Kansas SWS Field Guide - Version 2019.1
Supplemental Specifications for Manufactured Housing

Weatherization Works
Standard Work Specifications
Field Guide for
Manufactured Housing
created by
4.13 Floors

4.13.03 Manufactured Housing Floor Cavity Insulation

4.13.03.1 Insulation of Floor Cavity with Blown Material

4.13.03.2 Insulation of Floor Cavity with Batt Material

4.14 Basements and Crawl Spaces

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2.0107.5 - Prework Qualifications (Home Installation)

Desired Outcome:
Manufactured home is properly installed

2.0107.5a - Installation deficiencies

Desired Outcome:
Manufactured home is properly installed

Specification(s):
Any installation deficiencies that may affect worker safety or integrity or installed measures will be repaired before starting work

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

Unsafe
The concrete pad is not centered under the pier, rendering the pier susceptible to tilting or collapse

Safe
Approved, properly installed piers, anchors, and tie downs

Tools:
1. Level
2. Cordless driver drill
3. Flashlight

Inspect homes for safety before work. Homes with safety concerns may need to be deferred. Required corrections will be performed by a Kansas licensed Manufactured Home Installer.

Inspection tips; Stuck doors and windows, buckled siding, and loose tie-downs may be evidence of settling. Visually inspect piers to ensure that they are solid and level, check for loose or missing wooden shims and wedges, and inspect anchors and straps for tightness and proper installation per manufacturer's recommendations.

Carefully inspect the foundation piers. Look for loose or missing shims and wedges
2.0107.5b - Stabilization

Desired Outcome:
Manufactured home is properly installed

Specification(s):  
Home must be stabilized in accordance with manufacturer specifications or local authority having jurisdiction  
Concerns regarding stabilization deficiencies will be verified and corrected by a Kansas licensed manufactured home installer.

Objective(s):  
Ensure the home is secured properly  
Prevent injury  
Minimize exposure to health and safety hazards

Unsafe

Unstable mobile homes are unsafe work environments. Do not crawl under mobiles that are not stabilized

Safe

Properly stabilized homes have a solid foundation and have anchored straps, unless otherwise indicated by manufacturer

Homes may have to be deferred until safety concerns are corrected.
2.0204.1 - Isolating Combustion Water Heater Closet

**Desired Outcome:**
Isolate combustion water heater closet from conditioned space

**Note:**

2.0204.1a - Work assessment

**Desired Outcome:**
Isolate combustion water heater closet from conditioned space

**Specification(s):**
Installer prework assessment will be conducted to determine:

- Combustion safety
- Proper venting
- Structural integrity
- Roof leaks
- Insect infestation
- Accessibility
- Number, type, size, and location of penetrations

**Objective(s):**
- Ensure combustion appliance is functioning safely
- Ensure work space is safe and ready for air sealing
- Verify scope of work

2.0204.1b - Air seal closet

**Desired Outcome:**
Isolate combustion water heater closet from conditioned space

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

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

**Objective(s):**
- Prevent combustion gases from entering living area and minimize extension of interior pressures caused by exhaust fan, dryers, and interior door closure into the water heater closet
2.0204.1c - Materials

**Desired Outcome:**
Isolate combustion water heater closet from conditioned space

**Specification(s):**
Only noncombustible materials will be used in contact with chimneys, vents, and flues

**Objective(s):**
Prevent a fire hazard

![Best Practice](image)

When sealing around combustion flue penetrations, use appropriate materials

![After](image)

26-gauge steel sheeting and high temp caulk should be used to seal around flue

**Tools:**
1. Caulk gun
2. Metal snips
3. Drill

**Materials:**
1. High-temperature caulk
2. 26-gauge steel sheeting
3. Fasteners

2.0204.1d - Post-work testing/verification

**Desired Outcome:**
Isolate combustion water heater closet from conditioned space

**Specification(s):**
Blower door assisted zonal pressure diagnostics will be used to verify isolation has been achieved

**Objective(s):**
Prevent combustion gases from entering living area

![Before](image)

The reading is closer to 0, indicating strong connection to the inside.

![After](image)

The reading is closer to 50, indicating strong connection to the outside.

**Tools:**
1. blower door assembly
2. manometer
3. 1/4" hose
4. steel tube or probe
5. drill
Depressurize the house to 50 pascals. Close the CAZ door or otherwise gain access to the CAZ. Reading is closer to 50 pascals indicating combustion closet is connected to the outside.
2.0403.4 - Pier and Skirting Foundations—Ground Moisture Barriers

Desired Outcome:
Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

2.0403.4a - Coverage

Desired Outcome:
Durable, effective ground moisture barrier that provides ongoing access and minimizes ground vapor

Specification(s):
If existing conditions of the ground and skirting mandates, a moisture barrier that covers the crawl space ground will be installed with allowances for structural supports (piers) and accessibility.

Objective(s):
Reduce ground moisture entering crawl space

Tools:
1. Utility knife
2. Hammer or mallet
3. Scissors

Materials:
1. Polyethylene vapor barrier, 6-mil thickness or greater
2. Waterproof tape
3. Polyurethane caulking or construction adhesive
4. Landscape staples

Manufactured housing with an enclosed, unvented area below the belly (typical of permanent foundations) will be treated like enclosed crawlspace and will have a vapor barrier installed. Manufactured Housing with typical skirting will be considered an open crawlspace and no vapor barrier is warranted. Aim for complete coverage. If access to the entire crawlspace is impossible, cover all accessible areas. Overlap seams in vapor barrier by at least twelve inches, and seal them with waterproof tape and/or polyurethane caulk or adhesive. Wrap and cover support piers at least twelve inches high.
Secure vapor barrier to ground with corrosion-resistant landscape staples, or weigh it down with ballast.

Remove tools and excess material.

Reinstall skirting.
2.0602.2 - House Current Electric Hazard

Desired Outcome:
Prevention of injury to the installer and occupant, and prevent damage to the structure, if required by authority having jurisdiction

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

2.0602.2d - Aluminum wiring

Desired Outcome:
Prevention of injury to the installer and occupant, and prevent damage to the structure, if required by authority having jurisdiction

Specification(s):
If aluminum wiring is present and there is concern about the safety of its condition or the proposed work scope has the potential to compromise the safety of the wiring, work on the home will be stopped until the suspect wiring is inspected and determined to be safe by a licensed electrician.

