapter 16](#)

Objective(s):

Ensure effectiveness of air sealing system

3.5.2.1.2 - New component to existing component

Specification(s):

Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic

Mastic alone will be acceptable for holes less than ¼" that are more than 10' from air handler

Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:

- They will be backed using temporary tape (e.g., foil tape) as a support prior to sealing
- They will be sealed using fiberglass mesh and mastic

Objective(s):

Eliminate air leakage into or out of ducts and plenums

Ensure adhesion of primary seal (mastic and fiberglass mesh) to the duct

Reinforce seal

Support mastic and fiberglass mesh during curing

3.5.2.1.3 - Existing component to existing component

Specification(s):

Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using UL 181 fiber-embedded mastic

Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:

- They will be backed using temporary tape (e.g., foil tape) as a support prior to sealing
- They will be sealed using fiberglass mesh and mastic

Seams, cracks, joints, holes, and penetrations larger than ¾" will be repaired using rigid duct material

Mastic will overlap repair joint or existing temporary tape by at least 1" on all sides

Objective(s):

Eliminate air leakage into or out of ducts and plenums

Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct

Reinforce seal

Support fiberglass mesh and mastic during curing

3.5.2.2 - Duct Spray Polyurethane Foam (SPF) Installation

Desired Outcome:

Exposed ductwork in unconditioned spaces insulated and sealed

3.5.2.2.1 - Installation

Specification(s):

Insulation will be installed according to manufacturer specifications and all provisions of the IRC

SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer
Sufficient insulation will be applied to all joints and around all penetrations to the conditioned space through walls, floors, and ceilings

SPF will be covered with proper fire protective coverings or coatings appropriate for location of ductwork and type of foam used and provisions of the IRC and local codes

If ducts are used for air-conditioning, an appropriate vapor retarder will be applied on the SPF if open-cell SPF used

If 2" or more of closed-cell SPF is used, follow manufacturer specification to determine if additional vapor retarder is needed

The flame spread index will not be greater than 25 and the smoke- developed index is not greater than 450 at the specified installed thickness

The foam plastic will be protected with an ignition barrier

Objective(s):

Insulate and seal all exposed ductwork in unconditioned spaces

Manage moisture condensation on ductwork that carry cooled air in warm, moist climates

Provide adequate fire protection for exposed SPF

3.5.2.3 - Proprietary Spray Application

Desired Outcome:

Ducts and plenums sealed to prevent leakage

3.5.2.3.1 - Internal or external application

Specification(s):

Installation of sealant will be applied in accordance with manufacturer specifications as well as [UL 181M](#), [NFPA 90A](#), and [NFPA 90B](#)

Objective(s):

Reduce duct leakage

3.5.2.4 - Air Sealing System Components

Desired Outcome:

Ducts and plenums sealed to prevent leakage

3.5.2.4.1 - Duct boot to interior surface

Specification(s):

All gaps between boot and interior surface that defines conditioned space will be air sealed

Gypsum edge will be wetted before applying water-based sealant

Sealants will be continuous and be in accordance with IRC

Objective(s):

Prevent air leakage

Prevent a fire hazard

3.5.2.4.2 - Wooden plenums and building cavities

Specification(s):

Accessible connections and joints will be made airtight using approved material

Objective(s):

Ensure ducts and plenums will not leak

3.5.2.4.3 - Air handler cabinet

Specification(s):

Joints will be closed and cracks and holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape) or in accordance with the original equipment manufacturer directions (if available)

Objective(s):

Reduce air leakage while maintaining accessibility

3.5.2.4.4 - Filter slot

Specification(s):

A pre-manufactured or site manufactured durable filter slot cover will be installed

Objective(s):

Reduce air leakage while maintaining accessibility

3.5.2.5 - Return—Framed Platform

Desired Outcome:

The return duct installed to prevent air leakage

3.5.2.5.1 - Preparation

Specification(s):

Debris and dirt will be cleaned out of the return platform

Objective(s):

Allow for the application of rigid materials and sealants

3.5.2.5.2 - Infill and backing

Specification(s):

Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space

Backing or infill will not bend, sag, or move once installed

Material will be rated for use in return duct systems

Objective(s):

Minimize hole-size to ensure successful use of sealant

Ensure closure is permanent and supports any load (e.g., return air pressure)

Ensure sealant does not fall out

3.5.2.5.3 - Sealant selection

Specification(s):

Sealants will be continuous and be in accordance with IRC

Objective(s):

Select permanent sealant

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

3.5.2.6 - Capping Dual-Cooling Up-Ducts

Desired Outcome:

Dual-cooling up-duct is sealed to prevent leakage

3.5.2.6.1 - Backing and infill

Specification(s):

Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the up-duct opening

A material will be rated for use in duct systems

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

Objective(s):

Minimize hole-size to ensure successful use of sealant

Ensure closure is permanent and supports any pressure produced by wind or air handler fan

Ensure sealant does not fall out

3.5.2.6.2 - Sealant selection

Specification(s):

Sealants will be continuous and be in accordance with IRC

Objective(s):

Select permanent sealant

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

3.5.2.7 - Return and Supply Plenums in Basements and Crawl Spaces

Desired Outcome:

Connections between the crawl space/unconditioned basement and living space eliminated to improve indoor air quality (IAQ) and efficiency of the distribution system

3.5.2.7.1 - Supply plenums (includes conditioned crawl spaces)

Specification(s):

Basements and crawl spaces that are used as heating and cooling supply plenums will not be allowed

Objective(s):

Eliminate connection between the crawl space/unconditioned basement and living space

3.5.2.7.2 - Return plenums

Specification(s):

Basements and crawl spaces that are used as heating and cooling return plenums will not be allowed

Objective(s):

Eliminate connection between the crawl space/unconditioned basement and living space

3.6 Roofs

3.6.1 Roof/Wall Connections

3.6.2.1 - Roof/Exterior Wall Connection, Including Joints at Roof/Parapet/Wall Connections

Desired Outcome:

Continuous air barrier between roof and exterior walls where connection is within conditioned space

3.6.2.1.1 - Pre-inspection

Specification(s):

Conduct pre-inspection in accordance with [SWS 2.0100.4 Work Area Inspection and Stabilization](#)

Existing water control measures will be identified

Air sealing locations will be identified between the roof and the exterior wall

Objective(s):

Provide a safe and stable work environment

Avoid compromising existing water control system

Ensure a continuous air barrier will be appropriately located at the roof/exterior wall junction

3.6.2.1.2 - Backing and infill

Specification(s):

Where gaps, cracks, or holes are larger than 1/4" across and/or where the air sealing materials will be subject to temperature variations in excess of 50° F, the need for backing or infill will be evaluated

If used, backing or infill will meet specific characteristics of the fire-resistance-rated assembly, and be compatible with the characteristics of the gap, crack, or hole, including preservation of any expansion/contraction characteristics for assembly (e.g., expansion joints, steam pipes, or dissimilar material interfaces with differing coefficients of expansion)

Backing or infill will be selected that maintains sealant placement and durability while allowing for the expected movement from expansion, contraction, load deflection, settling at the location, or if existing water control measures are compromised (e.g., rain screen, drip edge, weep holes, gutter and roof drains, scuppers, or other exterior water management elements)

Objective(s):

Minimize gap or hole-size to ensure successful use of sealant

Ensure closure is permanent and supports appropriate load (e.g., wind, snow, insulation) Ensure sealant does not fall out

Ensure integrity of the existing water control system

3.6.2.1.3 - Sealant selection

Specification(s):

Sealants will be compatible with their intended surfaces and applied in accordance with manufacturer specifications

Selection will be durable, pest resistant, and have a weather-appropriate seal

Indoor sealants will be low volatile organic compound (VOC) products that meet independent testing and verification protocols

Fire-resistance-rated assemblies will be provided with sealants permitted by the authority having jurisdiction and adopted building code

Objective(s):

Prevent intrusion of moisture and pests into the sealed assembly

Prevent exposing workers or occupants to excessive VOC levels

Ensure sealant meets or exceeds the performance characteristics of the assembly and is compliant with local fire code requirements

3.6.2.1.4 - Joint seal

Specification(s):

