Retrofitting Nebraska 2015

Installation Standards for

Single Family and *Manufactured Homes*

created by

The Nebraska Weatherization Assistance Program

Nebraska Weatherization Assistance Program
Weatherization Installation Standards

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1 Inspections, Energy Audits, Deferrals and Client Education

Completing a thorough and accurate inspection and energy audit is essential for assessing how much energy a building uses, how the building uses the energy, what measures are cost effective for implementation in the building and how much energy/ costs can be saved with following implementation. Utilizing a systematic process of inspecting, documenting, evaluating and analyzing the building and its energy using systems helps ensure the accuracy of the *savings-to-investment ratio* (*SIR)* calculations for energy efficiency measures to be installed through the Nebraska Weatherization Assistance Program (NeWAP).

1.01 Inspections

1.0101 Initial On-Site Inspection

Completing an accurate on-site inspection for use in completing an Energy Audit includes, but is not limited to verification and documentation of:

- Inspecting the exterior of the building, noting:
  - the exterior sheathing material(s)
  - roof conditions, pitch, materials, and penetrations
  - building exposure, orientation and conditions
  - plumbing or electrical penetrations into the home/building
  - door and window locations, types, conditions, and sizes
- Inspecting the interior of the building and documenting:
  - wall condition, types, and thickness
  - existing insulation types, locations, and R-values

    2.0104.1 (a, b, c, d) Health and Safety – Safe Work Practices – Insulation – Vermiculite (SF) (MH)

  - sources and signs of moisture and/or *Vapor barriers*
  - existing electrical hazards

    2.0107.1 (a) Health and Safety – Safe Work Practices – Baseload – Baseload Worker Safety (SF)

  - existing lead based paint
  - the location and type of existing CO detectors
- Conducting Indoor Air Quality and CO Tests
- Conducting Combustion Safety and Efficiency Tests

  2.0203.1 (a, b) Combustion Air for Natural Draft Appliances (SF)

- Completing *Combustion Appliance Zone* (*CAZ*) Testing

  2.0105.1 (a, b, c) Health and Safety – Safe Work Practices – Heating and Cooling Equipment – Combustion Worker Safety (SF)

- Performing HVAC Distribution Tests

- Evaluating and documenting all existing Mechanical Systems, including but not limited to:
  - furnaces, boilers, heat pumps, air conditioners, water heaters
  - all system controls
  - all system working conditions
  - wiring or electrical concerns
  - signs of corrosion or rust
  - duct and/or flue conditions or concerns
  - signs of water leakage
- Evaluating and documenting existing Ventilation Systems
  - existing ventilation equipment, controls and working condition
- Evaluating and documenting existing Appliances
  - appliance type, age, condition, hours/patterns of use
- Evaluating and documenting baseload equipment
  - equipment type, age, condition, hours/patterns of use
- Performing Blower Door Tests
- Verifying and evaluating the adequacy of Attic Ventilation
  - Use the following tables to calculate the net free area of the existing roof/attic venting:

Roof Vent	**Net Free Vent**
8″ diameter	50 square inches
9″ diameter	60 square inches
9.5″ diameter	70 square inches
10″ diameter	80 square inches
13.5″ diameter	144 square inches
Turbine	239 square inches

Rectangular Gable	**Net Free Vent**
8″ x 12″	48 square inches
12″ x 18″	108 square inches
14″ x 24″	168 square inches
18″ x 24″	216 square inches
24″ x 30″	360 square inches

Soffit Vent	**Net Free Vent**
4″ x 16″	32 square inches
8″ x 16″	64 square inches
4″ x 8″	16 square inches

Triangular Gable Vent	**Net Free Vent**
30″ base	82 square inches
48″ base	144 square inches
72″ base	197 square inches

- Net free vent area for other size rectangular vents may be determined by using the following formula: **Net Free Inches = (Width x Height) divided by 2**
- Net free vent area for other size triangular vents may be determined using the following formula: **Net Free Inches = (Width x Height) divided by 4**

1.0102 Pre-Implementation Inspection

When you receive the weatherization file review the approved estimation form and other related documents:

- Understand what work has been called for and what materials will be needed.
- Note any mechanical work that was to be completed prior to the start of building shell weatherization activities.
- Know the order in which activities are to be completed.
- Clarify with the auditor anything about the job that is unclear or incomplete.
- Confirm the date/time of arrival at the client's house.
- Verify that all materials, supplies, tools, equipment are on the truck. Track inventory items as required.

At the job site greet the owner/tenant, identify yourself, state your purpose, and review the job schedule.

- Manage their expectations as needed.

Walk around the exterior of the home:

- Confirm the information in the audit.
- Note anything not recorded in the estimation form that could affect the completion of installation activities.
- Record any changes to the building exterior or problems that could interfere with installation activities.

Walk through the interior of the home:

- Confirm the information in the audit.
- Note anything not recorded in the Estimation forms that could affect the completion of installation activities.
- Record any changes to the building interior or problems that could interfere with installation activities.
- Contact your weatherization coordinator or supervisor for further instructions if:
  - The *Heating Plant* or other combustion appliance is currently malfunctioning.
  - Household members exhibit symptoms that could be from carbon monoxide poisoning. Open windows or evacuate the house if necessary.
  - There is a strong odor of heating gas or sewer gas. Open windows or evacuate the house if necessary.
  - Existing conditions have changed in ways that would make proposed work difficult or no longer cost-effective. Example: shingles/roof are in such bad shape that attic and/or slanted ceiling insulation could be damaged by water.

Complete initial diagnostics:

- Include blower door and pressure diagnostics tests.

- Record test results in the client file.

Review proposed work with the client:

- Explain what will be happening, and approximately how long it will take.

1.0103 Quality Control Inspections

As per U.S. Department of Energy Weatherization Program Notice 15-4 – Every Unit reported as a "completed unit" must receive a final *Quality Control Inspection* ensuring that all work meets the minimum specifications **1.0101** outlined in the Standard Work Specification (SWS) in accordance with 10 CFR 440. *Quality Control Inspections* ensure that weatherization services have been provided in a quality manner and that the home is left in a safe condition.

All *Quality Control Inspections* will include, but not be limited to:

- A complete file review verifying:
  - Appropriate lead paint documentation
  - Completion of a mold and moisture assessment
  - Appropriate completion and documentation of combustion appliance testing
  - Appropriate completion of blower door and pressure diagnostics
- An on-site work assessment of completed weatherization work including, but not limited to:
  - *Building envelope* insulating and air sealing
  - Installation of venting and damming for *High Heat Sources* and insulation preservation
  - Heating, cooling and water *Heating System* repairs and/or replacement
  - Energy related window/door repairs
  - Baseload energy saving work
  - Health and safety related work
- Client Interview(s)
- Core Sampling ***must*** be completed on a minimum of 5% of all frame homes billed each month in which insulation is installed in an enclosed cavity ***must*** be tested by the sub-grantee for proper weight and density by taking a minimum of 3 core samples.
  - The core samples ***must*** be taken in random locations.
  - In sidewalls, 1 core sample ***must*** be taken within 3 feet of the top of the wall.
  - The results of the core samples ***must*** be recorded on the inspection form and retained in the client's files.
- Verify that all completed work and installed materials meet minimum state and local codes.
- Verify that all completed work and installed materials are installed according to manufacturer's instructions, unless otherwise specified by the State Plan.