Objective(s):
Prevent injury to installer and occupant
Prevent damage to structure

Tools:
1. Screwdriver (to remove panel cover)
2. Flashlight

Check for the presence of aluminum wire (identified by its light gray color). A licensed electrician will only be required to inspect aluminum wiring when there is a safety concern or the proposed work scope has the potential to negatively impact the condition of the aluminum wiring.
3.1001.4 - General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

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

Note:

3.1001.4d - Ceiling hole repair

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

Specification(s):
Ceiling repair material must meet or exceed strength of existing ceiling material

Ceiling repair must span from truss to truss or add blocking as needed for support

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

All accessible damaged vapor barriers will be repaired

Penetrations through the air barrier must be repaired

Objective(s):
Ensure ceiling is structurally sound

Minimize air leakage

Ensure closure is permanent and supports expected wind and mechanical pressure loads

Ensure sealant does not fall out

Tools:
1. 6-inch and 12-inch drywall taping knives
2. Sanding block or sanding sponge
3. Utility knife
4. Keyhole saw
5. Screw gun

Materials:
1. Drywall or paneling
2. Fiberglass joint tape
3. Joint compound
4. Drywall screws
5. Support material if needed (typically 1X4, 1X6, or 2X4 dimensional lumber)

For holes in paneled ceilings, use matching panels for repairs. Consider replacing entire sections to avoid creating unsightly mismatched patches. For small holes, enlarge to a rectangular shape and install 1 X 4 blocks above two edges of the hole. For larger holes, enlarge opening to centers of nearest trusses and fasten the patch to the framing.

Interior patch work should strive for the highest quality of finished product. Clients shall be informed and agree to the type of patching performed. Patches should be finished to provide a smooth, nearly paint ready surface. Minimal to zero sanding is the desire
1. Replace any missing insulation and repair holes in vapor barrier.

2. Prepare the hole by cutting the edges clean and square.

3. Cut drywall and fasten in place.

4. Add joint tape and first coat of joint compound.
3.1101.1 - Exterior Holes and Penetrations

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

3.1101.1a - Work assessment

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

Specification(s):
Installer prework assessment will be conducted to determine:

- Structural integrity
- Size of wall stud
- Insect infestation
- Accessibility
- Number, type, size, and location of penetrations

Objective(s):
Ensure work space is safe and ready for air sealing

Verify scope of work
3.1101.3 - Holes, Penetrations, and Marriage Line

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

3.1101.3b - Marriage wall air sealing of holes and penetrations

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

**Specification(s):**
All accessible holes and penetrations in top and bottom plates will be sealed

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

**Objective(s):**
- Minimize air leakage
- Maintain durability

Ensure resulting closure is permanent and supports expected wind and mechanical pressure loads

Ensure sealant is effective and durable

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**Tools:**
1. Caulking gun
2. Reusable spray foam gun

**Materials:**
1. Extruded polystyrene ((XPS) foam board
2. Caulk
3. Spray foam
4. Foam backer rod or fiberglass batt insulation

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**Before**
Cobwebs may indicate air leaks at the marriage line

**After**
Completed air sealing at marriage line

1. Clean belly wrap before air sealing
2. Stuff wide gaps in the marriage line with fiberglass insulation or foam backer rod before applying sealant
3. Apply foam or caulking over backer
3.1101.3c - Marriage line air sealing

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

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

Backimg or infill will be provided at the marriage line as needed.

All remaining gaps will be sealed with an approved material.

Objective(s):
Minimize air leakage

Maintain durability

Ensure sealant is effective and durable.

Tools:
1. Reusable spray foam gun
2. Caulking gun
3. Utility knife
4. Tape measure
5. Square
6. Screw gun
7. Hammer
8. Prybar
9. Blower door
10. Chemical smoke dispenser

Materials:
1. Caulk
2. Spray foam
3. Foam board
4. Screws

You may need to remove trim to determine what type of sealing is needed at the marriage line. Some original installations use a compressed open-cell polyurethane foam sealing strip with excellent air sealing properties and will need little or no additional work. Other installations may feature fiberglass or other ineffective air sealing measures and require extensive caulking and foaming to reduce air infiltration. Use a blower door and smoke to pinpoint leak locations.

Identify leaks in marriage line using a blower door and smoke.

Foam, caulk, and seal leaks between halves of double wide manufactured homes.
3.1101.3d - Materials

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

Specification(s):
Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):
Select materials to ensure durable and permanent repair

![Before](image1)
Hole in exterior wall of manufactured home aluminum siding

![After](image2)
Completed wall patch

**Tools:**
1. Sheet metal nibbler
2. Snips
3. Screw gun
4. Caulking gun

**Materials:**
1. Aluminum siding or flashing
2. Caulk (formulated for exterior use)
3. Corrosion-resistant fasteners
3.1201.6 - Interior Storm Windows

Desired Outcome:
Minimize air infiltration through existing leaky windows while maintaining safe egress for occupants

Note:

3.1201.6b - Fixed storm window

Desired Outcome:
Minimize air infiltration through existing leaky windows while maintaining safe egress for occupants

Specification(s):
Fixed interior storm windows will not be installed in egress locations

Objective(s):
Safety

Unsafe
Do not install fixed storm windows in bedroom windows designated as egress locations

Safe
Fixed storm windows may be installed in non-egress locations only

Storm windows installed in egress (bedroom) windows must be operable or removable, and conform to the following standard: Voluntary Standard Egress Window Systems for Utilization in Manufactured Housing, AAMA 1704-85

3.1201.6c - Installing operable storm window

Desired Outcome:
Minimize air infiltration through existing leaky windows while maintaining safe egress for occupants

Specification(s):
Operable interior storm windows will be installed in accordance with manufacturer specifications

Objective(s):
Minimize air leakage

Provide safe egress for occupants
Before
No interior storm window has been installed.

After
Storm window has been installed according to manufacturers specifications and operates smoothly.