Continuous seal will be installed at roof/exterior wall junctions or roof/exterior and wall/parapet junctions, including, but not limited to, beams, cracks, joints, edges, penetrations, and connections

For metal roof decks, flutes will be accessed to install sealant between top side of roof deck and roof assembly

Objective(s):

Provide airtight, durable seal that does not move, bend, or sag

Ensure hidden flutes are properly sealed

3.6.2.1.5 - Cavity seal

Specification(s):

For framed parapets that are open between conditioned and unconditioned space, the parapet/wall cavity will be accessed, and an internal air barrier will be created within the parapet wall cavity at the roof plane

For parapet walls constructed with hollow core concrete masonry units, the hollow cores will be accessed at the roof plane, and an internal air barrier will be created within the parapet wall cavity at the roof plane

For exterior insulated finishing system (EIFS) parapet, air sealing measures will preserve designed

moisture control gaps between EIFS and wall sheathing

Objective(s):

Stop air movement within the parapet/wall cavity to create a continuous air barrier at the roof plane

Provide airtight, durable seal that does not move, bend, or sag

4 Insulation

4.1 Attics

4.1.1 General Preparation

4.1.1.1 - Fireplace Chimney and Combustion Flue Vents

Desired Outcome:

Combustible materials kept away from combustion sources

4.1.1.1.1 - Verify attic prep

Specification(s):

Holes, penetrations, and bypasses will be sealed

Dams will be fixed in places that maintain required clearance

Objective(s):

Prevent air leakage

Ensure insulation dams maintain clearance

4.1.1.1.2 - Required clearance

Specification(s):

A rigid dam having a height to ensure a 3" clearance area free of insulation or combustibles between combustion flue vent and dam, unless the flue vent is listed for a lesser clearance

Objective(s):

Ensure dam material does not bend, move, or sag

Prevent a fire hazard

4.1.1.1.3 - Safety

Specification(s):

Insulation will not be allowed between a heat-generating appliance and a dam unless material is rated for contact with heat generating sources

Objective(s):

Prevent a fire hazard

4.1.1.1.4 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupant

Objective(s):

Provide occupant with documentation of installation

4.1.1.2 - Vented Eave or Soffit Baffles

Desired Outcome:

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

4.1.1.2.1 - Installation

Specification(s):

If soffit venting or eave venting is present, baffles will be mechanically fastened to block wind entry into insulation or to prevent insulation from blowing back into the attic

If soffit venting or eave venting is present, baffles will be installed to maintain clearance between the roof deck and baffle in accordance with manufacturer specifications

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

Objective(s):

Ensure insulation R-value is not reduced

Maintain attic ventilation

4.1.1.3 - Dense Pack Preparation

Desired Outcome:

Proper material density achieved safely and cleanly

4.1.1.3.1 - Preparation

Specification(s):

Lead safety procedures will be followed

Cavities will be free of hazards, intact, and able to support dense pack pressures

All escape openings will be blocked for material

Access will be gained and each cavity will be probed, locating all attic floor joists and blockers

Interior will be masked and dust controlled during drilling when accessing from interior, shrouds and containment devices are recommended

Electricity supply will be confirmed and will support blowing machine power demand

Blowing machine pressure test will be performed with air on full, feed off, agitator running, and gate closed

Hose outlet pressure will be at least 80" of water column (IWC) or 2.9 pounds per square inch (psi) for cellulose insulation; for other types of dense pack insulation, check manufacturer specifications for blowing machine set up

Objective(s):

Prevent damage to house

Provide thorough access to allow 100% coverage

Use proper equipment and process to achieve consistent density, prevent settling, and retard air flow through cavities

4.1.1.4 - Unvented Roof Deck—Preparation for Spray Polyurethane Foam

Desired Outcome:

Backstop provided to prevent SPF from entering soffit areas

4.1.1.4.1 - Surface preparation

Specification(s):

Underside of roof deck will be prepared by sealing penetrations

Roof deck will be free of contaminants to ensure adhesion of foam

Objective(s):

Ensure proper bonding of SPF to substrate surfaces

4.1.1.4.2 - Installation of insulation dams

Specification(s):

Dams will be fastened to underside of roof deck and outside edge of exterior wall top plate to prevent SPF insulation from entering soffit area

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

Objective(s):

Ensure insulation R-value is not reduced

Minimize waste of SPF

Ensure continuous insulation and air seal of exterior wall top plate and roof deck

4.1.1.4.3 - Elimination of attic venting

Specification(s):

All gable vents, ridge vents, and roof vents will be covered with suitable backstop material to provide substrate for SPF application

Objective(s):

Remove ventilation points when converting from vented to unvented attic

4.1.1.4.4 - Removal of existing insulation and vapor retarder

Specification(s):

All existing attic floor insulation and vapor retarder will be removed

Objective(s):

Ensure the new conditioned space is coupled with the house

4.1.1.5 - Vented Roof Deck—Preparation for SPF

Desired Outcome:

Backstop or substrate provided to prevent SPF from entering soffit areas while ensuring required attic ventilation is provided

4.1.1.5.1 - Surface preparation

Specification(s):

All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation

Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt

Grease and oil will be removed using appropriate cleaners or solvents

Moisture content of all wood substrate materials will be checked to ensure it is below 20%

Objective(s):

Ensure proper bonding of SPF to substrate surfaces

4.1.1.5.2 - Installation of vent chutes

Specification(s):

Vent chutes will be installed between all rafters or trusses to ensure a continuous ventilation path between the eave or soffit area and the ridge or roof vent

Vent chutes will penetrate dams as needed

Objective(s):

Allow ventilation of underside of roof deck sheathing while creating an unvented, conditioned attic space

4.1.1.5.3 - Installation of insulation dams

Specification(s):

Dams will be fastened to underside of roof deck and outside edge of exterior wall top plate to prevent SPF insulation from entering soffit area

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

Objective(s):

Ensure insulation R-value is not reduced Minimize waste of SPF

Provide a ventilation path from eave or soffit to ridge vent when a vented roof deck is required

Ensure continuous insulation and air seal of top plate and roof deck

4.1.1.5.4 - Removal of existing insulation and vapor retarder

Specification(s):

All existing attic floor insulation and vapor retarder will be removed

Objective(s):

Ensure the new conditioned space is coupled with the house

4.1.2 Attic Ceilings

4.1.2.1 - Pitched/Vaulted/Cathedralized Ceilings—Loose Fill Over

Desired Outcome:

Reduce the rate of heat transfer through cathedral or vaulted ceiling

4.1.2.1.1 - Ventilation

Specification(s):

Venting will be continuous, if applicable

Objective(s):

Ensure capacity to increase R-value while not altering ventilation

4.1.2.1.2 - Lighting

Specification(s):

Existence of rated insulation contact can lights, which allow for insulation encapsulation, will be verified

Non-insulation contact rated can lights will not be insulated

Objective(s):

Prevent a fire hazard

4.1.2.1.3 - Installation

Specification(s):

When using cellulose, stabilized product is preferred when available

On roof pitches less than 6/12, loose fill cellulose can be used; on roof pitches greater than 6/12, install non-woven polypropylene netting (webbing) baffles of the same height as the insulation every 6' across slope to prevent the loose fill insulation from sliding downward, or dense pack cellulose above webbing stapled to the bottom (underside) of the rafters

Loose fill fiberglass will only be used on a slope less than or equal to a 6/12 pitch or the slope application approved by the manufacturer, whichever is less (dense packed fiberglass at slopes greater than 6/12 may be used)

Roof cavities will be insulated with loose fill according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):

Ensure appropriate material and application Insulate to prescribed R-value

4.1.2.1.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value

- Installed thickness and minimum settled thickness
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.1.2.2 - Pitched/Vaulted/Cathedralized Ceilings—Dense Pack Over

Desired Outcome:

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

4.1.2.2.1 - Fill slant ceilings

Specification(s):

Using fill tube, 100% of each cavity will be filled to a consistent density:

Cellulose material will be installed to a minimum density of 3.5 pounds per cubicfoot

Loose fiberglass material will be installed and will be specifically approved for air flow resistance per manufacturer's recommendation

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

Insulation will be verified to prevent visible air movement at 50 Pascals of pressure difference using chemical smoke, IR scans, or other approved verification method.