1.02 Energy Audit

Completing an accurate Energy Audit requires appropriate analysis of the on-site inspection information based on the following NeWAP requirements:

- Using the appropriate, most current authorized version, of the NeWAP and DOE approved auditing program to determine what Energy Efficiency Measures ***must*** be implemented. The auditing Tools currently mandated for use in the NeWAP are:

- The National Energy Audit Tool (NEAT), for single family homes
- The *Manufactured Home* Energy Audit (MHEA), for *Manufactured Homes* or
- The Targeted Retrofit Energy Analysis Tool (TREAT) *for Multi-family Buildings*

- Performing a site-specific Energy Audit on all frame, masonry, modular, and *Manufactured Homes* and verifying that:
  - Homes with a cumulative *SIR* of less than 1.0 *must not* be weatherized.
  - Individual audit measures with an *SIR* of less than 1.0 *must not* be implemented.
- Retaining a copy of the audit in the clients' file.
- Using local weather data when running the site-specific audits.
- Using average state fuel costs when running site-specific audits.
  - The Nebraska Energy Office will provide updated fuel costs to sub-grantees on an annual basis.
- Using local material and labor costs when running site-specific audits.
  - If sub- grantees cannot use actual material and labor costs, use estimated material and labor costs updated a minimum of every 12 months.

Verifying that the audit measures recommended for implementation by NEAT, MHEA or TREAT audit have individual *SIRs* of 1.0 or greater. Audit measures with an *SIR* of less than 1.0 ***must not*** be implemented. Installing a measure with a lower *SIR* without installing others with greater *SIR*s is not allowed.

Verifying and documenting that, in addition to the measures that are required to be implemented based on Energy Audit, all additional weatherization requirements included in the Installation Standards are implemented. Any exceptions associated with not completing recommended or required measures must be appropriately documented in the client's file.

Verifying that all Energy Audits are completed using the Key Parameters and Default Parameters established by the Nebraska Energy Office with no modifications unless authorized.

- NEAT Candidate Measures mandated for use by all sub-grantees: in single family homes
  - R-11, R-19, R-30, R-38 and R-49 ceiling/attic insulation
  - Fill ceiling cavity
  - Sill box insulation
  - Foundation wall insulation
  - R-11, R-19 R-30 and R-38 floor insulation
  - Wall and *Knee wall* insulation
  - Window sealing
  - Window replacement
  - Storm windows
  - Low E windows
  - Furnace tune up
  - High efficiency boiler
  - High efficiency furnace
  - AC tune up
  - AC replace
  - Install/replace heat pump

- Water heater tank and pipe insulation
- Water heater replacement
- Lighting retrofits
- Low flow shower heads

- MHEA Candidate Measures mandated for use by all sub-grantees: in *Manufactured Homes*
  - General air sealing
  - Add skirting
  - Wall fiberglass batt, loose fill cellulose and fiberglass
  - Wall fiberglass batt, loose fill cellulose and fiberglass in Additions
  - Floor loose fill fiberglass
  - Floor loose fill cellulose and fiberglass in Additions
  - Roof loose fill fiberglass
  - Roof loose fill cellulose and fiberglass in Additions
  - Add skirting on Additions
  - Replace marked doors (mandatory)
  - Replace wooden doors
  - Replace wooden doors in Additions
  - Storm doors
  - Storm doors in Additions
  - Window sealing
  - Window sealing in Additions
  - Replace single paned windows
  - Replace single paned windows in Additions
  - Glass or Plastic storm windows
  - Glass or Plastic storm windows in Additions
  - Tune Heating System
  - Tune cooling system
  - Replace dx (direct expansion) cooling equipment
  - Lighting retrofits
  - Water heater tank and pipe insulation
  - Low flow shower heads
  - Water heater replacement
  - Replace Heating System

  Note: Blown fiberglass insulation is non-corrosive to metal skinned *Manufactured Home*s and can achieve good R-values and convection resistance at lower densities and weights that won't cause damage to the interior sheeting or underbelly of the home. Installations that include cellulose insulation may be completed only after warrantee information is provided by the installer ensuring no future damage to either the ceiling or underbelly of the home as a result of the use of cellulose insulation.

Audits determine what energy efficiency measures must be implemented. The Installation Standards determine how audit measures are to be implemented.

Verifying that Ineligible Materials/Measures, as listed below, are not recommended for implementation or installed:

- Shade screens, rigid awnings, louver systems or window films
- Vestibules

- Automatic gas ignition systems
- Microcomputer burner controls
- Desuperheater/water heaters
- Energy recovery equipment
- Whole-house fans
- Liquefied petroleum gas storage
- Electric freeze-prevention tape for pipes
- Stack dampers on gas or oil-fueled water heaters
- Gas conversion power burners for gas or oil-fueled *Heating Systems*
- Reduce input of burner or derate gas-fueled equipment
- Vent dampers for gas or oil-fueled *Heating Systems*
- Reduce excess combustion air by reducing vent connector size of gas- fueled appliances
- Industrial-grade white paint used as a heat-reflective measure on awnings, window louvers, doors and exposed, exterior ductwork

Verifying that, pursuant to DOE Guidance:

- ALL *multi-family* projects that include 5-24 units per building having a centralized heating/cooling system, or projects that have 25+ units per building have been submitted for DOE evaluation and approval by the DOE Project Officer prior to any weatherization work being done.
- Projects with 2-4 units per building are treated as *single-family* units, not requiring DOE Project Officer approval.
- *Multi-family* projects with 5-24 units per building that are individually heated/cooled (also known as *distributed* heating/cooling) are evaluated using the Grantee's *single-family* audit tool (if it has been approved by DOE for such use) and also do not require approval from the DOE Project Officer.
- The Nebraska Energy Office has reviewed the submission from the Sub-grantee and made a compliance determination regarding DOE Guidance as well as whether the proposed measure cost test are reasonable (ex. no manipulation of the costs have occurred to make certain measures allowable). Following NEO approval, the project package was submitted (by NEO) to the DOE Project Officer requesting DOE approval to proceed with the project.

All *multi-family* projects must be submitted to the Nebraska Energy Office as per the U.S. Department of Energy's *Multi-Family* Review Protocol revised on November 1, 2011. Common areas in *Multi-family Buildings* may be weatherized like the closest living unit.

Verifying and documenting all *Incidental Repair* Costs necessary for the installation or preservation of a weatherization measure. Keeping in mind that:

- The cost of the incidental repairs, specific to weatherization measures, should be included in the cumulative cost indicated by the Energy Audit and *SIR* calculation for the home.
- Repairs that can be classified as incidental to specific weatherization measures (i.e. attic, walls and floor insulation) should be charged to those measures if the inclusion does not make the implementation of the measure ineligible by reducing the individual *SIR* below 1.0.
- *Incidental repair cos*ts on a home must not exceed $500.

Verifying that the home complies with ASHRAE Standard 62.2 and DOE Guidance requirements

- Complete pre- and post-weatherization ASHRAE 62.2 evaluations to ensure that the home meets the *Standard for Acceptable Indoor Air Quality* and include both evaluations in the client file.
- Install Continuous Ventilation as required.