Tools:
1. drill

Materials:
1. mechanical fastners
2. weatherstripping

1. Ensure the perimeter surfaces are clean and ready to accept sealant.
2. Install weatherstrip or other appropriate sealant to the perimeter of the opening.
3. Install the window, ensuring it is level in the opening.
4. Secure the window to the opening, being sure the mechanical fasteners compress the desired sealant.
5. Storm window has been installed according to manufacturers specifications and operates smoothly.
3.1201.6d - Health and safety

Desired Outcome:
Minimize air infiltration through existing leaky windows while maintaining safe egress for occupants

Specification(s):
Interior storm windows will be operable and egress rated in egress locations

Objective(s):
Provide safe egress for occupants

Only operable storm windows conforming to HUD standards may be installed in egress (bedroom) windows

Storm windows installed in egress (bedroom) windows must be operable or removable, and conform to the following standard: Voluntary Standard Egress Window Systems for Utilization in Manufactured Housing, AAMA 1704-85
3.1202.3 - Replacing Damaged Window Glass in Manufactured Housing

Desired Outcome:
Glass complete and intact

Note:

3.1202.3e - New glass installation

Desired Outcome:
Glass complete and intact

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

Tools:
1. Caulk gun
2. Tape measure

Materials:
1. New glass, measured to fit, tempered if necessary
2. Glazing or replacement stops
3. Adhesive sealant
4. Window cleaner

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

In Progress
Sash should be completely clear debris before installing new glass

After
Replacement glass should match previous tint and dimensions, and be tempered, if location requires it

Measure sash for width of replacement glass -- cut glass to 1/4" less than sash width

Measure sash for height of replacement glass -- cut glass to 1/4" less than sash height

Apply sealant to sash with bead at least 3/16" wide
Run sealant bead around entire sash to seal glass from the interior.

Install new glass, ensuring 1/8" gap from frame on all sides.

Apply glazing or install replacement stops to seal window from exterior.

Clean glass to ensure there is no out of place adhesive or glazing remains to bake onto glass.
3.1301.1 - Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board

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

Note:

3.1301.1d - Bottom board penetrations

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

Specification(s):
Combustion air supplies will be labeled for identification and will not be blocked or sealed

Penetrations will be sealed to meet both the specific characteristics of the bottom board material and the characteristics (hole size and type) of the penetrations (e.g., electrical, PVC, gas line, dryer vent)

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

Objective(s):
Ensure combustion equipment is not compromised

Minimize air leakage around penetrations

Before
Unsealed penetration through bottom board

After
Properly sealed penetration through manufactured home bottom board

Tools:
1. Outward clinching (stitch) stapler
2. Utility knife
3. Cordless driver/drill
4. Reusable foam gun
5. Caulking gun
6. Nail gun

Materials:
1. Belly/bottom board fabric
2. Belly/bottom board repair tape
3. Staples
4. Screws
5. Foam board
6. 1X2 nailers
7. Spray foam sealant
8. High quality exterior caulk

Label combustion air inlets with the words, "DO NOT SEAL"

Seal around penetrations with compatible materials like foam board, belly board, house wrap, or Flex Mend (tm)
3.1601.5 - Preparation and Mechanical Fastening

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Note:

3.1601.5a - Preparation

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Surrounding insulation will be cleared to expose joints being sealed; salvage for reuse if possible

Duct surface to receive sealant will be cleaned

Objective(s):
Gain access while maintaining insulation value

Achieve proper adhesion for airtight seal when needed to ensure a tight fit to the framing structure and ensure the register can be removed and reinstalled by the dwelling occupant

Before
Locate disconnected or damaged ducts and clean work area of debris

In Progress
Clean surfaces to receive sealant. Allow to dry before applying sealant

Materials:
1. Cleaning solution or cleaning wipes

When making connections at interior walls, mastic should be applied to boot and wall, and allowed to dry entirely
3.1601.5b - Metal to metal

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Ducts will be fastened with a minimum of three equally spaced screws

Objective(s):
Ensure durable joints

Before
Reconnect ducts that have come undone, using fasteners to strengthen connection

After
At minimum, use three fasteners evenly spaced

Tools:
1. Drill

Materials:
1. Fasteners

1
Realign and join ducts to create a smooth transition

2
Use fasteners to hold duct together and prevent future dislocation

3
Attach ducts using a minimum of three, evenly-spaced fasteners

3.1601.5c - Flex to metal

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Joints will be fastened with tie bands using a tie band tensioning tool

For oval flexible duct to metal connections, tie bands cannot be used; appropriate mechanical fastener will be used

All connections, regardless of fastener, will be sealed

Objective(s):
Ensure durable joints
Before
Disconnected ducts are useless and need to be reconnect and securely fastened

After
Flexible duct should be securely fastened to metal ducting to prevent future dislocation and minimize leakage

**Tools:**
1. Band tensioner
2. Brush

**Materials:**
1. Tie bands
2. Mastic or other appropriate sealant

Apply mastic to flange
Slide inner liner onto flange with sealant
Using band tensioner, securely attach liner in place with tie band
Slide insulation and outer casing over metal ducting
Extend insulation and casing until in contact with other insulation
Secure insulation and casing in place using tie band and band tensioner

Air Sealing > Ducts > Duct Preparation

3.1601.5d - Duct board to duct board

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
Joints will be fastened with outward clinching (stitch) staples and c-channels if possible

**Objective(s):**
Ensure durable joints
3.1601.5e - Duct board to flexible duct

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
Metal take-off collar specifically designed for the thickness of the duct board will be used

All finger tabs will be bent down securely

Finger tabs will be longer than the thickness of the duct board and the shank will not extend beyond the thickness of the duct board

There will be an internal metal backer inside the duct board through which three evenly spaced screws can be secured; the metal backer will not interfere with air flow

**Objective(s):**
Ensure durable joints

Prevent the collar from moving into or out of the duct board or slipping

**Tools:**
1. Cordless driver/drill
2. 1/4” nut driver bit
3. Disposable brushes
4. Tin snips
5. Utility knife
6. Zip tie tensioning tool

**Materials:**
1. Galvanized metal backer rings
2. Tabbed starting collars
3. Rubber gloves
4. Zip ties
5. Duct sealing mastic
6. Fiberglass mesh tape

Make sure to use a starting collar that is made for the thickness of the duct board you are using. R-6 duct board is 1-1/2” thick. The correct starting collar would therefore have 1-1/2” of solid metal between the shoulder that fits against the outside of the duct board and the base of the tabs.

You may need to cut a slot in the duct board to slide the backer ring through. Use at least three equally spaced screws to fasten the starting collar to the backer ring.

**Bad Practice**
Flex duct improperly attached to duct board. No starting collar is installed.

**Best Practice**
Flex duct, starting collar, and backer ring installed and sealed to duct board
Coat joint between starting collar and duct board with mastic. Liberally coat the metal collar where flex attaches.

Slide flex duct liner over mastic-coated metal collar.

Secure with properly tensioned zip tie.