Objective(s):

Ensure complete and consistent coverage throughout ceiling plane

Eliminate voids and settling

Minimize framing cavity air flows

4.1.2.2.2 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R- value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.2.3 - Unvented Flat Roof with Existing Insulation

Desired Outcome:

Insulation reduces heat flow through unvented roof

4.1.2.3.1 - Ventilation

Specification(s):

Code compliant ventilation will be installed before insulation

Objective(s):

Reduce possibility of moisture issues

4.1.2.3.2 - Installation

Specification(s):

Roof cavities will be blown with loose fill insulation (or roof cavities will be dense packed with insulation) without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.1.2.3.3 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.1.2.4 - Cape Cod Side Attic Roof—Dense Pack Installation

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space

4.1.2.4.1 - Vapor barrier removal

Specification(s):

Vapor barriers will be removed from existing attic floor

Objective(s):

Ensure the new conditioned space is coupled with the house

4.1.2.4.2 - Netting, fabric, rigid sheathing

Specification(s):

When using netting or fabric, staples will be placed in accordance with manufacturer specifications; whichever is more stringent

Netting or fabric will meet local fire codes

Rigid materials will close the cavity

Objective(s):

Secure insulation

4.1.2.4.3 - Installation

Specification(s):

Roof cavities will be dense packed with loose fill insulation in accordance with manufacturer density specifications

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.1.2.4.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.1.2.4.5 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupants

Objective(s):

Provide occupant with documentation of installation

4.1.2.5 - Unvented Roof Deck—Spray Polyurethane Foam Installation

Desired Outcome:

Reduced heat transfer and air leakage through roof and closed attic sections as well as framing cavities inaccessible to other treatments

4.1.2.5.1 - Installation

Specification(s):

Insulation will be installed to prescribed R-value in accordance with manufacturer specifications

SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer, onto roof sheathing between rafters or trusses

When desired, underside of rafters or trusses will be covered with SPF to provide layer of continuous insulation

Upper vent openings will be covered with SPF, including ridge, roof, and gable that are covered with a substrate

In colder climates (IECC Zones 5-8), SPF will be installed to a thickness of least [Class II vapor retarder](#) or have at least Class II vapor retarder coating or covering in direct contact with the underside of the SPF

Objective(s):

Ensure complete and consistent coverage throughout roof plane

Eliminate cracks, gaps, and voids

Improve structural integrity of roof deck (closed cell SPF only)

Ensure alignment of insulation and air barrier

4.1.2.5.2 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.2.5.3 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupant

Objective(s):

Provide occupant with documentation of installation

4.1.2.6 - Vented Roof Deck—Spray Polyurethane Foam Installation

Desired Outcome:

Reduced heat transfer and air leakage through roof and closed attic sections as well as framing cavities inaccessible to other treatments

4.1.2.6.1 - Installation

Specification(s):

Insulation will be installed at the ceiling level to prescribed R-value in accordance with manufacturer specifications

SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer, onto roof sheathing between rafters or trusses

In colder climates (IECC Zones 5-8), SPF will be installed to a thickness of least [Class II vapor retarder](#) or have at least Class II vapor retarder coating or covering in direct contact with the underside of the SPF

Objective(s):

Ensure complete and consistent coverage throughout ceiling plane

Eliminate cracks, gaps, and voids

Ensure alignment of insulation and air barrier

4.1.2.6.2 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.2.6.3 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupant

Objective(s):

Provide occupant with documentation of installation

4.1.2.7 - Ignition and Thermal Barriers—Spray Polyurethane Foam

Desired Outcome:

Meet building code requirements for fire protection of spray polyurethane foam

4.1.2.7.1 - Identify fire safety requirements

Specification(s):

Meet or exceed local fire safety requirements for installation of SPF foam
Consult local codes to ensure installation complies with fire safety requirements
If code requirements are unclear, consult local code officials for clarification

Objective(s):

Ensure SPF installed in attic meets fire safety requirements

4.1.2.7.2 - Installation of ignition barrier

Specification(s):

If attic is to be used only for the service of utilities, foam will be separated from the attic space using a suitable ignition barrier covering or coating
Check manufacturer specifications and/or local codes for appropriate ignition barrier coatings/ materials

Objective(s):

Protect SPF insulation in the attic to minimize possibility of ignition and combustion

4.1.2.7.3 - Installation of thermal barrier

Specification(s):

If attic is to be used for storage or occupancy, spray foam will be separated from the attic space using thermal barrier material (e.g., ½" gypsum wallboard)
Consult manufacturer specifications and local codes for approved ignition/thermal barrier, materials, or coatings

Objective(s):

Protect SPF insulation in the attic to minimize possibility of ignition and combustion

4.1.2.7.4 - Occupant education

Specification(s):

Documentation of ignition or thermal barrier material installation and limitations on attic use, if any, will be provided

Objective(s):

Provide occupant with documentation of installation

4.1.3 Knee Walls

4.1.3.1 - Preparation for Dense Packing

Desired Outcome:

Airtight cavity and insulated knee wall

4.1.3.1.1 - Backing

Specification(s):

All knee walls will have top and bottom plate or blockers installed using rigid materials
When knee wall floor and walls are being insulated, the floor joist running under the knee wall will be air sealed
If fabric is used before dense packing, it will be secured, according to manufacturer's specifications or with furring strips every wall stud
If rigid material is used, material will be installed to cover 100% of the surface of the accessible knee wall area
If foam sheathing is used, sheathing will be listed for uncovered use in an attic or covered with a fire barrier

Objective(s):

Eliminate bending, sagging, or movement that may result in air leakage

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

Ensure material will not tear under stress from wind loads or insulation

4.1.3.1.2 - Installation**Specification(s):**

All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates

Insulation that is blown behind fabric or air barrier material will be blown dense to a minimum specification of 3.5 pounds per cubic foot for cellulose

Follow manufacturer's requirements for fiberglass dense pack applications

Objective(s):

Eliminate misalignment of existing insulation

Prevent insulation from settling or moving

4.1.3.2 - Strapping for Existing Insulation**Desired Outcome:**

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

4.1.3.2.1 - Sealing**Specification(s):**

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.1.3.2.2 - Installation**Specification(s):**

Insulation will be installed in full contact with all sides of existing cavity without gaps, voids, compressions, misalignments, or wind intrusions

Objective(s):

Insulate to prescribed R-value

4.1.3.2.3 - Attachment**Specification(s):**

Strapping material will have a minimum expected service life of 25 years

Objective(s):

Maintain alignment

4.1.3.2.4 - Occupant education**Specification(s):**

Documentation of material and R-value will be provided to occupant

Objective(s):

Provide occupant with documentation of installation

4.1.3.3 - Knee Wall without Framing**Desired Outcome:**

Consistent uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

4.1.3.3.1 - Sealing

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.1.3.3.2 - Flat cavity present

Specification(s):

Gap between framing and existing air barrier will be insulated

Objective(s):

Create a flat insulated surface

4.1.3.3.3 - Installation

Specification(s):

A rigid insulated sheathing will be mechanically fastened to code required R-value

Seams will be sealed

Objective(s):

Insulate to prescribed R-value

4.1.3.3.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.3.5 - Knee Walls and Gable End Walls—Preparation for and Installation of Spray Polyurethane Foam (SPF)

Desired Outcome:

Airtight and insulated knee and gable end walls

4.1.3.5.1 - Installation of backing

Specification(s):

Knee walls will have a top and bottom plate or blockers installed using a rigid material

A suitable backstop material attached to the back of the knee wall will be used to support the application of SPF

If foam sheathing is used as a backstop, sheathing will be listed for uncovered use in an attic or covered with an ignition barrier, thermal barrier, or approved alternate assembly

Objective(s):

Provide a backstop or substrate for application of SPF

4.1.3.5.2 - Installation

Specification(s):

Insulation will be installed to prescribed R-value

Using SPF application, SPF will be applied to desired thickness onto substrate material from top to bottom plate between studs using pass thickness maximum in accordance with manufacturer specifications