1.03 Deferrals

The decision to defer work in a dwelling is difficult but necessary in some cases. Sub-grantees are expected to pursue reasonable options on behalf of clients and to use good judgment in dealing with difficult situations. Deferral conditions may be found in the Health and Safety Section 2 of this Installation Standard. Should any dwelling be determined to be a deferral:

- The client will be advised of the problem, and, if possible, refer them to other service organizations that may be able to assist in solving the problem.
- Inform the client in writing as to why the dwelling cannot be weatherized and if there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing.
- Indicate clearly in the client file why the dwelling was given "deferral" status on the NeWAP Weatherization Deferral Notice.
- Provide and utilize a system for a timely and fair administrative hearing of complaints received from clients denied services. An unreasonable delay in acting on an application for assistance will constitute grounds for a hearing.
- Provide the applicant, at the time of application, written information that outlines the applicant's rights and the method for filing a complaint. All Sub-grantees are required to adhere to their agency's grievance polices. If the grievance cannot be resolved through the Sub-grantee's process, the applicant will file a complaint with the Energy Office.

A "walk-away/deferral" is not a completion. Reimbursement for "walk-away/ deferral" must be obtained through the normal monthly billing process. Indicate on the BCJO (Building Check Job Order) that the dwelling is a "walk- away/deferral" and the client was advised in writing of the conditions determining this status.

Defer all units undergoing remodeling or which have untreated remodeled areas that directly affect the weatherization process.

- Keep the client's application as part of the sub-grantee's records until recertification is necessary. Weatherization of the unit may proceed if remodeling is completed to the standards of a completed dwelling unit and the client continues to qualify for the program at the time of completion.

1.04 Client Education

The NeWAP provides sub-grantees with an opportunity to educate clients and provide them with some simple, easy and inexpensive energy saving tips to help them save additional energy while improving comfort.

1.0401 Heating and Cooling Saving Suggestions:

- During the heating season, keep the draperies and shades on your south-facing windows open during the day and close them at night to reduce the chill from cold windows.

- During the cooling season, keep the window coverings closed during the day to prevent overheating.
- Check/change/clean furnace filters monthly or as needed.
- Don't obstruct registers with furniture and if they operable use them accordingly.
- Clean dirty grilles.
- Use circulating fans indoors to improve comfort.
- Close interior doors to limit heating and cooling areas of the home that are not used continually.
- Securely close prime and storm windows regularly during the heating and cooling seasons.
- Complete annual furnace and air conditioner inspections and maintenance.
- Turn off kitchen, bath, and other exhaust fans within 20 minutes after you are done cooking or bathing.

1.0402 Hot Water and Laundry Saving Suggestions:

- Wash clothes in cold water whenever possible.
- Wash and dry full loads of clothes.
- Clean the dryer lint filter after each load and keep the outside vent clear and clean.
- Repair leaky faucets promptly.
- Sink aerators

1.0403 Other Energy Saving Opportunities:

- Turn off lights, appliances, electronics, TVs, and computers when not in use.
- Cook in a microwave oven to save energy compared to cooking with a conventional range or oven.
- Unplug small electrical charging transformers when not needed.

1.0404 Health and Safety Educational Material

The NeWAP requires that all clients be provided with educational material specifically associated with Health and Safety issues with documentation of receipt included in the client file.

2 Health and Safety

Health and safety measures ***must*** be performed in conjunction with cost-effective weatherization. Allowable health and safety activities are those that eliminate hazards that are affected or caused by the installation of weatherization materials.

Major hazards and potentially life-threatening conditions ***must*** be corrected before weatherization installers can work in the dwelling unless the installers are making the corrections.

When a weatherization agency finds serious safety problems in a customer's home, they ***must*** inform the customer in writing about the hazards.

When Not to Weatherize a Dwelling
There are some conditions and situations under which a sub-grantee ***must*** not or ***may choose*** not to weatherize an otherwise eligible dwelling unit. Information for making this determination may become evident during either the eligibility process or during the initial inspection. If the sub-grantee makes a determination that there are circumstances that prevent the weatherization process from proceeding,

they ***must***:

- Advise the client of the problem, and, if possible, refer the client to other service organizations that may be able to assist in solving the problem.
- Inform the client in writing as to why the dwelling cannot be weatherized. A copy of the letter must be in the client file.
- Provide documentation of the conditions that the client must correct before weatherization services are provided.
- Clearly indicate in the client file why the dwelling was given "deferral" status.
- Have available a system for a timely and fair administrative hearing of complaints received from clients denied services. An unreasonable delay in acting on an application for assistance will constitute grounds for a hearing.
- Provide the client with a completed copy of the Nebraska WAP Weatherization Deferral Notice (Form Wx4).

At the time of application, the applicant is given a written notice outlining the applicant's rights and the method to file a complaint. All Sub-grantees are required to adhere to their agency's grievance polices. If the grievance cannot be resolved through the Sub-grantee's process, the applicant will file a complaint with the Nebraska Energy Office.

A sub-grantee ***must*** not weatherize if:

- The unit was weatherized with DOE funds after September 30, 1994. For current DOE guidelines and further explanation see DOE regulations in CFR440.
- The dwelling is vacant. (Exception: multi-family units using DOE funds and the 50% or 66% rule).
- Demolition of the dwelling is scheduled in the next 12 months.
- The dwelling is for sale.
- The dwelling has serious structural problems that make weatherization impossible or impractical.
- The *Heating System* has not passed a safety and operational audit and inspection.
- The building structure is in such state of disrepair that failure is imminent and the conditions cannot be resolved cost-effectively.
- The house has sewage or other sanitary problems that would further endanger the client and weatherization installers if weatherization work were performed.
- The house has been condemned by local or state building or enforcement officials.
- Moisture and/or mold problems are so severe they cannot be resolved with minor repairs.
- The occupant or client is abusive or threatening to the crew, subcontractors, auditors, inspectors or others who must work on or visit the house.

A sub-grantee **may choose** not to weatherize a dwelling unit if:

- The building mechanical systems, including electrical and plumbing, are in such state of disrepair that failure is imminent and the conditions cannot be resolved cost-effectively.
- The extent and condition of lead-based paint in or on the house would potentially create further health and safety hazards.
- In the judgment of the energy auditor, any condition exists which may endanger the health and/or safety of the occupant, work crew or subcontractor, the work should not proceed until the condition is corrected.
- There are unusual situations which in the judgment of the auditor/sub-grantee must be corrected

before providing weatherization services.

Client Health and Safety

There are a number of important health and safety issues related to weatherization work that can impact weatherization employees as well as clients. When any of these issues are detected, the client ***must*** be informed of the issue and, if possible, addressing these problems should be a top priority.

- All NeWAP sub-grantees ***must*** complete appropriate safety testing on all combustion appliances. Documentation of the testing results **must** be included in all client files.
- All moisture problems ***must*** be documented and discussed with the client. Sub-grantees must ensure that no weatherization work will contribute to making moisture problems worse. Mold and Moisture information must be documented on the Mold Assessment and Release Form (Form Wx5) and included in the client file.