Coat seam with mastic.

Pull insulation over duct liner and secure with a zip tie.

Air Sealing > Ducts > Duct Preparation

3.1601.5f - Duct board plenum to air handler cabinet

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Flange/c-channel will be fastened with screws with the duct board installed between c-channel flanges

Duct board plenum will be connected to air handler plenum with flexible duct in upflow units

Objective(s):
Ensure durable joints

Best Practice
Duct board plenum fastened with C-channel and screws

Tools:
1. Screw gun
2. Tin snips
3. Utility knife
4. Tape measure
5. Square

Materials:
1. Fiberglass duct board
2. C-channel (same width as duct board)
3. Sheet metal screws longer than the duct board thickness
4. Foil tape (for assembling duct board)
5. Mastic
6. Mesh tape (for gaps larger than 1/4”)
7. Flex duct
8. Zip ties
9. Starting collar
10. Backing ring (fits inside duct board and fastens to starting collar)
3.1601.5g - Boot to wood

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
Predrill for screws or use ring shanked nails to fasten boot to wood

**Objective(s):**
Ensure durable joints

**Before**
Unattached ducts are useless

**After**
Damaged ducts should be repaired and securely fastened and sealed

**Tools:**
1. Drill
2. Hammer

**Materials:**
1. Metal screws
2. Ring-shank nails

1. Replace damaged ducting if necessary
2. Use ring-shank nails to hold ducting in place to subfloor
3. Drill pilot holes for metal fasteners
4. Use metal fasteners to secure duct to subfloor
5. After securely fastened, duct should be sealed with mesh and mastic
3.1601.5h - Boot to gypsum

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
If accessible, boot hanger will be fastened to adjacent framing with screws or nails

Boot will be connected to boot hanger with screws

If inaccessible, boot will be fastened to gypsum with a durable, adhesive sealant

**Objective(s):**
Ensure durable joints

Register boot fastened to framing and sealed to gypsum with spray foam

**Tools:**
1. Caulking gun or foam gun
2. Cordless driver/drill

**Materials:**
1. Polyurethane caulk
2. Mastic and mesh tape (for gaps larger than 1/4")
3. Screws
4. Fiberglass mesh tape (for gaps larger than 1/4")
5. Disposable brushes
6. Spray foam sealant

Fasten boot hangers to adjacent framing, or screw through the boot into adjacent framing. Polyurethane caulk is a durable adhesive, and can accommodate up to 50% expansion and contraction. Mastic and mesh tape also form a strong, permanent seal. Spray foam may be used to seal boots into the opening once the boot is fastened in place

1. Remove diffuser
2. Caulk the boot to the gypsum board. Angle the tip forward and force caulk into the joint
3. Wipe the caulk into the joint and smooth it as you go
4. Wipe away excess caulk (use water on siliconized acrylic, alcohol on silicone, and solvent on polyurethane caulk)
3.1601.5i - Duct board to flex

**Desired Outcome:**
Ducts and plenums properly fastened to prevent leakage

**Specification(s):**
Metal take-off collar with a hip and an internal metal backer will be used

Take-offs will be in accordance code requirements

**Objective(s):**
Ensure durable joints

- **Bad Practice**
  Improper attachment of flex to duct board

- **After**
  - Flex duct correctly installed and sealed to duct board

- Select a backer ring and flex duct installation tools
- Cut the proper size hole in duct board
- Select starting collar with tabs matching the thickness of the duct board
- Insert the starting collar, bend tabs over and install at least 3 screws through the collar, duct board, and backer ring
- Starting collar with tabs bent over and screws through the duct board and backer ring
- Apply mastic liberally and install flex duct
3.1602.8 - Supply Plenum (Furnace to Trunk Duct Connection) in Both Upflow and Downflow Air Handler Configurations

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Note:**

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3.1602.8a - Work assessment

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Specification(s):**
Installer prework assessment will be conducted to determine:

- Size of plenum
- Alignment
- Connection method
- Existing sealing

**Objective(s):**
Ensure an efficient and effective way to accomplish work

Verify scope of work

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3.1602.8b - Preparation

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Specification(s):**
Debris will be removed

Surface will be prepared for work (e.g., remove tape, oil)

Floor will be prepared to receive the appropriately sized plenum

**Objective(s):**
Provide unobstructed path for work access and air flow

Ensure adhesion of materials to be installed

Provide a properly sized plenum to maximize distribution of air flow (equal to the furnace discharge)
Closet prepared for furnace installation

**Tools:**
1. Shop vac
2. Scraper
3. Bench duster
4. Dust pan

**Materials:**
1. Rags

Dust walls and floor of cabinet. Sweep debris into piles for pickup. Wipe down walls and floor.

Vacuum cabinet clean

Inspect plenum for damage, then clean, scrape, and seal

Scrape loose material from insides of cabinet

Apply mastic to inside seams of plenum

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Specification(s):**
Plenum will be rebuilt or repaired using compatible materials and will be:

- Mechanically fastened
- Sealed
- Durable
- Structurally sound
- Insulated
- Equipped with a vapor retarder where climate appropriate

**3.1602.8c - Plenum rebuild or repair**
Equipped with a vapor retarder where climate appropriate

If possible, flow diverter or turning vanes will be installed for air flow and/or balancing (e.g., bullhead Ts, offset air handler)

**Objective(s):**

Minimize restrictions

Maximize air flow and air distribution

Minimize moisture issues

Prevent condensation on plenum

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**Best Practice**

Whenever possible, install turning vanes in plenums to reduce turbulence and improve airflow

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**In Progress**

Rebuilding and sealing a leaky existing plenum

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**Materials:**

1. Starting collars and flanges
2. Zip ties
3. Mastic duct sealant
4. Fiberglass mesh tape
5. Sheet metal screws
6. Turning vanes
7. Duct board

Using turning vanes reduces turbulence and increases air flow. Use mastic and mesh tape on the outside of duct board plenums. Properly install metal starting collars to duct board and flex duct to metal collars (see spec 3.1601.5e for detail)

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**3.1602.8d - Repair work access**

**Desired Outcome:**

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

**Specification(s):**

Point of access options include:

**Option 1: Through the trunk duct**

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

**Option 2: Remove crossover duct**

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

**Option 3: Remove air handler**

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

Option 4: Through the furnace panel
• Replace and seal panels

Objective(s):
Repair work access
Prevent condensation
Minimize heat loss and heat gain from plenum

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

Tools:
1. Utility knife
2. Saw
3. Prybar
4. Screw gun
5. Hammer
6. Drill
7. Saw
8. Disposable brushes

Materials:
1. Belly repair tape
2. Mastic duct sealant
3. Fiberglass mesh tape
4. Insulation
5. Air handler gasket

Choose the least invasive and labor-intensive method that will allow full access for sealing.