In colder climates (IECC Zones 5-8), the SPF will be installed to a thickness of at least [Class II vapor retarder](#) or have at least Class II vapor retarder coating or covering in direct contact with the interior of the SPF

Objective(s):

Eliminate cracks, gaps, and voids Minimize framing cavity air flows

Minimize moisture migration and unwanted condensation in insulation (vapor retarders)

Ensure alignment of insulation and air barrier

4.1.3.5.3 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.4 Attic Floors

4.1.4.1 - Accessible Floors—Loose Fill Installation

Desired Outcome:

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

4.1.4.1.1 - Preparation

Specification(s):

Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee- wall attic floor spaces

Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier

All electrical boxes will be flagged to be seen above the level of the insulation

Open electrical junctions will have covers installed

Insulation dams and enclosures will be installed as required

Objective(s):

Access the workspace

Verify uniformity of insulation material

Provide location of electrical boxes for future servicing

Prevent an electrical hazard

4.1.4.1.2 - Air barrier

Specification(s):

Existence of air barrier material in line with the knee walls will be installed or verified when dense packing

Air barrier material will not bend, sag, or move once dense packed

Objective(s):

Hold dense pack in place

4.1.4.1.3 - Installation

Specification(s):

All insulation will be installed to the minimum unsettled depth and the maximum coverage per bag to reach a consistent depth for desired R-value indicated on the manufacturer's coverage chart.

Objective(s):

Reduce heating and air conditioning costs

Improve comfort

Minimize noise

4.1.4.1.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specification

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.1.4.1.5 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupants

Objective(s):

Provide occupant with documentation of installation

4.1.4.2 - Accessible Floors—Loose Fill Over Existing Insulation

Desired Outcome:

Insulation controls heat transfer through ceiling

4.1.4.2.1 - Preparation

Specification(s):

Existing insulation will be in contact with the air barrier prior to installing additional insulation on top

Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier

All electrical junction boxes will be flagged to be seen above the level of the insulation

Open electrical junction boxes will have covers installed

Insulation dams and enclosures will be installed as required

Objective(s):

Ensure proper performance of insulation

Verify uniformity of insulation material

Provide location of electrical junctions for future servicing

Prevent an electrical hazard

4.1.4.2.2 - Installation

Specification(s):

The correct depth and number of bags will be blown in accordance with manufacturer specifications
Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.1.4.2.3 - Safety

Specification(s):

Insulation will not be allowed on top of non-IC rated can light boxes (not to be confused with a constructed, air sealing enclosure) or between a heat-generating appliance and a dam

Objective(s):

Prevent a fire hazard

4.1.4.2.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.1.4.3 - Enclosed Bonus Room Floor over Unconditioned Space—Dense Pack Installation

Desired Outcome:

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

4.1.4.3.1 - Air barrier

Specification(s):

Existence of air barrier material in line with the knee walls will be installed or verified when dense packing
Air barrier material will not bend, sag, or move once dense packed

Objective(s):

Hold dense pack in place

4.1.4.3.2 - Fill floors

Specification(s):

Each cavity will be 100% filled to consistent density:

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

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

Insulation will be verified to prevent visible air movement at 50 Pascals of pressure difference using chemical smoke or other approved verification method by the authority having jurisdiction

Objective(s):

Eliminate voids and settling Minimize framing cavity air flows

4.1.4.3.3 - Safety

Specification(s):

Insulation will not be allowed on top of IC or non-IC rated can light boxes or between a heat-generating appliance and a dam, unless material is rated for contact with heat generating sources

Objective(s):

Prevent a fire hazard

4.1.4.3.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.4.4 - Enclosed Attic Storage Platform Floor—Dense Pack Installation

Desired Outcome:

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

4.1.4.4.1 - Fill floors

Specification(s):

Each cavity will be 100% filled to consistent density:

- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot or to a maximum density structurally allowable
- Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density per the manufacturer's recommendations
- The number of bags installed will be confirmed and will match the number required on the coverage chart

Insulation will be verified to prevent visible air movement at 50 Pascals of pressure difference using chemical smoke or other approved verification method by the authority having jurisdiction

Objective(s):

Eliminate voids and settling

Minimize framing cavity air flows

4.1.4.4.2 - Safety

Specification(s):

Insulation will not be allowed on top of IC or non-IC rated can light boxes or between a heat generating appliance and a dam, unless material is rated for contact with heat generating sources

Objective(s):

Prevent a fire hazard

4.1.4.4.3 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.4.4.4 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupants

Objective(s):

Provide occupant with documentation of installation

4.1.4.5 - Attic Floor—Preparation and Installation of Spray Polyurethane Foam (SPF)

Desired Outcome:

Consistent, thermal boundary and air barrier between conditioned and unconditioned space controls the heat flow and air leakage

4.1.4.5.1 - Preparation

Specification(s):

Subfloor or drywall will be removed to access cavities as necessary (e.g., beneath attic knee walls)

All electrical junctions will be flagged to be seen above the level of the insulation

Open electrical junction boxes will have covers installed

Objective(s):

Access the workspace

Provide location of electrical junctions for future servicing

Prevent an electrical hazard

4.1.4.5.2 - Installation

Specification(s):

Insulation will be installed to prescribed R-value

SPF will be applied to desired thickness onto attic floor to ceiling material below between attic floor joists using pass thickness maximum as indicated by manufacturer

Objective(s):

Insulate to prescribed R-value

4.1.4.5.3 - Safety

Specification(s):

Spray foam shall never be installed over light fixtures regardless of if fixture is rated for IC or not. Nor between a heat-generating appliance and a dam, unless material is rated for contact with heat-generating sources.

Objective(s):

Prevent a fire hazard

4.1.4.5.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.4.5.5 - Occupant education

Specification(s):

Documentation of material and R-value will be provided to occupant

Objective(s):

Provide occupant with documentation of installation

4.1.5 Attic Openings

4.1.5.1 - Pull-Down Stairs

Desired Outcome:

Pull-down attic stair properly sealed and insulated

4.1.5.1.1 - Installation

Specification(s):

Top-side of the attic enclosure will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

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

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

Objective(s):

Achieve uniform R-value

Prevent loose insulation from entering the living area

4.1.5.1.2 - Sealing

Specification(s):

Entire pull-down stair assembly will be covered with an airtight and removable/openable enclosure inside the attic space

Pull-down stair frame will be caulked, gasketed, weather-stripped, or otherwise sealed with an air barrier material, suitable film, frictionally engaging components or solid material that allows attic door operation

Objective(s):

Prevent air leakage

4.1.5.1.3 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.5.2 - Access Doors and Hatches

Desired Outcome:

Attic access door properly sealed and insulated

4.1.5.2.1 - Installation

Specification(s):

Hatches will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly

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

Objective(s):

Achieve uniform R-value on the attic door or hatch

Achieve uniform R-value on the attic floor

Prevent loose attic floor insulation from entering the living area

4.1.5.2.2 - Sealing

Specification(s):

Access hatch frames will be sealed using caulk, gasket, weather-strip, or otherwise sealed with an air barrier material, suitable film, or solid material

Options will include installing a latch or lock or frictionally engaged components that do not require a latch

The measure must include a protective baffle or insulation barrier

Objective(s):

Prevent air leakage

4.1.5.2.3 - Attachment

Specification(s):

Insulation will be permanently attached and in complete contact with the air barrier

Objective(s):

Insulate to prescribed R-value

4.1.5.2.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.5.3 - Whole-House Fan (Insulated Enclosure Method)

Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value of

an adjoining insulated assembly

4.1.5.3.1 - Installation

Specification(s):

Sides of fan insulation box assembly will be insulated to the same R-value as adjoining insulated assembly

Objective(s):

Insulate to prescribed R-value

4.1.5.3.2 - Air sealing

Specification(s):

Fan insulation box frame will be continuously weather-stripped to ensure a tight fit

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

Objective(s):

Prevent air leakage

4.1.5.3.3 - Attachment

Specification(s):

Non-compressible insulation will be permanently attached in contact with fan insulation box

Appropriate adhesive or mechanical fastener will be used

Objective(s):

Ensure continuous alignment with air barrier

4.1.5.3.4 - Durability

Specification(s):

Material integrity will meet a minimum expected service life of 20 years

Objective(s):

Ensure a minimum expected service life

4.1.5.3.5 - Occupant education

Specification(s):

Purpose of insulation will be communicated to occupant

Objective(s):

Educate occupant on how to use the whole-house fan to ensure integrity of the fan insulated assembly throughout service life

4.1.5.4 Whole-House Fan (Decommissioning)

Desired Outcome:

Creating a consistent, uniform thermal boundary over an aligned and continuous pressure plane.