HEALTH AND SAFETY ASSESSMENT

Energy Auditors and crews/subcontractors are required to take all reasonable precautions against performing work on homes that will subject workers or clients to health and safety risks. The initial home inspection ***must*** include a health and safety assessment of the dwelling. The assessment ***must*** include interviewing the client regarding known health concerns, inspecting the dwelling for present or potential moisture concerns, indoor air quality concerns and other environmental concerns or hazards that may or may not be covered by the NeWAP. In addition, clients will receive the following publications or documents when applicable:

- Health & Safety Assessment Consent (Form Wx6)
- Health and Safety Home Screening Questionnaire (Form Wx7)
- Renovate Right (occupants of all buildings built pre-1978)
- Lead Hazard Pre-Renovation Form (Form Wx3)
- Nebraska Radon Information Fact Sheet
- A Brief Guide to Mold, Moisture and your Home
- Nebraska Mold Assessment and Release Form (Form Wx5)
- Consumer Product Safety Asbestos Fact Sheet
- Nebraska WAP Even More Dollar and Energy Savings Brochure
- Weatherization Deferral Notice (Form Wx4)
- Consent to Perform Work (Form Wx6)
- Client Education Confirmation of Receipt (Form Wx2)

Sub-grantee personnel will interview and assist clients in completing a Health and Safety Home Screening Questionnaire (Form Wx7) as part of the application process. The survey will be included in the client file for future reference. The Energy Auditor will then review the Questionnaire with the client at the time of the initial assessment. The information collected during this process will be used in determining the best course of action for weatherization of the home. When a client's health is fragile and/or the weatherization activities would constitute a health or safety hazard, the occupants at risk will be required to leave the home during the activities and requested to return at least 1 hour (or a reasonable time as determined by the installers) after installers are scheduled to leave to allow for clean-up and appropriate ventilation of the home. If it is determined through the Health and Safety Home Screening Questionnaire that someone in the home is sensitive to a product that is intended to be used during the weatherization process, the sensitivity ***must*** be documented in the file and, if possible, an alternative product may be used. If no successful alternative is found, the weatherization of the home may proceed without completion the measure with no impact on weatherization measures with lower *SIR*s, ***with prior Nebraska Energy Office approval***. Weatherization funds ***cannot*** be used to

relocate clients or reimburse them for such costs incurred as a result of the requirement to leave during the day. If the client is unable to leave the home and the intended work may exacerbate an occupant's health condition, the home may need to be deferred.

Sub-grantees ***must*** take all reasonable precautions against performing work on homes that would subject clients to health and safety risks.

2.01 Safe Work Practices

Worker Health and Safety
Grantee weatherization staff is vitally important and staff ***must not*** be required to work in unsafe and/or excessively unsanitary conditions. Costs related to grantee health and safety training ***must*** be charged to Training & Technical Assistance.

- Sub-grantee crews and contractors must comply with Occupational Safety and Health Administration (OSHA) standards and Material Safety Data Sheets (MSDS) and take precautions to ensure the health and safety of themselves and other workers, including the use of personal protection equipment.
- OSHA 10 hour training is required for all weatherization workers.
- OSHA 30 hour training is required for all crew leaders.
- Costs incurred by sub-grantees to comply with OSHA requirements may be charged to the Health and Safety budget category.
- OSHA standards including, but not limited to:
  - respirator protection,
  - techniques for safely lifting heavy objects,
  - electrical equipment safety,
  - ladder safety, and
  - general worker protection.
- Sub-grantees ***must*** consult OSHA standards for further details.
- MSDS documentation for all materials installed through the Nebraska Weatherization Program ***must*** be maintained on site during the weatherization of the home and on file by each program sub-grantee.

  2.0110.1 (a, b, c) Health & Safety – Safe Work Practices – Material Selection, Labeling, and Material Safety Data Sheets (MSDSs) (SF) (MH)

- Personal protective equipment ***must*** be worn when appropriate.

  2.0100.1 (b, c, f) Health & Safety – Safe Work Practices - Global Worker Safety (SF)

  2.0100.2 (b, c, d) Health & Safety – Safe Work Practices - Global Worker Safety (MH)

  2.0105.2 (d) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Protective Clothing (SF)

  2.0105.4 (d) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Protective Clothing (MH)

- The following Worker Health and Safety concerns ***must*** be addressed, implemented and enforced within the NeWAP:

- Global Worker Safety

  2.0100.1 (b, c, d, e, f, g, h, i, j, k, l, m, n, o, p) Health & Safety – Safe Work Practices – Global Worker Safety (SF)

  2.0100.2 (a, b, c, d, e, f, g, h, i, j, k, l, m) Health & Safety – Safe Work Practices – Global Worker Safety (MH)

  2.0103.1 (a) Health & Safety – Air Sealing – Air Sealing Worker Safety (SF) (MH)

  2.0106.1 (a) Health & Safety – Ventilation Equipment – Ventilation Worker Safety (SF) (MH)

- Tool Safety

  2.0100.1 (h, k, l) Health & Safety – Safe Work Practices - Global Worker Safety – Power Tool Safety (SF)

  2.0100.2 (f, i, j) Health & Safety – Safe Work Practices - Global Worker Safety (MH)

- Electrical Safety

  2.0100.1 (d) Health & Safety – Safe Work Practices - Global Worker Safety – Electrical Safety (SF)

- Ergonomic and Repetitive Stress Injuries

  2.0100.1 (j) Health & Safety – Global Worker Safety – Safe Work Practices – Ergonomic Safety (SF)

  2.0100.2 (h) Health & Safety – Global Worker Safety – Safe Work Practices – Ergonomic Safety (MH)

- First aid supplies ***must*** be available in the office and at the job site.

Potential Hazard Considerations
Weatherization services ***must*** be provided in a manner that minimizes other potential risks to workers and clients. Awareness of potential hazards is essential in providing quality weatherization services. A list of common weatherization work situations that may present hazardous situations are addressed below:

2.0100 Safe Work Practices

2.0100.1 Global Worker Safety

2.0100.1 (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p) Health & Safety – Safe Work Practices – Global Worker Safety (SF)

2.0100.2 (a, b, c, d, e, f, g, h, i, j, k, l, m) Health & Safety – Safe Work Practices – Global Worker Safety (MH)

2.0103 Air Sealing

2.0103.1 (a) Health & Safety – Air Sealing – Air Sealing Worker Safety (SF) (MH)

2.0104 Insulation

2.0104.1 (a, c) Health & Safety – Safe Work Practices— Insulation— Insulation Worker Safety

(SF) (MH)

2.0105 Heating and Cooling Equipment

2.0105.1 (a, b, c) Health and Safety – Safe Work Practices– Heating & Cooling Equipment – Combustion Worker Safety (SF)

2.0105.2 (a, b, c, d) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Protective Clothing (SF)

2.0105.4 (d) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Protective Clothing (MH)

2.0201.1 (a, b, c, d, e, f, g) Health and Safety – Combustion Safety – Combustion Safety Testing-General -*Combustion Appliance Zone* (*CAZ*) Testing (SF)

2.0201.3 (a, b, c, d, e, f, g, h) Health and Safety – Combustion Safety – Combustion Safety Testing-General -*Combustion Appliance Zone* (*CAZ*) Testing (MH)

2.0203.1 (a, b) Health and Safety – Combustion Safety – Vented Gas Appliances - Combustion Air for Natural Draft Appliances (SF)

2.0203.4 (a, b, c, d, e) Health and Safety – Combustion Safety – Vented Gas Appliances - Combustion Air for Natural Draft Appliances (MH)

2.0203.5 (a, b, c, d, e, f) Health and Safety – Combustion Safety – Vented Gas Appliances - Combustion Flue Gas—*Orphaned* Water Heaters (MH)

2.0203.6 (a, b, c, d, e) Health and Safety – Combustion Safety – Vented Gas Appliances - Draft Regulation—Category I Appliance (MH)