Always wear hand protection when working with sharp objects.

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

Create an opening large enough to completely seal the plenum to the trunk line.

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

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

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

Plenum to duct trunk connection coated with mastic sealant.
3.1602.8f - Performance testing

**Desired Outcome:**
Deliver all air from air handler to the trunk duct without leakage or restriction

**Specification(s):**
Pre- and post-retrofit duct leakage will be performance tested using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program

**Objective(s):**
Document post-retrofit duct leakage test has been performed

**Best Practice**
Test duct performance using pressure pan or duct blaster. Record before and after readings.

**Tools:**
1. Pressure Pan
2. Blower door
3. Manometer

**Materials:**
1. Duct mask

Pressure pan testing is required at the initial inspection and at the final inspection. Said requirement applies to all ductwork, crossover ducts, etc. With the HVAC system off, use a blower door to depressurize the home to -50 pascals. Measure and record all pressures for duct boots where accessible. Sealed ducts should read near 0 pascals. Completely disconnected ducts will read closer to -50 pascals. Determine leakage area and feasibility to minimize duct leakage.
3.1602.9 - Crossover Ducts

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

Note:

3.1602.9a - Work assessment

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

Specification(s):
Installer prework assessment will be conducted to determine:

- Location
- Types
- Leakage points

Objective(s):
Verify scope of work

3.1602.9b - Flexible crossover duct connections

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

Specification(s):
Flexible crossover duct connections will be added, rebuilt, or repaired using compatible materials and will be:

- Mechanically fastened at both inner and outer liner
- Sealed using UL-listed sealant that is durable, structurally sound, insulated
- Equipped with a vapor retarder

Whenever possible, rigid elbow or equivalent will be installed in crawl space crossover ducts

Floor insulation will be in contact with the outer liner of the crossover duct

Crossover duct vapor retarder will be sealed to the bottom liner (e.g., belly fabric)

New flex duct installation will be insulated to a minimum of R-8
When feasible, 26-gauge hard duct should be installed

If a new crossover is required, it must be insulated to at least R-8 and be air sealed

**Objective(s):**
Ensure lasting durable connections

Minimize air leakage and heat transfer

Maintain duct diameter around the turns

Maximize air flow and distribution

Unattached ducts are useless

Crossover ducts should be attached securely, sealed to reduce leakage, and insulated to R-8

**Tools:**
1. Band tensioner
2. Drill
3. Brush

**Materials:**
1. Tie bands
2. Mastic or other appropriate sealant
3. 26 gauge elbow duct
4. R-8 insulated flexible duct with vapor retarder

1. Attach elbow duct and orient in correct direction to minimize duct run
2. Fasten elbow in place with at least three evenly-spaced fasteners
3. Apply mastic at metal-to-metal connection
4. Apply mastic to all elbow joints and flange
5. Slide inner liner onto flange with sealant
6. Fasten inner liner with tie band using band tensioner
7. Extend insulation and exterior casing up over elbow until they reach belly
8. Secure insulation and outer casing place with tie band
9. Use band tensioner to ensure that insulation and casing remain tight against belly
3.1602.9c - Support

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

 Specification(s):
Crossover ducts will be installed so they are not in contact with the ground
Crossover ducts will be supported in accordance with flex duct manufacturer specifications, local codes
Support materials will be applied in accordance with manufacturer specifications for interior dimensions and will not crimp ductwork, dip, or sag

 Objective(s):
Maximize air flow and distribution
Minimize condensation
Minimize air leakage and heat transfer

 Flexible ducting should not come in contact with ground
Supports should be evenly spaced, securely fastened to floor joists and should not compress or kink duct

 Tools:  
1. Drill
2. Utility knife

 Materials:  
1. Fabric straps
2. Fasteners
3.1602.10 - Hard and Flex Branch Ducts

Desired Outcome:
Deliver air from trunk to termination (register/diffuser) without leakage

Note:

3.1602.10b - Reduce excess flex duct length

Desired Outcome:
Deliver air from trunk to termination (register/diffuser) without leakage

Specification(s):
Excess flex duct will be removed between the takeoff at trunk and floor register boot

Objective(s):
Improve air flow

Before
This duct is far too long, resulting in poor airflow.

After
The duct has been shortened, and is now properly supported.

3.1602.10c - Duct connection repairs

Desired Outcome:
Deliver air from trunk to termination (register/diffuser) without leakage

Specification(s):
Hard and flex duct branch connections will be rebuilt or repaired using compatible materials and will be mechanically fastened and sealed

Ends will be sealed

Objective(s):
Ensure lasting durable connections

Minimize air leakage

Maximize air flow and distribution
Here the worker is rebuilding a hard connection to the trunk line.

**Tools:**
1. drill
2. tin snips
3. inspection mirror
4. utility knife

**Materials:**
1. metal boot material
2. mesh tape
3. mastic
4. replacement grille

After

The duct has been sealed, ensuring proper airflow to the home.

Measure the dimensions required for the new boot.

Fit the new boot on to the trunk line.

Seal the boot to the trunk line using mastic and mesh tape. An inspection mirror can make this easier.

Mechanically fasten the boot to the subfloor.

Install a new grille on the rebuilt boot.

---

**Desired Outcome:**
Deliver air from trunk to termination (register/diffuser) without leakage

**Specification(s):**
Access hole in the trunk/branch duct will be repaired and sealed

Insulation will be reinstalled

Bottom liner/belly will be repaired
Objective(s):
Repair work access

Minimize heat transfer

Tools:
1. Utility knife
2. Disposable brushes
3. Outward clinching stapler
4. Scissors

Materials:
1. Fiberglass mesh tape
2. Mastic duct sealant
3. Foil tape
4. Insulation
5. Belly repair tape
6. Belly wrap
7. Staples
8. Solvent (acetone, paint thinner, denatured alcohol, Goof-Off, or similar) to clean aluminum duct
9. Spray adhesive for belly repairs

Before
Access hole cut into manufactured home branch duct

After
Reppaired, insulated, and sealed access hole in manufactured home duct and belly

1. Thoroughly clean duct with solvent before applying foil tape and mastic
2. Secure edges of repair with foil tape and then liberally coat with mastic
3. Overlap foil tape with mastic by at least one inch on all sides
4. Replace or reinstall fiberglass belly insulation
5. Apply belly repair tape and fasten with outward clinching (stitch) staples. Spray adhesive will help adhere the tape
3.1701.1 - Holes, Penetrations, and Connection Seam

Desired Outcome:
The exterior of the seam is weathertight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between unconditioned and conditioned space.