4.1.5.4.1 – Electrical Disconnection

Specifications:

Disconnection and termination of electrical service to whole-house fan in accordance with the authority having jurisdiction.

Objective(s):

To safely remove power connections to the whole-house fan unit prior to removal and according to state and local codes.

4.1.5.4.2 – Removal

Specifications:

Remove shutter assembly

Remove, or disassemble and remove, whole-house fan taking into consideration type and weight during removal

Objective(s):

Safely uninstall the whole-house fan unit from the residence with no injury to people or property.

4.1.5.4.3 – Ceiling Closure

Specifications:

Install same or similar ceiling interior sheeting meeting building codes for the authority having jurisdiction.

Finish to match immediate area within limits of construction and age of surrounding area

Objective(s):

Create a finished pressure plane that allows for the installation of loose fill insulation

4.1.5.4.4 – Occupant Education

Specifications:

Purpose of whole-house fan removal will be communicated to occupant

Objective(s):

Inform occupant on the removal of the whole-house fan.

4.1.6 Special Considerations

4.1.6.1 - Attic Ventilation

Desired Outcome:

Properly restored vents minimize moisture and ice dams

4.1.6.1.1 - Air barrier and thermal boundary

Specification(s):

Attic ventilation will be recommended or installed if local code requires attic ventilation during weatherization or retrofits

The presence of an effective air barrier and thermal boundary between the attic and the living space must be verified and appropriate attic sealing and proper insulation is specified as part of the scope of work

With the presence of an effective air barrier, the amount of required attic ventilation will be equal to the attic area (including vaulted areas) divided by 300

Objective(s):

Ensure presence of continuous air barrier and thermal boundary

4.1.6.1.2 - Vent type

Specification(s):

Attic vent types will be made of corrosion-resistant material for their specific location (e.g., exterior soffit, gable end, roof) and material and intended use (e.g., metal vent on metal roof)

Attic-powered ventilators will not be used

Objective(s):

Ensure vent meets proper performance characteristics for location and roofing type

4.1.6.1.3 - Vent location

Specification(s):

Placement of attic vents will be considered for proper air flow and prevention of entry of wind driven rain

or snow

Objective(s):

Encourage proper air flow

Minimize entry of wind driven rain or snow

4.1.6.1.4 - Ventilation baffling

Specification(s):

Baffling for attic soffit vents will be installed to:

- Ensure proper air flow
- Prevent wind washing of insulation
- Allow maximum insulation coverage
- Ensure baffle terminates above insulation

Objective(s):

Ensure vent allows proper air flow without compromising insulation performance

4.1.6.1.5 - Ventilation screens

Specification(s):

All attic ventilation will have screens with non-corroding wire mesh with openings of 1/16" to 1/4" to prevent pest entry (e.g., birds, bats, bees)

Existing vents that are not screened will be covered with non-corroding wire mesh with openings of 1/16" to 1/4"

Ensure net free area requirements are met

Additional vents or larger vents can be added if screen size is smaller than designated

Objective(s):

Prevent pest entry

4.1.6.2 - Radiant Barrier [Informative]

Desired Outcome:

To inform allies when they come across this product already in existence in a customer's residence. Radiant heat flow reduced

4.1.6.2.1 - Stapling

Specification(s):

An air space no less than 3/4" will be maintained between the barrier and the bottom of the roof deck

Objective(s):

Ensure performance of radiant barrier

4.1.6.2.2 - Ventilation

Specification(s):

A minimum of 3" clearance from soffit vents and ridge vents will be maintained

Objective(s):

Allow for air flow behind barrier

4.1.6.2.3 - Gable walls

Specification(s):

Radiant barrier will apply to gable walls while maintaining a 3/4" air space Radiant barrier will not block gable vents

Objective(s):

Ensure performance of radiant barrier

4.1.6.2.4 - Porch and garage attic spaces

Specification(s):

Radiant barrier will be installed to separate the attic above conditioned space from adjacent attics

Radiant barrier will be installed to withstand local wind loads

Objective(s):

Reduce radiant heat entry Ensure durability

4.1.6.2.5 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Number and thickness of air spaces
- R-value
- Direction of heat flow

Objective(s):

Document job completion to contract specifications

Comply with [16 CFR 460.17](#)

4.1.6.3 - Skylights

Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

4.1.6.3.1 - Sealing

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.1.6.3.2 - Installation

Specification(s):

Insulation will be installed in accordance with manufacturer specifications and will be in full contact with all sides of existing cavity without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.1.6.3.3 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.1.6.4 - Parapet Walls—Dense Pack

Desired Outcome:

Properly installed insulation reduces heat flow through parapet wall

4.1.6.4.1 - Access

Specification(s):

Proper access in wall exterior or interior containment area will be ensured

Lead safety procedures in houses built before 1978 will be followed in accordance with [EPA Healthy Indoor Environment Protocols for Home Energy Upgrades](#)

Objective(s):

Protect worker and occupant health

4.1.6.4.2 - Installation

Specification(s):

Dense pack insulation will be installed in accordance with manufacturer specifications at void area

Objective(s):

Seal wall

4.1.6.4.3 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed Comply with [16 CFR 460.17](#)

4.1.6.5 - Parapet Walls—Spray Polyurethane Foam (SPF)

Desired Outcome:

Properly installed insulation reduces heat flow through parapet wall

4.1.6.5.1 - Access

Specification(s):

Proper access in wall exterior or interior containment area will be ensured

Lead safety procedures in houses built before 1978 will be followed in accordance with [EPA Healthy Indoor Environment Protocols for Home Energy Upgrades](#)

Objective(s):

Protect worker and occupant health

4.1.6.5.2 - Installation

Specification(s):

SPF insulation will be installed in accordance with manufacturer specifications at void area

Objective(s):

Seal and insulate wall

4.1.6.5.3 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.2 Walls

4.2.1 Preparation

4.2.1.1 - Exterior Wall Dense Packing

Desired Outcome:

Walls properly prepared to receive dense pack insulation

4.2.1.1.1 - Preparation

Specification(s):

Lead and asbestos safety procedures will be followed

Cavities will be free of hazards, intact, and able to support dense pack pressures Drilling hazards (e.g., wiring, venting, fuel piping) will be located

Blocking will be installed around:

- All openings to inside crawl space and basement for fibrous material
- High temperature fire-rated materials
- Wiring and electrical hazards
- Heat sources

Access to exterior wall cavities will be gained, sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers

Interior will be masked and dust controlled during drilling when accessing from interior Electricity supply will be confirmed and will support blowing machine power demand

Blowing machine pressure test will be performed with air on full, feed off, agitator running, and gate closed

Hose outlet pressure will be at least 80 IWC or 2.9 psi for cellulose insulation; for other types of dense pack insulation, check manufacturer specification for blowing machine set up

Objective(s):

Prevent damage to house Provide a clean work space

Provide thorough access to allow 100% coverage

Ensure proper equipment and process results in consistent density

Prevent settling and retard air flow through cavities

Protect worker and occupant health

4.2.1.1.2 - Exterior dense pack

Specification(s):

Using fill tube, 100% of each cavity will be filled to a consistent density:

- Cellulose material will be installed to a minimum density of 3.5 pounds per cubicfoot
- Loose fiber glass material will be installed and will be specifically approved for air flow resistance per manufacturer's specifications

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

Any necessary hole drilling through exterior siding(s) will be completed as neatly and uniform as possible.

Integrity of the drainage plane will be maintained. Any plugs or caps will be installed as neat and aesthetically pleasing as the existing conditions allow.