2.0204.1 (a, b, c, d) Health and Safety – Combustion Safety – Isolation Isolating Combustion Water Heater Closet (MH)

2.0299.1 (a, b, c, d, e, f, g, h, i) Health and Safety – Combustion Safety – Combustion Appliance Depressurization Limits Table (MH)

2.0107 Baseload

2.0107.1 (a) Health & Safety – Safe Work Practices - Baseload – Baseload Worker Safety (SF)

2.0602.1 (a, b) Health and Safety – Electrical – Electrical Hazard - Static Electric Shock (MH)

2.0602.2 (a, b, c, d) Health and Safety – Electrical – Electrical Hazard - House Current Electric Hazard (MH)

2.0110 Material Safety

2.0100.1 (o) Health & Safety – Global Worker Safety – Safe Work Practices – Asbestos-Containing Materials (SF)

2.0104.1 (b) Health & Safety – Safe Work Practices – Insulation Worker Safety (SF) (MH)

2.0105.2 (c) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Asbestos (SF)

2.0105.4 (c) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Asbestos (MH)

2.0110.1 (a, b, c) Health & Safety – Safe Work Practices – Material Selection, Labeling, and Material Safety Data Sheets (MSDSs) (SF) (MH)

2.0111 Basements and Crawl Spaces

2.0111.1 (a) Health and Safety – Safe Work Practices – *Basements* and *Crawl Spaces* - Basements and Crawl Spaces Worker Safety (SF)

2.0111.2 (a, b, c, d, e, f, g) Health and Safety – Safe Work Practices – *Basements* and *Crawl Spaces* - *Crawl Spaces*—Pre-Work Qualifications (SF)

2.0111.3 (a, b) Health and Safety – Safe Work Practices – *Basement*s and *Crawl Spaces* - *Crawl Spaces*—Debris Removal (SF)

2.0111.4 (c) Health and Safety – Safe Work Practices – *Basement*s and *Crawl Spaces* - Negative Pressure Contamination Control (SF)

2.0111.5 (a, b) Health and Safety – Safe Work Practices – *Basement*s and *Crawl Spaces* - Prework Qualifications (Home Installation) (MH)

2.02 Combustion Safety Testing

NeWAP Sub-Grantees *Certified Weatherization Staff* or *Qualified Heating Technician must* complete inspections, testing and assessments on all combustion appliances within a home to ensure all equipment is operating safely.

2.0201 Combustion Safety Testing and Verification - General

Leak Test Gas Appliances and Piping
Conduct a fuel leakage test of the appliance piping and control system downstream of the meter to each appliance. Natural gas and propane piping systems may leak at their joints and valves. An electronic combustible gas detector (gas sniffer) will find all significant gas leaks if used carefully. Remember that natural gas rises from a leak and propane falls, so position the sensor accordingly.

- Sniff all valves and joints with the gas sniffer.

2.0105.1 (a, b, c) Health and Safety – Safe Work Practices– Heating & Cooling Equipment – Combustion Worker Safety (SF)

- Accurately locate leaks using a non-corrosive bubbling liquid, designed for finding gas leaks.
- If gas leak is detected at the initial inspection, have occupant notify the fuel supplier or a *Qualified Heating Technician*. All gas leaks should be repaired prior to implementation of weatherization services.

2.0105.1 (a, b, c) Health and Safety – Safe Work Practices– Heating & Cooling Equipment – Combustion Worker Safety (SF)

Verify the BTU Input on Natural Gas Appliances by Clocking (timing) the Gas Meter
To verify whether the gas being consumed matches the input of the appliance or to measure the input of a specific appliance:

- Turn off all gas combustion appliances such as water heaters, dryers, cook stoves, and space heaters that are connected to the meter you are timing, except for the appliance you wish to test.
- Fire the unit being tested, and watch the dials of the gas meter.
- Monitor the dials on the gas meter, timing how long it takes to burn a cubic foot of gas.
- Use the length of time it took to burn a cubic foot of gas (in seconds) in the following formula to calculate BTUs/hour: (3,600 x 1,000)/number of seconds
- In this formula 3,600 represents the number of seconds in an hour, and 1,000 is the number of Btu in one cubic foot of natural gas.
- Compare the BTUs/hour value you calculate at the meter with the input BTUs/hour labeled on the appliance.
- If the measured input is higher or lower than input on the name plate by more than 10%, the gas pressure can be adjusted by a *Qualified Heating Technician.*
- If the measured input is still out of range, the tech should recommend the system be inspected by the gas supplier.

Complete initial Inspection of the *Heating System*

- Visually inspect the venting system for proper size and horizontal pitch and determine that there is not blockage, vent size reduction or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.
- Inspect burners and crossovers for blockage and corrosion.
- Determine that the pilot is burning properly, that main burner ignition is satisfactory and main burner is burning properly.
- Test the pilot safety device to determine that it is operating properly.
- If the appliance is equipped with a high and low flame control or flame modulator, check for proper main burner operation at low flame.
- Test for spillage at the draft hood relief opening.
- On furnaces and console heaters, check the fan control for proper operation.

  5.3003.9 (a, b, c, d, e, f, g, h, i, j, k, m, n) Heating & Cooling – Forced Air – System Assessment & Maintenance – Heating and Cooling Controls (SF)

- On boilers, inspect for evidence of water or combustion product leaks.
- On boilers, determine that the water pumps and automatic controls are in operating condition.
- If accessible, inspect the central air conditioner coils.
- Check the fan and belt condition.
- Inspect for exposed wiring.

  5.3003.4 (a, b, c, d, e, f, g, h) Heating & Cooling – Forced Air – System Assessment & Maintenance – Evaluating Electrical Service (SF)

- Inspect the furnace heat exchanger.

- Look for rust at exhaust ports and vent connector.
- Look for flame impingement on the heat exchanger during firing.
- Observe flame movement, change in chimney draft, or change in CO reading as blower is turned on and off.
- Look for flame-damaged areas near the burner flame.
- Measure the flue-gas oxygen concentration before the blower starts and just after it has started. There should be no more than a 1% change in the oxygen concentration.
- Examine the heat exchanger, shining a bright light on one side and looking for light traces on the other using a mirror to peer into tight locations.

- Test and confirm the furnace efficiency operating standards.
  - Check heat rise after 5 minutes of operation. Refer to manufacturer's nameplate for acceptable heat rise (supply temperature minus return temperature).
  - The fan-off temperature should be between 90° and 95° F, or as per manufacturer's recommendations, with the lower end of the scale being preferable for maximum efficiency.
  - The fan-on temperature should be less than 120° F, or as per manufacturer's recommendations.
  - The high-limit controller should shut the burner off before the furnace temperature reaches 250°F.

Verify, Assess and Document Adequate Combustion Air Supply for All Combustion Zones
Combustion appliances required oxygen or combustion air to operate and some appliances draw combustion air from inside the home or *building envelope*. Completing an assessment on each combustion appliance in a home ensures that a combustion air problem does not interfere with combustion, create Carbon Monoxide or contribute to spillage or back-drafting.

Combustion appliance zones are classified as either un-confined spaces or confined spaces.

- Un-confined spaces are open or connected to enough building volume to provide adequate combustion air.
- Confined spaces are *combustion appliance zones* with a closed door and sheeted walls and ceiling that create an air barrier between the appliance and other indoor spaces. A confined space is defined as a room containing less than 50 cubic feet of volume for every 1000 Btu per hour of appliance input.