3.1701.1c - Materials

Desired Outcome:
The exterior of the seam is weathertight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between unconditioned and conditioned space.

Specification(s):
Materials will be used or installed in accordance with product manufacturer specifications.

Objective(s):
Select materials to ensure durable and permanent repair.

3.1701.1h - Floor repair

Desired Outcome:
The exterior of the seam is weathertight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between unconditioned and conditioned space.

Specification(s):
Floor repair material will meet or exceed strength of existing floor material.
Repair will span from joist to joist and blocking added as needed to support floor.

Patches smaller than 144 square inches will not require repairs from joist to joist.

Floor repair material will be glued, fastened, and air sealed.

Objective(s):
Ensure floor is structurally sound.
Minimize air leakage.

Before
Holes in the floor should be repaired.

After
Completed floor patches should be air sealed to prevent leakage from belly.
Tools:
1. Saw
2. Tape measure
3. Caulk gun
4. Marker
5. Utility knife
6. Drill

Materials:
1. Plywood or other suitable subflooring material
2. Fasteners
3. Caulk
4. Sealant

When possible, measure patch to reach surrounding joist. If not, blocking will be required.

Mark damaged area to be removed to create most efficient patch.

Cut out damaged area of floor, with minimal damage to surrounding floor and joists.

Once damaged area has been removed, measure for new patch and cut replacement subflooring to size.

Clean debris from surrounding area and mounting surfaces.

Apply sealant to mounting surfaces.

Securely fasten new subfloor in place, attaching to joist or blocking as necessary.

Seal gaps around patched in subfloor to create air seal between conditioned living space and crawl space.
4.1003.10 - Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access Through the Ceiling)

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

4.1003.10a - Attic, ceiling, and roof verification

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

Specification(s):
All combustion appliance flues will be terminated to the exterior of the house and terminations will maintain proper clearance above snow loads
A distance no less than 2” will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place
All ventilation systems will maintain a continuous connection and terminate to the outdoors
All broken mushroom vents will be replaced or removed and sealed
All plumbing stacks will be terminated to the outdoors
Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures, if feasible and only when installed measures will compromise the fire rating of the fixture
All Weatherization installed recessed lights will be labeled as having an air leakage rate no more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential
All obvious ceiling penetrations will be sealed
The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials
All roof, attic, and ceiling assemblies will be structurally sound:
- Loose ceiling panels will be secured
- Temporary ceiling bracing will be recommended while installing installation
Dishing and pooling issues that allow standing water will be addressed
All known roof water leaks will be repaired before installing installation

Objective(s):
Ensure occupant and worker safety
Verify attic space is ready to insulate
Ensure structural integrity of the roof and ceiling assembly
Prevent intrusion of bulk moisture
Prevent damage while installing insulation
Best Practice
90+ flue terminates above the snow line and penetrations have been sealed.

Best Practice
Flue penetrations have been sealed correctly from the interior.

Best Practice
Plumbing stacks must be terminated to the outdoors.

Dishing and pooling issues must be addressed.

Broken mushroom vents must be replaced, or removed and sealed.

Proper clearance to combustibles will be maintained through the roof assembly.

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

Insulation > Attics > Attic Ceilings

4.1003.10b - Construction prep

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

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

**Objective(s):**
Protect occupant health and safety

Protect occupant belongings
Bad Practice
Improperly prepared workspace with cellulose all over client belongings and bedroom

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

Tools:
1. Utility knife

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

Insulation > Attics > Attic Ceilings

4.1003.10c - Attic access

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

Specification(s):
Equidistant holes will be drilled in a straight row parallel to the longitudinal exterior wall of the ceiling

If a longitudinal ceiling trim piece exists, trim piece will be removed and holes will be drilled behind the trim

Hole location and size will be placed to provide access to allow for consistent and uniform coverage of installed insulation throughout the attic assembly

There will be, at a minimum, one hole between each roof truss

Holes will be large enough to accommodate the chosen fill tube without damaging the ceiling material during installation

If a vapor barrier or ceiling-mounted insulation is present, access will be gained through them

Attic will be visually inspected for the location of existing insulation, obstructions, hazards, and construction type

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

Determine insulation installation technique

Prevent damage to ceiling

Create a professionally finished ceiling

Holes are drilled in such a fashion that they allow uniform coverage of attic insulation.

Hole is the proper size in relation to the fill tube.
Tools:
1. holesaw bit
2. drill
3. borescope
4. camera

Materials:
1. protective plastic

Plastic plugs will be allowed for manufactured homes with written client permission

Insulation > Attics > Attic Ceilings

4.1003.10e - Fiberglass blown insulation installation

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

Specification(s):
Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot
Using fill tube, 100% of each cavity will be filled to a consistent density
Fill tube will be inserted within 6” of the end of each attic cavity
Insulation will be installed into the void of the attic cavity:
- If existing insulation is roof-mounted, insulation will be blown below
- If existing insulation is ceiling-mounted, insulation will be blown above
- If existing insulation is mounted at both locations, insulation will be blown in between

Flame spread and smoke-developed index for insulation will be a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84

Objective(s):
Fill entire attic cavity to the prescribed R-value to reduce air infiltration
Avoid clogging of the cavity and the fill tube
Prevent damage to the ceiling

Fire safety will be maintained

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

Clarification: Fill tube will be able to reach within 6 inches of the end of each cavity when inserted.
Blown fiberglass will be used as the allowed insulation for manufactured housing.
If insulation is roof mounted, blow below it. If insulation is ceiling mounted, blow above it.

If insulation is mounted at both the ceiling and the roof, blow between it.

Insulation meets ASTM E 84.

4.1003.10f - Patching and sealing holes

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

Specification(s):
Holes will be plugged or covered and sealed to be aesthetically pleasing

If existing trim was removed, it will be reinstalled

Objective(s):
Create an airtight seal

Create a visually acceptable ceiling finish

In Progress

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

Tools: 1. color matched plug
Materials: 1. color matched plug

4.1003.10g - Verification of details

Desired Outcome:
Consistent, uniform thermal boundary and air barrier between the conditioned space and unconditioned space
**Specification(s):**
Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process.