Insulation density will be verified by bag count, core sampling, or infrared camera with the blower door at 50 Pascals to prevent visible air movement using chemical smoke at 50 Pascals of pressure difference

Objective(s):

Eliminate voids and settling

Minimize framing cavity air flows

4.2.1.2 - Exterior Wall Insulating Sheathing

Desired Outcome:

Wall cladding removed and replaced to expose wall sheathing for installation of insulating wall sheathing

4.2.1.2.1 - Wall cladding removal

Specification(s):

Existing cladding will be removed

Lead and asbestos safety procedures will be followed

Objective(s):

Expose existing wall sheathing to prepare for installation of insulating sheathing

4.2.1.2.2 - Wall cladding replacement

Specification(s):

New cladding will be installed in accordance with manufacturer specifications and local codes after exterior wall insulation is installed

Objective(s):

Install wall cladding correctly

Meet local codes

4.2.1.3 - Exterior Wall Spray Polyurethane Foam (SPF)—Masking and Surface Preparation

Desired Outcome:

Finished surfaces are protected and SPF has a suitable surface to adhere to

4.2.1.3.1 - Surface protection

Specification(s):

Finished surfaces that should not be covered with SPF (e.g., windows, doors) will be identified

Surfaces will be covered or sealed with appropriate material (e.g., plastic film, masking tape) to protect from SPF overspray

Objective(s):

Prevent overspray and potential damage to finished surfaces

4.2.1.3.2 - Substrate repair

Specification(s):

Cracks, gaps, and holes in the substrate will be covered or sealed in accordance with manufacturer specifications with appropriate material

Objective(s):

Prevent waste of SPF

Prevent overspray into adjacent areas

4.2.1.3.3 - Substrate cleaning

Specification(s):

All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation

Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt

Grease and oil will be removed using appropriate cleaners or solvents

Moisture content of all wood substrate materials will be checked to ensure it is below 20%

Objective(s):

Ensure proper bonding of SPF to substrate surfaces

4.2.1.4 - Exterior Wall Spray Polyurethane Foam (SPF)—Electrical System Considerations

Desired Outcome:

Outlet, junction, switch, and light fixture boxes and existing wiring are protected from SPF

4.2.1.4.1 - Box protection

Specification(s):

All front and back openings of all outlet, switch, and light fixture boxes will be covered with masking tape

All electrical junction boxes will be accessible after the installation of SPF

Open electrical junction boxes will have covers installed

Objective(s):

Prevent SPF from covering any switches and outlets and from entering the inside of any electrical box

4.2.2 Accessible Walls

4.2.2.1 - Open-Cavity Wall Insulation—General

Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value

4.2.2.1.1 - Sealing

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.2.2.1.2 - Installation

Specification(s):

Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.2.2.1.3 - Pre-drywall verification

Specification(s):

Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided

Objective(s):

Install insulation correctly

4.2.2.1.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications (for loose-fill only)

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.2.2.2 - Open-Cavity Wall—Spray Polyurethane Foam (SPF) Installation

Desired Outcome:

Exterior walls are insulated and sealed

4.2.2.2.1 - Installation

Specification(s):

Interior cladding or interior finish material will be removed on areas to be insulated

SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer

SPF will be applied onto exterior sheathing or interior finish materials between studs and top/bottom plates

Objective(s):

Insulate and seal exterior walls

4.2.2.2.2 - Vapor retarders

Specification(s):

If vapor retarder is needed, it will be applied in proper location

In colder climates (IECC Zones 5-8), the SPF used will be installed to a thickness of at least [Class II vapor retarder](#) or have at least Class II vapor retarder coating or covering in direct contact with the inside surface of the SPF

Objective(s):

Minimize water vapor condensation in walls

4.2.2.2.3 - Fire protection

Specification(s):

SPF will be separated from the occupied interior spaces of the building with a thermal barrier (typically ½" or thicker gypsum wallboard or approved alternate assembly)

Check local codes for fire protection requirements

Objective(s):

Provide necessary fire protection for combustible SPF insulation

4.2.2.2.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area

- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.2.3 Enclosed Walls

4.2.3.1 - Dense Pack Exterior Walls

Desired Outcome:

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

4.2.3.1.1- Exterior dense pack

Specification(s):

Using fill tube or an alternative method as approved by the authority having jurisdiction, 100% of each cavity will be filled to a consistent density:

- Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density
- Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit air flow that corresponds to an air permeance value of 3.5 cfm /sq. ft. at 50 Pascals, as measured using ASTM , [SITE C 522](#), [E 283](#), or [E 2178](#); the number of bags installed will be confirmed and will match the number required on the coverage chart
- All holes and penetrations will be plugged and/or sealed

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

Objective(s):

Eliminate voids and settling Minimize framing cavity air flows

4.2.3.1.2 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.2.3.2 - Additional Exterior Wall Cavities

Desired Outcome:

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

4.2.3.2.1 - Location of cavities

Specification(s):

Details remaining in or between completed wall sections will be located and accessed

Objective(s):

Ensure the last gaps and framing edges in the thermal boundary, roof-wall joints, floor-wall joints, etc., are found and finished

4.2.3.2.2 - Sealing

Specification(s):

Backing will be provided and all newly uncovered openings will be sealed with air barriers, foam, or mastic, maintaining all required clearances

Objective(s):

Ensure the air barrier is connected across all accessible house elements

4.2.3.2.3 - Dense packing

Specification(s):

Using fill tube, 100% of each cavity will be filled to a consistent density:

- Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density
- Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit airflow that corresponds to an air permeance value of 3.5 cfm/sq. ft. at 50 Pascals, as measured using ASTM , [SITE C 522](#), [E 283](#), or [E 2178](#)
- The number of bags installed will be confirmed and will match the number required on the coverage chart

Insulation will be verified to prevent visible air movement at 50 Pascals of pressure difference using chemical smoke or other approved verification method by the authority having jurisdiction

Objective(s):

Eliminate voids and settling Minimize framing cavity air flows

4.2.3.2.4 - Close holes

Specification(s):

Installation holes will be plugged as follows:

- Exterior holes will be weather barrier patched
- Interior holes will be coated and patched to match original interior surface

All construction debris and dust will be collected and removed

Objective(s):

Ensure house is returned to watertight and clean condition

4.2.3.2.5 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.2.3.3 - Insulated Sheathing and Insulated Siding Installation

Desired Outcome:

Properly installed insulated wall sheathing and insulated siding

4.2.3.3.1 - Sealing

Specification(s):

Holes, gaps, and penetrations in existing sheathing will be sealed

Objective(s):

Prevent air leaks

4.2.3.3.2 - Location of wall framing

Specification(s):

Wall studs and other framing will be located and marked

Objective(s):

Provide secure attachment of insulating sheathing

4.2.3.3.3 - Installation

Specification(s):

Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):

Install insulation properly

4.2.3.3.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.3 Floors

4.3.1 Accessible Floors

4.3.1.1 - Standard Floor System—Loose Fill with Netting

Desired Outcome:

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

4.3.1.1.1 - Sealing

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

4.3.1.1.2 - Netting, fabric

Specification(s):

When using netting or fabric, staples will be placed according to manufacturer specifications

Netting or fabric will meet local fire codes

Objective(s):

Secure insulation

4.3.1.1.3 - Installation

Specification(s):

Insulation in netted or fabric cavities will be dense packed with loose fill insulation in accordance with manufacturer specifications

Insulation will be installed to prescribed R-value

Insulation will be in continuous contact with air barrier

Objective(s):

Insulate to prescribed R-value

Ensure a continuous thermal boundary between conditioned and unconditioned space

4.3.1.1.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.3.1.2 - Standard Floor System—Loose Fill with Rigid Barrier

Desired Outcome:

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

4.3.1.2.1 - Sealing

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

4.3.1.2.2 - Rigid air barrier

Specification(s):

A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly

Seams and penetrations will be sealed

Objective(s):

Relocate air barrier

4.3.1.2.3 - Installation

Specification(s):

Loose fill insulation will be installed between air barrier and subfloor according to manufacturer

specifications

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.3.1.2.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.3.1.3 - Dense Pack Floor System with Rigid Barrier

Desired Outcome:

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

4.3.1.3.1 - Sealing

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

4.3.1.3.2 - Rigid air barrier

Specification(s):

A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly

Seams and penetrations will be sealed

Objective(s):