2.0203.1 (a, b) Health and Safety – Combustion Safety – Vented Gas Appliances - Combustion Air for Natural Draft Appliances (SF)

NeWAP sub-grantees must verify and document in each client file that each *Combustion Appliance Zone* in a weatherized home has adequate combustion air supply.

When additional combustion air is required the following options shall:

- Provide combustion air from adjacent indoor spaces by installing a combustion air vent or grille or *Under-cutting* interior doors.
  - The following is an example of sizing grilles to supply combustion air to a confined space from an adjacent indoor area:
    1. *The furnace has an input rating of 100,000 Btu/hour.*
    2. *The water heater has an input rating of 40,000 Btu/hour.*

3. *Therefore, there should be 280 in^2 of net free area of vent between the mechanical room and other rooms in the home. ([100,000 + 40,000] ÷ 1,000 = 140 x 2 in^2 = 280 in^2).*

- provide outdoor combustion air into the *combustion appliance zone* (*CAZ*), or
- analyze the cost effectiveness of installing direct-vent appliances that utilize outdoor combustion air.

The costs associated with installing the make-up fresh air must be charged to Health and Safety.

***Combustion Appliance Zone* (*CAZ*) Testing**

NeWAP Sub-Grantees *must* complete *CAZ* testing on all areas within a home that contain one or more *atmospherically vented combustion appliances*. *CAZ* testing *must* be completed on all weatherized homes, at the time of the initial and *Quality Control Inspections*, with all testing results documented in the client file using *CAZ* Depressurization Test Form (Wx9).

CAZ testing must include, but not be limited to:

- Carbon monoxide Testing
- Measuring Draft and House Pressures in Worst Case

2.0201.1 (a, b, c, d, e, f, g) Health and Safety – Combustion Safety – Combustion Safety Testing-General -*Combustion Appliance Zone* (*CAZ*) Testing (SF)

2.0201.3 (a, b, c, d, e, f, g, h) Health and Safety – Combustion Safety – Combustion Safety Testing-General -*Combustion Appliance Zone* (*CAZ*) Testing (MH)

Investigate Improving Inadequate Draft

If measured draft is below minimum draft pressures, investigate the reason for the weak draft. Open a window or door to observe whether the addition of combustion air will improve draft.

- If this added air strengthens draft, the problem usually is depressurization or lack of combustion air. Options to consider:
  - Return duct leaks.
  - Improper balancing between the supply and return.
  - Large whole house exhaust fans.
  - Attic fans.
  - Lack of appropriate make-up air.
- If opening a window has no effect, inspect the chimney. The chimney could be blocked, excessively leaky or a chimney liner is needed. Options to consider:
  - Improper sizing of the vent connector and/or chimney.
  - A vent connector or chimney liner that is either too large or too small.
  - Wind causing erratic draft.
  - The masonry chimney is deteriorated.

Combustion Monoxide Testing

Ambient CO levels should be monitored in the combustion zone during draft testing. If ambient CO levels in the combustion zone exceed 35 parts per million (ppm), draft tests should cease for the technician's safety. The combustion zone should be ventilated before draft-testing and diagnosis of CO problems resumes.

2.0201.2 (a, b, c, d, e, f, g) Health and Safety – Combustion Safety – Combustion Safety Testing-General - Combustion Safety (MH)

Gas Range and Oven Safety Testing

- Over-firing, dirt buildup, and foil installed around burners and oven burners obstructed by dirt or foil are likely to produce CO and *must* be tested before and after weatherization by *Certified Weatherization Staff* or *Qualified Heating Technician*. Replacement, repair and cleaning of gas rang and ovens are not eligible expenditures thru the NeWAP.
- Inspect cooking burners for operability and flame quality.
- Test each stove-top burner separately, using a digital combustion analyzer or CO meter and holding the probe about 8 inches above the flame for 2 minutes.
- Turn on the oven to bake at high temperature. Sample the CO level in exhaust gases at the oven vent and in the ambient air after 10 minutes.
- Actions include cleaning the oven, removing aluminum foil, or adjusting the burner's adjustable gas control.
- If the CO reading is over 100 ppm or if the ambient-air reading rises to 35 ppm or more during the test, abort the test and advise the client of hazardous condition. *Deficiencies must be corrected before proceeding with weatherization work can proceed*.
- Provide client with combustion safety and hazards information, including the importance of using exhaust ventilation when cooking and the importance of keeping burners clean to limit the production of CO.
- Advise the client of the following important operating practices;
- Never install aluminum foil around a range burner or oven burner.
- Never use a range burner or gas oven as a space heater.
- Open a window or turn on the kitchen exhaust fan when using the range or oven.
- Keep range burners and ovens clean to prevent dirt from interfering with combustion.
- Burners should display hard blue flames. Yellow or white flames, wavering flames, or noisy flames should be investigated by *a Qualified Heating Technician*.
    - Observe the installed CO detector, and discontinue use of the range and oven if the CO level rises above 35 ppm in ambient air.

2.0201.2 (a, b, c, d, e, f, g) Health and Safety – Combustion Safety – Combustion Safety Testing-General - Combustion Safety (MH)

2.0203 Vented Gas Appliances

Inspect, testing, assess and appropriate document information on vented gas appliances within a home to ensure all equipment is operating safely and clients are educated on the proper use of the equipment. To be inspected by Certified *Weatherization Staff*.

2.0203.4 (a, b, c, d, e) Health and Safety – Combustion Safety – Vented Gas Appliances - Combustion Air for Natural Draft Appliances (MH)

2.0203.5 (a, b, c, d, e, f) Health and Safety – Combustion Safety – Vented Gas Appliances - Combustion Flue Gas—Orphaned Water Heaters (MH)

2.0203.6 (a, b, c, d, e) Health and Safety – Combustion Safety – Vented Gas Appliances - Draft

Regulation—Category I Appliance (MH)

Isolation of Water heater Closets form *Conditioned Spaces* in *Manufactured* Housing

- Prevent combustion gases from entering *Living area* and minimize interior pressures caused by equipment and conditions in the water heater closet.

2.0204.1 (a, b, c, d) Health and Safety – Combustion Safety – Isolation Isolating Combustion Water Heater Closet (MH)

2.0299 Additional Resources

2.0299.1 (a, b, c, d, e, f, g, h, i) Health and Safety – Combustion Safety – Combustion Appliance Depressurization Limits Table (MH)

2.03 Safety Devices

2.0301 Combustion Safety Devices

- Provide the client with verbal and written information on the use of CO detectors.

2.0301.1 (a, b) Health & Safety – Safety Devices – Combustion Safety Devices – Smoke Alarm (SF) (MH)

2.0301.2 (a, b) Health & Safety – Safety Devices – Combustion Safety Devices – Carbon Monoxide Alarm or Monitor (SF) (MH)

2.04 Moisture

2.0401 Air Sealing

2.0403 Vapor barriers

The NeWAP requires a full ground laid moisture barrier be installed whenever possible in accessible crawlspaces except when one exists or the space has a concrete floor.

Ground Moisture Barrier Installation Standards

- The moisture barrier must be a Class I *Vapor retarder*, a minimum of 6 mils thick, extended up the walls and the support columns at least 12 inches and the joints must overlap a minimum of 12 inches.
- In the event the entire floor cannot be covered, all accessible areas must receive a moisture barrier.
- When installing insulated skirting without adequate clearance to install a full ground laid moisture barrier, the moisture barrier must extend a minimum of 24 inches beyond the insulation.