**Objective(s):**
Verify the integrity of the house has been maintained.

**In Progress**
Verify that no damage has been done by the workers. When in doubt, verify with photo documentation.

**Best Practice**
Document and repair any damage the workers caused.
4.1303.1 - Insulation of Floor Cavity with Blown Material

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

4.1303.1a - R-value

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

Specification(s):
Insulation will be installed in accordance with recommended R-value and density

Objective(s):
Insulate to prescribed R-value for the climate zone

R-value should be determined by climate zone, and be listed in work order

Best Practice
Consult density chart on insulation packaging to determine proper insulation application to achieve prescribed R-value
4.1303.2 - Insulation of Floor Cavity with Batt Material

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

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4.1303.2c - Insulate floors

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

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

If insulation has facing, facing will be in contact with the heated side

Insulation will be in contact with subfloor

Insulation will not have gaps, voids, or be compressed

Insulation will be supported (e.g., metal insulation supports) to maintain a permanent contact with subfloor

Insulation will be notched around all wires, pipes, and blocks

Ducts and water lines will be insulated for climate conditions

Water lines will be located above the warm side of the insulation (toward the conditioned space), when feasible

A rigid air barrier will be installed in contact with the bottom of the joists, when feasible

Rigid air barrier will be fastened as to not sag, bend, or fall off

Seams, holes, and joints in the air barrier will be sealed

In cases where HVAC ducts hang below the level of the rigid air barrier and insulation, the ducts will be insulated and air barrier provided that is sealed to the rigid air barrier

**Objective(s):**
Eliminate voids

Minimize conductive heat transfer across the floor system

Ensure durability

Minimize convective heat transfer

Keep pipes from freezing

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**Tools:**
1. Utility knife
2. Tape measure
3. Metal snips
4. Drill
5. Caulk gun

**Materials:**
1. Fiberglass batts, may be kraft-faced
2. Metal tape
3. Insulation supports (lightning rods)
4. Fasteners
5. Caulk
6. Duct insulation

If fiberglass insulation is kraft-faced, ensure kraft is in contact with subfloor

Notch insulation around pipes, blocks, and other obstructions

To prevent insulation from moving away from subfloor, supports should be fastened in place

A rigid air barrier should be securely in place so prevent sagging, gaps and penetrations should be sealed

When ductwork or water pipes run below joists, insulation should be threaded above to fill joist cavity, uncompressed

Water lines and ducts should be insulated if running below joists

A rigid air barrier should be mechanically fastened to hold it tight against the floor joists

When insulating around low-hanging ducts and water pipes, run a line of sealant before placing insulation

Insulation around ducting should be securely fastened and sealed to maintain air barrier

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**4.1303.2d - Materials**

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

**Specification(s):**
Insulation materials will be of minimal water absorbency and flame spread, and smoke-developed index for insulation will be in accordance with IRC

Foam plastic insulation will comply with IRC

Fasteners will be corrosion resistant
Objective(s):
Ensure durability
Prevent moisture damage

Bad Practice
Do not use absorbent insulation material, such as cellulose, in the floor cavity

Best Practice
Fiberglass batts are a good choice for insulating floor cavities

Materials:
1. XPS insulation board
2. Fiberglass batts
3. Corrosion resistant exterior screws

XPS insulation board is a non-absorbent insulation option
XPS (extruded polystyrene) is safe for use in floor cavities
Do not use EPS (expanded polystyrene) foam board in floor cavities due to flame spread rate

Use only corrosion resistant, exterior screws as fasteners in floor cavities
4.1488.1 - Climate Considerations for Insulating Water Lines Located Between Bottom Board and Ground

Desired Outcome:
Water supply line does not freeze in cold climates

Note:

4.1488.1a - Work assessment

Desired Outcome:
Water supply line does not freeze in cold climates

Specification(s):
Installer prework assessment will be conducted to determine:

- Water leaks do not exist
- Accessibility

Water leaks will be repaired before installation

Objective(s):
Verify scope of work
Ensure that work space is safe and ready for work

4.1488.1b - Installation

Desired Outcome:
Water supply line does not freeze in cold climates

Specification(s):
Pipe freeze protection system will have thermostatic heat control and circuit protection
Insulation will be installed over pipe freeze protection system when necessary
Pipe will be protected from wind

Objective(s):
Ensure fire safety
Protect supply pipe from freezing
Properly installed freeze protection heat tape

**Tools:**
1. Utility knife
2. Rags

**Materials:**
1. Heat tape
2. Zip ties (to attach thermostat)
3. Electrical tape
4. 1/2” thick fiberglass insulation

If heat tape is needed, it will be installed this way. There is no requirement to install heat tape on existing waterlines and condensate lines.

To prevent pipe freezing and reduce the risk of fire, follow manufacturer's instructions carefully. Choose the proper length heat tape for the pipe to be protected. When using multiple lengths of heat tape on long pipes, start subsequent runs of heat tape one foot before the end of the previous run on opposite sides of the pipe. Never overlap or cross heat tape with itself. Complete heat tape installation instructions may be found here: https://www.foremost.com/mygreathome/mobile-home-repair/seasonal/how-to-install-heat-tape.asp

Educate occupants on efficient and safe operation and maintenance of heat tape.

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1. Install thermostat in firm contact with the pipe at the coldest point
2. Fasten heat tape to pipe with electrical tape every six inches.
3. Measure and cut insulation to fit water lines. Miter insulation at elbows and tees
4. Fasten insulation to water lines with zip ties
5. Cover all exposed portions of the water supply lines with insulation
4.1601.3 - Insulation and Vapor Barrier

Desired Outcome:
Minimize condensation

Note:

4.1601.3a - Ducts in unconditioned spaces (e.g., crawl space, attic, unconditioned basements)

Desired Outcome:
Minimize condensation

Specification(s):
Ducts will have continuous insulation and vapor barrier

Insulation will be sufficient to prevent dew point on surface of ducts

Objective(s):
Minimize condensation

Materials:
1. Pipe wrap
2. Seam tape
3. Tie bands
4.1601.3c - Exposed metal

**Desired Outcome:**
Minimize condensation

**Specification(s):**
All exposed metal will have continuous insulation and vapor retarder

**Objective(s):**
Minimize condensation

Repair holes in belly which would expose metal components to potential condensation

Metal components that extend beyond the belly must be insulated and have a vapor barrier
4.1601.4 - Insulating Flex Ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Note:

4.1601.4b - Selection of new flexible ducting

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
All flexible ducting will have a minimum of R-8

Objective(s):
Minimize thermal conductance through the duct system

Tools:  
1. Tie band tensioner

Materials:  
1. Flex duct, min R-8

4.1601.4d - Installation of flex

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Flex duct will be supported in accordance with flex duct manufacturer’s directions or local codes

Beaded rigid elbow or equivalent will be installed in duct runs whenever change in direction is required

Objective(s):
Prevent sags, drops, or other bends that may interfere with correct air flow

Maintain duct diameter around the turns

Maximize air flow and distribution
Best Practice
Straps should be at least 1.5” wide.