Relocate air barrier

4.3.1.3.3 - Installation

Specification(s):

Dense pack insulation will be installed between air barrier and subfloor according to manufacturer specifications

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.3.1.3.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.3.1.4 - Cantilevered Floor— Dense Pack Fiber Installation

Desired Outcome:

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

4.3.1.4.1 - Air barrier

Specification(s):

Air barrier will be installed between joists and sealed

Air barrier will be placed to the most interior edge of the top plate of the wall below

Objective(s):

Separate cantilevered floor from conditioned floor space

Allow for insulation

4.3.1.4.2 - Installation

Specification(s):

Air barrier will be insulated between joists from top plate of the wall below to subfloor above

Cantilevered subfloor will be insulated in complete contact with the floor without gaps, voids, compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed density R-value

Objective(s):

Insulate to prescribed R-value

Ensure insulation remains in contact with subfloor and air barrier

4.3.1.4.3 - Exterior soffit

Specification(s):

Exterior soffit material will be installed and sealed

Objective(s):

Cover and protect insulation

4.3.1.4.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.3.1.5 - Pier Construction Subfloor Insulation—Loose Fill with Rigid Barrier

Desired Outcome:

Consistent, uniform thermal barrier between conditioned and unconditioned space to prescribed R- value of an adjoining insulated assembly

4.3.1.5.1 - Subfloor preparation

Specification(s):

Sealing between house and crawl space will be completed before insulating

Objective(s):

Prevent air leakage

4.3.1.5.2 - Rigid air barrier

Specification(s):

A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly

Seams and penetrations will be sealed

Objective(s):

Relocate air barrier

4.3.1.5.3 - Installation

Specification(s):

Loose fill insulation will be installed between air barrier and subfloor according to manufacturer specifications

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.3.1.5.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Insulation type
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with [16 CFR 460.17](#)

4.3.1.6 - Pier Construction Subfloor Installation—Dense Pack with Rigid Barrier

Desired Outcome:

Consistent, uniform thermal barrier between conditioned and unconditioned space to prescribed R- value of an adjoining insulated assembly

4.3.1.6.1 - Subfloor preparation

Specification(s):

Sealing between house and crawl space will be completed before insulating

Objective(s):

Prevent air leakage

4.3.1.6.2 - Rigid air barrier

Specification(s):

A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly

Seams and penetrations will be sealed

Objective(s):

Relocate air barrier

4.3.1.6.3 - Installation

Specification(s):

Dense pack insulation will be installed between air barrier and subfloor according to manufacturer specifications

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

4.3.1.6.4 - Occupant education

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.3.1.7 - Open Floors Over Unconditioned Space and Cantilevered Floors, Floors Over Garages, Floors Over Unconditioned Crawl Spaces—Spray Polyurethane

Desired Outcome:

Floors over unconditioned spaces (e.g., basements, garages) insulated and sealed

4.3.1.7.1 - Preparation

Specification(s):

All floor areas will be open and accessible for SPF application

Cracks, gaps, and holes will be covered or sealed per manufacturer guidelines with appropriate material

Insulation dams or end blockers will be installed where needed

All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation

Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt

Grease and oil will be removed using appropriate cleaners or solvents

Moisture content of all wood substrate materials will be checked to ensure it is below 20%

Objective(s):

Prepare all substrate surfaces for the application of SPF

4.3.1.7.2 - Installation

Specification(s):

Insulation will be installed to prescribed R-value according to manufacturer specifications

SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer, onto subfloor between floor joists and all rim/band joists

When desired, underside of joists will be covered with SPF to provide layer of continuous insulation

Objective(s):

Insulate and seal floors

4.3.1.7.3 - Fire protection

Specification(s):

SPF will be separated from the interior occupied space of the building with a 15-minute thermal barrier (typically ½" or thicker gypsum wallboard or approved ignition barrier coating)

Check local codes for fire protection requirements

Objective(s):

Provide necessary fire protection for combustible SPF insulation

4.3.1.7.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.4 Basement and Crawl Spaces

4.4.1 Band/Rim Joists

4.4.1.1 - Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation

Desired Outcome:

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

4.4.1.1.1 - Preparation

Specification(s):

All band/rim joist areas will be open and accessible for SPF application

All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation. Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt.

Grease and oil will be removed using appropriate cleaners or solvents.

Moisture content of all wood substrate materials will be checked to ensure it is below 20%.

Objective(s):

Prepare all substrate surfaces for the application of SPF.

4.4.1.1.2 - Installation

Specification(s):

SPF will be applied to desired thickness, using pass thickness maximum in accordance with manufacturer specifications, onto subfloor between floor joists and all rim/band joists.

When applied to first floor, SPF will be continuous from subfloor surface, over band/rim joist and sill plate, and in contact with foundation below, except as stipulated by classification 4.1402.1c.

When applied to second story floor or above, SPF will be continuous from subfloor surface, over band/rim

joist, and in contact with top plate below

Objective(s):

Insulate and seal floors

4.4.1.1.3 - Fire protection

Specification(s):

If SPF exceeds a thickness of 3", all SPF will be separated from the occupied interior space of the building with an approved thermal barrier material (typically ½" or thicker gypsum wallboard or an approved thermal barrier coating)

Application to rim/band joist up to 3" can be left exposed if the foam is Class I, unless the space is a habitable space and then cover it with drywall or another thermal barrier

Local codes will be confirmed and followed for fire protection requirements

Objective(s):

Provide necessary fire protection for combustibile SPF insulation

4.4.1.1.4 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.4.1.2 - Band/Rim Joists – Insulation other than Spray Polyurethane Foam

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

4.4.1.2.1 - Preparation

Specification(s):

The rim joist, sill plate and adjacent surfaces will be sufficiently clean and free of debris to allow for the proper adhesion of any caulks, adhesives or spray foam used during installation.

Objective(s):

Prepare all surfaces for the installation of insulation

4.4.1.2.2 - Insulation installation

Specification(s):

A foam-based insulation will be installed so as to create a continuous thermal and pressure boundary. If rigid insulation is used, all edges will be sealed and the insulation will be installed tightly to the wood to prevent the movement of moisture throughout the assembly. Insulation will be installed in accordance with local/national code requirements and/or manufacturer's instructions regarding flame spread

Objective(s):

Improve thermal performance

Prevent moisture condensation on the inside of the band joist

4.4.1.2.3 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.4.2 Basement and Crawlspace Walls

4.4.2.1 - Closed Crawl Spaces—Wall Insulation

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

4.4.2.1.1 - Insulation selection

Specification(s):

A fire-rated insulation (25 or less flame spread or Class I or Class A) will be used

Reference Available Residential Measures Guide for final material selection

Objective(s):

Provide fire-safe, durable insulation that will not exacerbate moisture issues in the crawl space

4.4.2.1.2 - R-value

Specification(s):

Current program measure guidelines will be followed for required R-values; see the Available Residential Measures Guide for more details

Objective(s):

Improve thermal performance

4.4.2.1.3 - Termite inspection gap

Specification(s):

Where termite pressure exists, a 3" inspection gap will be maintained from the top of the insulation to the bottom of any wood

Objective(s):

Allow for termite detection

4.4.2.1.4 - Attachment

Specification(s):

Insulation will be attached with a durable connection better than or equal to manufacturer specifications

Objective(s):

Prevent insulation from detaching from the foundation wall

4.4.2.1.5 - Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.4.2.2 - Basement Wall Insulation—No Groundwater Leakage

Desired Outcome:

Basement insulation improves thermal performance and ensures sufficient drying potential

4.4.2.2.1 - R-value

Specification(s):

Current program measure guidelines will be followed for required R-values; see the Available Residential Measures Guide for more details

Objective(s):

Improve thermal performance of the basement and living space

4.4.2.2.2 - Air barrier

Specification(s):

A continuous air barrier will be installed on the warm side of the insulation

Objective(s):

Prevent condensation on the basement wall

4.4.2.2.3 - Vapor permeability

Specification(s):

When absorbent insulation materials are installed, assembly will remain vapor semi-impermeable to the interior

Objective(s):

Provide drying potential to the basement

4.4.2.3 - Basement Wall Insulation—Groundwater Leakage

Desired Outcome:

Basement insulation improves thermal performance and ensures sufficient drying potential

4.4.2.3.1 - Drainage

Specification(s):

A continuous drainage plane at the interior surface of the exterior basement wall will be created from the top of the wall to a drainage field at the bottom of the wall or sub-slab

Drainage field will be run to daylight or pumped to the outside

Objective(s):

Remove moisture on the surface of the exterior basement wall

4.4.2.3.2 - Rough finish walls (e.g., rubble walls)

Specification(s):

Drainage plane will be replaced with a waterproof membrane

Only a non-absorbent insulation that complies with [ASTM C665-06](#) will be applied Insulation will adhere to the waterproof membrane without voids

Drainage field will be run to daylight or pumped to the outside

Objective(s):

Create an air and moisture barrier on the interior side of the exterior basement wall and allow the insulation to conform to the irregularity of the surface

Improve thermal performance of the basement and the living space

4.4.2.3.3 - Thermal barrier, insulation

Specification(s):

A non-absorbent insulation will be used

A fire-rated material will be used if the insulation is left exposed

Objective(s):

Improve thermal performance of the basement and the living space

4.4.2.3.4 - Location

Specification(s):

Insulation will be installed continuously from the top of the band joist to the top of the slab

Objective(s):

Maintain a continuous thermal boundary on the interior side of the exterior basement wall

4.4.2.3.5 - Termite protection

Specification(s):

Where termite pressure exists, if sub-slab drainage is installed, termite treatment will be performed before re-installing the slab

Objective(s):

Provide termite protection

4.4.2.3.6 - Insulation attachment

Specification(s):

Insulation will be attached with a durable connection equal to or better than the manufacturer specifications, whichever is more durable

Objective(s):

Secure thermal boundary without compromising the insulation

4.4.2.3.7 - R-value

Specification(s):

Current program measure guidelines will be followed for required R-values; see the Available Residential Measures Guide for more details

Objective(s):

Improve thermal performance of the basement and living space

4.4.2.3.8 - Sealing

Specification(s):

A continuous air barrier on the warm side of the thermal boundary will be installed, including floor-to-wall and wall-to-ceiling connections

Objective(s):

Prevent convective air leakage from the basement, through the drainage plane, and back into the basement

4.4.2.3.9- Finish wall requirements

Specification(s):

IRC will be followed for finished wall details in basements

Objective(s):

Install a durable, finished wall

4.4.2.3.10- Onsite documentation

Specification(s):

A dated invoice signed by the installer will be provided that includes:

- Coverage area
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with [16 CFR 460.17](#)

4.5 Ducts

4.5.1 Insulating Ducts

4.5.1.1 - Insulating Flex Ducts

Desired Outcome:

Lower conductive heat transfer by ducts and decreased condensation on duct vapor barrier

4.5.1.1.1 - Removal of existing flexible ducting

Specification(s):

All accessible low R-value flexible ducting will be removed from premises

Objective(s):

Ensure installation of proper R-value ducts

4.5.1.1.2 - Selection of new flexible ducting

Specification(s):

All flexible ducting outside of the building envelope will have a minimum of R-7

Objective(s):

Minimize thermal conductance of the duct system

4.5.1.1.3 - Sizing of new flex

Specification(s):

Duct sizing procedures will be conducted when replacing flex duct

Objective(s):

Improve comfort in rooms

Improve fan performance

4.5.1.1.4 - Installation of flex

Specification(s):

Flexible ducts will be supported in accordance with flex duct manufacturer's directions or local codes

Objective(s):

Prevent sags, drops, or other bends that may interfere with correct air flow

4.5.1.1.5 - Interior liner attachment

Specification(s):

Interior liner of the flex-to-metal connection will be fastened with tie bands using a tie band tensioning tool or a mechanical band

Objective(s):

Create a strong, secure attachment

4.5.1.1.6 - Sealing of interior liner

Specification(s):

Systems used to seal flexible air ducts and flexible air connectors will comply with program approved materials; see Available Residential Measures Guide

Objective(s):

Create an airtight connection

4.5.1.1.7 - Attachment of exterior liner

Specification(s):

Liner will be pulled up onto the metal duct as far as possible before securing

The exterior liner of the flex duct will be fastened with tie bands using a tie band tensioning tool

Objective(s):

Create a strong, durable attachment

4.5.1.1.8- Sealing of all accessible ducts

Specification(s):

All accessible joints, seams, and connections in ductwork will be securely fastened and sealed with [UL 181 B-M](#) compliant mastic (adhesives) or mastic-plus-embedded-fabric systems

Objective(s):

Minimize duct leakage

4.5.1.1.9 - Insulation of all fittings

Specification(s):

All metal fittings including boots, elbows, and take-offs will be insulated separately using an R-11 duct wrap with vapor retarder

Objective(s):

Minimize thermal conductance of the duct system

4.5.1.1.10 - Completeness of vapor barrier

Specification(s):

Vapor retarder of all duct insulation will be taped to the flex duct using tape that complies with [UL 181B](#) and will be marked "181 B-FX" for pressure-sensitive tape or "181 B-M" for mastic

Objective(s):

Ensure a complete vapor barrier

4.5.1.2 - Insulating Metal Ducts

Desired Outcome:

Lowered thermal conductance of duct system and minimized condensation on the duct system

4.5.1.2.1 - Selection of duct insulation material

Specification(s):

Duct insulation on all ducts located in unconditioned spaces will be a minimum of **R-7**, in accordance with local code, or buried under attic insulation, whichever is greater, and have an attached vapor retarder

Hot humid and warm coastal regions will not bury ducts

Objective(s):

Decrease heat loss and condensation problems

4.5.1.2.2 - Duct sealing

Specification(s):

All joints, seams, and connections in ductwork shall be securely fastened and sealed with program approved materials (see Available Residential Measures Guide) installed in accordance with the manufacturer's instructions before insulation is applied

Objective(s):

Minimize duct leakage

4.5.1.2.3 - Attachment of duct insulation

Specification(s):

Duct insulation will be secured to the duct system using metal wire or rot-proof nylon twine
Pattern of the wire or twine will be sufficient to securely hold the duct insulation tight to the duct

Objective(s):

Ensure a secure connection between the duct system and the duct insulation

4.5.1.2.4 - Taping of the duct insulation

Specification(s):

Using a tape approved by the manufacturer, all seams and connection of the duct insulation will be taped
No gaps will exist between pieces of duct insulation

Objective(s):

Prevent gaps in the vapor barrier of the insulation

4.9 Insulation – Additional Resources

4.9.1 Materials

4.9.1.1 - General Information on Spray Polyurethane Foam (SPF)

Desired Outcome:

To provide general Information on spray polyurethane foam

4.9.1.1.1 - Low-Pressure SPF

Specification(s):

Low-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in pressurized canisters (~250 psi), dispensed through unheated hoses through a disposable mixing nozzle system, and applied as a froth-like material to substrate. This type of SPF product is typically used for large sealing and small-scale insulation products.

Objective(s):

To provide general Information on spray polyurethane foam

4.9.1.1.2 - High-Pressure SPF

Specification(s):

High-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in unpressurized drums or totes, and dispensed by a proportioner pump where heat and pressure are added. These chemicals travel through heated hoses to a spray gun where the material is aerosolized during application. This type of SPF product is typically used for larger insulation applications.

Once installed, there is essentially no difference in product performance between low- and high- pressure foams. It should be noted that the main differences between the delivery methods are in capital equipment investment, application rate, and PPE requirements.

Applicators should obtain training from the suppliers of SPF to help assure installation quality and use of all equipment as well as safe handling, use, and disposal of all chemicals used in the process. Spray Polyurethane Foam Alliance (SPFA) also offers additional training and accreditation for high-pressure

SPF applicators.

Objective(s):

To provide general Information on spray polyurethane foam

4.9.1.1.3 - Manufacturer Installation Instructions

Specification(s):

In addition to the guidelines above, SPF applicators should follow all manufacturer installation instructions for the product being used. These instructions include product-specific documents, such as application instructions, SDSs, and evaluation reports.

Objective(s):

To provide general Information on spray polyurethane foam