2.0401.1 (a, b, c, d) Health & Safety – Moisture - Air Sealing – Air Sealing Moisture Precautions (SF) (MH)

2.0403.1 (a, b, c, d, e) Health & Safety – Moisture— *Vapor barriers* — Vented *Crawl Spaces* – Ground Moisture Barriers (SF)

2.0403.2 (a, b, c, d, e, f, g, h, i) Health & Safety – Moisture— *Vapor barriers* — Closed *Crawl Spaces* – Ground Moisture Barriers (SF)

2.0403.4 (a, b, c, d) Health & Safety – Moisture – *Vapor barriers* – Pier and Skirting Foundations – Ground Moisture Barriers (MH)

2.06 Electrical

2.0601 Knob and Tube Wiring

- The Nebraska State Electrical Board does not permit directly covering knob and tube wiring with insulation. Sub-grantees ***must*** comply with the following fire and electrical safety procedures before insulating.
- Attic areas with knob-and-tube wiring that are indicated as cost-effective for implementation must be insulated after the wiring has been appropriately covered to prevent direct contact with the insulation and to provide adequate air space (a minimum of 3 ½" clearance) for "cooling" of the wire.
- Appropriate shielding materials for concealing the knob-and-tube wiring *must* include gypsum board (5/8" or thicker), plywood or oriented strand board.

4.1001.2 (a, b, c) Insulation – Attics — General Preparation — Knob and Tube Wiring (SF)

- Attics where Knob-and-Tube Wiring has been previously covered with insulation that is cost-effective to install additional insulation, must be insulated when it has been determined where the wiring is located and that it is actually still "active".
- Once the determination of the wire locations is documented in the client file, the wiring must be appropriately shielded to prevent direct contact with the additional insulation and to provide adequate air movement space for cooling of the wire, then insulated.
- In attic areas where knob-and-tube wiring penetrates the plane of the attic and extends up into a side or knee wall, a fire resistant baffling must be installed around the wire to provide sufficient space for air movement around the wire to provide adequate air space to accommodate the cooling of the wire, then insulated.
- Existing fuses must remain intact if no insulation is being completed in the home.

2.0602 Electric Hazards

2.0602.1 (a, b) Health and Safety – Electrical – Electrical Hazard - Static Electric Shock (MH)

2.0602.2 (a, b, c, d) Health and Safety – Electrical – Electrical Hazard - House Current Electric Hazard (MH)

2.07 Occupant Education and Access

2.0701 Basements and Crawl Spaces

2.0701.2 (a, b, c) Health and Safety – Occupant Education and Access – *Basement* and *Crawl Spaces - Crawl Space* Information Sign (SF)

2.0701.3 (a, b, c) Health and Safety – Occupant Education and Access – *Basement* and *Crawl*

Spaces - Crawl Space—Occupant Education (SF)

2.0702 Installed Equipment

2.0701.3 (a, b, c) Health and Safety – Occupant Education and Access – Installed Equipment — Warranty and Service Agreement (SF)

2.08 DOE Health and Safety Program Guidance Requirements

2.0801 Air Conditioning and *Heating Systems*

Action/Allowability

- "Red tagged", inoperable or non-existent ***Heating System*** replacement, repair, or installation ***is*** an allowable Health & Safety Cost. Repair of **air conditioning** systems ***is*** an allowable Health & Safety Cost. Replacement or installation of **air conditioning** system ***is not*** an allowable Health & Safety Cost.

Testing

- Make sure systems are present, operable, and performing. Determine presence of at-risk occupants.

Client Education

- Discuss and provide information on appropriate use and maintenance of units.

Training

- Awareness of guidance.

2.0802 Appliances and Water Heaters

Action/Allowability

- Replacement, repair and cleaning of **water heaters** are allowed ***on a case by case basis*** as a Health & Safety Cost. Repair, installation and cleaning of **other appliances** are ***not*** allowable Health & Safety costs.

Testing

- Determine whether appliances/water heaters are performing safely. Combustion safety testing is required when combustion appliances are present.

Client Education

- Discuss and provide information on appropriate use, maintenance, and proper disposal of appliances/water heaters.

Training

- Awareness of guidance, conduct diagnostic training.

2.0107.1 (a) Health & Safety – Safe Work Practices - Baseload – Baseload Worker Safety (SF)

ASBESTOS

WAP staff members often encounter asbestos siding or in pipe or furnace coverings, in vermiculite mined from areas known to contain asbestos, or even in some textured paints and interior finishes.

2.0100.1 (o) Health & Safety – Global Worker Safety – Safe Work Practices – Asbestos-Containing Materials (SF)

2.0104.1 (b) Health & Safety – Safe Work Practices – Insulation Worker Safety (SF) (MH)

2.0105.2 (c) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Asbestos (SF)

2.0105.4 (c) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Asbestos (MH)

2.0803 Asbestos in Siding, Walls, Ceilings, Etc.

When asbestos siding is present it may be removed and replaced, but it must not be cut, sanded, or drilled.

General Information:

- The costs associated with asbestos testing, remediation or removal ***are not*** eligible expenditures in the Nebraska Weatherization Assistance Program. If the presence of asbestos has been previously confirmed or if the Sub-grantee believes that the siding may contain asbestos:
- Removal of siding is allowed to perform energy conservation measures; however precautions must be taken not to damage the siding. Asbestos siding should never be cut, sanded or drilled. Where possible, insulate the exterior walls through home interior.
- Inspect exterior wall surface and subsurface for possible asbestos siding prior to drilling or cutting.
- Blower door testing ***must not*** be completed on homes where asbestos that has been disturbed is determined to be present by an appropriately trained crew leader, auditor or inspector or where testing has been completed verifying the presence of asbestos.
- Documentation regarding the presence of disturbed asbestos material by an appropriately trained crew leader, auditor or inspector or testing ***must*** be maintained in the client file.

Training Requirements:

- Crew leaders, auditor and inspectors ***must*** be trained on how to recognize asbestos through an AHERA or other appropriately trained or certified asbestos control professional training.
- Cost incurred by sub-grantees to comply with asbestos training requirements ***may*** be charged to the Health and Safety budget category.

Client Education:

- Inform the client that suspected asbestos siding maybe present and how precautions will be taken.

2.0804 Asbestos in Vermiculite

General Information:

- When vermiculite insulation is discovered precautions must be taken. The costs associated with asbestos testing, remediation or removal ***are not*** eligible expenditures in the Nebraska Weatherization Assistance Program.
- If the presence of asbestos has been previously confirmed or if the Sub-grantee believes that vermiculite insulation is present:
- The Sub-grantee ***must*** take precautionary measures as if it contains asbestos, such as not using blower door tests and utilizing personal air monitoring while in attics.
- When blower door tests are performed, it ***must*** be performed using pressurization instead of depressurization.
- Removal of vermiculite insulation ***is not*** allowed.
- Blower door testing ***must*** be completed on homes where vermiculite asbestos is determined to be present by using the door to establish a **positive** pressure for testing.
- Documentation regarding the presence of asbestos material by an appropriately trained crew leader, auditor or inspector or testing ***must*** be maintained in the client file.