Straps should be placed in accordance with manufacturers specification, typically 4ft.

Materials:
1. 1.5” webbing or strap material

Elbows are required when a change in direction is needed.

Insulation > Ducts > Insulating Ducts

4.1601.4e - Interior liner attachment

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Interior liner of the flex-to-metal connection will be fastened with tie bands using a tie band tensioning tool

For oval flexible duct-to-metal connections, tie bands cannot be used; appropriate mechanical fasteners will be used

Objective(s):
Create a strong, secure attachment

1. tie band tensioning tool
1. tie band
4.1601.4f - Sealing of interior liner

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
UL 181 B-M-listed mastic product will be used to seal the connection

Objective(s):
Create an airtight connection

Best Practice
Using a product like the mastic shown here results in an airtight connection

Materials:
1. UL 181 B-M listed mastic product

4.1601.4g - Attachment of exterior liner

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Liner will be pulled up onto the metal duct as far as possible before securing

Objective(s):
Create a strong, durable attachment

In Progress
Pull the outer liner so that all exposed surfaces are covered.

After
Duct is properly secured with a trimmed tie band.

Tools:
1. tie band tensioning tool

Materials:
1. tie band
Outer liner should be pulled up to cover all un-insulated surfaces.

Secure the tie band in place by hand or using a tie band tension tool.

Trim the excess tie band material.

4.1601.4h - Sealing of all accessible ducts

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
All accessible joints, seams, and connections will be sealed with UL 181 approved mastics

Objective(s):
Minimize duct leakage

In Progress
Here the technician is inspecting work in progress, ensuring a good seal.

After
The duct boot has been properly sealed, even though the area is difficult to reach.

Materials:
1. mastic
2. duct boot

4.1601.4i - Insulation of all fittings

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
All metal fittings, including boots, elbows, and takeoffs, will be insulated separately using a minimum of R-8 duct wrap with a vapor barrier mechanically fastened (e.g., stitch staples, tie bands) and sealed with no exposed metal

Objective(s):
Minimize thermal conductance of the duct system
Minimize condensation
Before
This elbow has been sealed, but is not insulated.

After
Fitting has been sealed and properly insulated.

Insulation > Ducts > Insulating Ducts

4.1601.4j - Completeness of vapor barrier

Desired Outcome:
Lower conductive heat transfer by ducts and decrease condensation on duct vapor barrier

Specification(s):
Vapor barrier of all duct insulation will be taped to the flex duct using the taping system required by the manufacturer of the duct insulation

Vapor barrier will be sealed to the belly liner

Objective(s):
Ensure a complete vapor barrier

After
Crossover duct with vapor barrier mended and sealed to manufactured home belly

Tools:
1. Reusable spray foam gun
2. Utility knife
3. Scissors
4. Outward clinching (stitch) stapler

Materials:
1. UL-181 B-M foil or Mylar tape
2. Foam sealant
3. Staples

Clean vapor barrier thoroughly before applying UL 181B Mylar tape to cuts and seams. Repair belly if necessary, and use foam sealant to seal the vapor barrier to the belly.
5.3003.5 - Refrigerant Line Inspection

**Desired Outcome:**
Refrigerant lines properly installed

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

5.3003.5a - Insulation

**Desired Outcome:**
Refrigerant lines properly installed

**Specification(s):**
All suction or vapor refrigerant lines will be insulated to a minimum of R-4

High-side or liquid refrigerant lines will not be insulated unless specified by the equipment's manufacturer

**Objective(s):**
Ensure refrigerant lines do not gain excessive heat, or cause condensation to occur inside the building envelope

5.3003.5b - Ultraviolet (UV) protection of insulation

**Desired Outcome:**
Refrigerant lines properly installed

**Specification(s):**
If exposed to sunlight, refrigerant line insulation will be protected from UV degradation in accordance with manufacturer specifications, IRC or local code

**Objective(s):**
Install insulation so it does not degrade

**Bad Practice**
Line set insulation is exposed to direct sunlight and is severely degraded.

**Best Practice**
Line set insulation is protected with integrated UV protection. Tapes and other sealants may be required.
5.3003.14 - Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

5.3003.14d - Carbon monoxide (CO) in flue gas

Desired Outcome:
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):
CO in the undiluted flue gas will be less than 400 ppm air-free

Objective(s):
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

Best Practice
CO levels should be less than 200 ppm AF (DWH) and 400 ppm AF (furnace) to ensure safe operation

Direct vent appliances have concentric venting. The inner liner exhausts flue gas and the outer draws in combustion air

Ensure that the test ports drilled penetrate into the flue. Be sure to drop the outer liner into position before testing

With the test ports lined up on the inner and outer pipe, measurements can be taken in undiluted flue gas.
5.3003.14e - Testing/inspection holes

**Desired Outcome:**
Analysis of critical components and operations completed in accordance with industry and manufacturer specifications

**Specification(s):**
All testing and inspection holes will be sealed with manufacturer approved materials

**Objective(s):**
Ensure equipment:

- Operates as designed
- Operates safely
- Operates efficiently
- Is durable

**Materials:**
1. high temperature sealant
2. stainless steel plug or cap
3. stainless 5/16” bolt

**Before**
The testing hole was left unsealed.

**After**
The hole in both walls has been properly sealed with a plug, cap, or other approved method.

1. Apply high temperature sealant to the bolt, so that both holes will be sealed.
2. Screw the bolt into place, ensuring a proper seal on both pipes.
3. If sealing each wall individually, insert the plug into each hole.
4. Apply high temperature sealant to the perimeter of the plug.