Training Requirements:

- Crew leaders, auditor and inspectors ***must*** be trained on how to recognize asbestos through an AHERA or other appropriately trained or certified asbestos control professional training for encapsulation.
- Cost incurred by sub-grantees to comply with asbestos training requirements may be charged to the Health and Safety budget category. Clients should be instructed not to disturb suspected asbestos containing material.

Client Education:

- Provide asbestos safety information to the client.

2.0805 Asbestos on Pipes, Furnaces, other Small Covered Surfaces

General Information

- The costs associated with asbestos testing, encapsulation, remediation or removal ***are not*** eligible expenditures in the Nebraska Weatherization Assistance Program. If the presence of asbestos has been previously confirmed or if the Sub-grantee believes that the pipe insulation may contain asbestos:
- Sub-grantees ***must*** assume asbestos is present and not disturb the covering materials.
- Blower door testing ***must not*** be completed on homes where asbestos that has been disturbed is determined to be present by an appropriately trained crew leader, auditor or inspector or where testing has been completed verifying the presence of asbestos.
- Documentation regarding the presence of disturbed asbestos material by an appropriately trained crew leader, auditor or inspector or testing ***must*** be maintained in the client file.

Training Requirements:

- Crew leaders, auditor and inspectors ***must*** be trained on how to recognize asbestos through an AHERA or other appropriately trained or certified asbestos control professional training for encapsulation.
- Cost incurred by sub-grantees to comply with asbestos training requirements may be charged to

the Health and Safety budget category. Clients should be instructed not to disturb suspected asbestos containing material.

Client Education:

- Provide asbestos safety information to the client.

2.0806 Biological and Unsanitary Conditions

General Information:

- Addressing bacteria, viruses biological and/or unsanitary conditions ***is not*** an allowable activity. Removal is not a Weatherization responsibility.

Deferral Requirements:

- May be necessary in cases where a known agent is present in the home that may create a serious risk to occupants or weatherization workers.

Client Education:

- Inform client of observed conditions.
- Provide information on how to maintain a sanitary home, steps to correct deferral conditions and the impact on the safety of Weatherization workers who come into contact with these conditions.

2.0807 Building Structure and Roofing

Program workers frequently encounter homes in poor structural condition; however building rehabilitation is beyond the scope of the Weatherization Assistance Program. Weatherization services ***may*** be delayed until the dwelling can be made safe for crews and occupants. Incidental repairs necessary for the effective performance or preservation of weatherization materials are allowed.

Deferral Requirements:

- Building structure rehabilitation and roofing is beyond the scope of the Weatherization Assistance Program.

Client Education:

- Notify client of structurally compromised areas.

2.0808 Code Compliance

The Nebraska Weatherization Program does not fund the costs of bringing homes "up to" the latest building code requirements. However, any eligible energy efficiency work that is completed as part of the weatherization work must meet all state and local building code requirements.

General Information:

- The costs associated with building rehabilitation work that is not specifically associated with the implementation of a cost-effective, approved Weatherization Measure is beyond the scope of the Weatherization Assistance Program.
- It is each sub-grantee's responsibility to ensure that weatherization-related work conforms with the applicable codes in jurisdictions where the work is being performed. Examples of eligible costs associated with cost-effective Weatherization Measures include, but are not limited to: window replacements that provide appropriate *Egress* and glass safety requirements, door replacements that provide appropriate minimum clear width for exiting, the installation of fans to provide appropriate ventilation in the home, appropriate disconnect switching and clearance

requirements on furnace installations, etc. Costs associated with the purchase of any required permits are eligible. The cost of the permits ***must not*** be passed onto the client.

Client Education:

- Inform client of observed code non-compliance issues.

2.0809 Carbon Monoxide

Carbon Monoxide (CO) is released by combustion appliances, automobiles, and cigarettes as a product of incomplete combustion. CO is normally tested in the flue of vented appliances. CO is usually caused by one of the following:

- Overfiring
- Backdrafting of combustion gases smothering the flame
- Flame interference with an object
- Inadequate combustion air
- Moving air flame interference
- Misalignment of the burner

General Information:

- A carbon monoxide (CO) test ***must*** be performed on all naturally drafting or induced draft combustion appliances, including cooking stoves, at the time of the initial and *Quality Control Inspections*. The CO levels ***must*** be tested in the undiluted flue gases. CO tests ***must not*** be performed on solid fuel burning appliances.
- If CO levels exceed 100-ppm as measured in the undiluted flue gases or 35-ppm in the ambient air at the time of the initial inspection, weatherization ***must not*** proceed until the CO levels have been reduced.
- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home.
- Unsafe water heaters that cannot be repaired **must** be replaced. Replacement is allowed **on a case by case basis with Nebraska Energy Office approval** if:
- the unit's CO levels exceed 100-ppm as measured in the flue gases or 35-ppm in the ambient air at the time of the initial inspection and the CO levels cannot be reduced,
- the unit has scorch marks that indicate past backdrafting occurrences, or the integrity of the water tank has been compromised as shown by signs of leakage.

Deferral Requirements:

- The *building envelope* ***must not*** be weatherized if the owner or client refuses a *Safety Inspection* of the *Heating System* or until any *Heating System* deficiency has been repaired and/or the *Heating Plant* replaced.
- Mobile homes that have non-*manufactured home* combustion water heaters.
- Mobile homes that have non-*manufactured home* solid fuel combustion *heating systems*.

Client Education:

- Provide client with combustion safety and hazards information, including the importance of using exhaust ventilation when cooking and the importance of keeping burners clean to limit the production of CO.
- Provide client with verbal and written information on the use of the CO detector.

2.0810 Combustion Appliance Testing

General Information:

- Prior to weatherizing the *building envelope*, all *Eligible Heating Plants* over two (2) years of age that have not received a *Safety Inspection* during the twelve (12) months prior to the initial inspection ***must*** be inspected by a *Qualified Heating Technician*, utility company or *certified weatherization staff*.
- A backdraft test ***must*** be performed at the time of Initial Inspection, the Quality Control and at the end of each work day if the project will require more than one day, on all vented naturally drafting combustion appliances.
- A backdraft test ***must not*** be performed on solid fuel burning appliances.
- Combustion safety testing is required when combustion appliances are present.
- Inspect venting of combustion appliances and confirm adequate clearances.
- Test naturally drafting appliances for draft and spillage under worst case conditions before and after air tightening.

  2.0203.3 (a, b, c, d, e) Draft Regulation—Category I Appliance (SF)

  2.0299.1 (a, b, c, d, e, f, g, h, i) Combustion Appliance Depressurization Limits Table (SF)

- Inspect cooking burners for operability and flame quality.
- The State of Nebraska's annual heating degree day normal, over the thirty year period from 1971-2000 is 6525, with January Mean °F temperatures that range from 23.2 in the warmest areas of the state to 22.8 in the coldest areas. Clients in units that contain *Heating Plants* that are inoperable or red-tagged are in danger of frost bite, hypothermia and other life threatening issues. Therefore units that contain *Heating Plants* that are inoperable or red-tagged at the time of the initial inspection ***must not*** be weatherized until the *Heating Plant* has been repaired or replaced.
- *Eligible Heating Plants* that cannot be repaired ***must*** be replaced.
- The replacement *Heating Plant* ***must*** be properly vented. If the new *Heating Plant* will not be vented through the masonry chimney, but the water heater will still be vented through that chimney, a properly sized flue liner ***must*** be installed. As an alternative, a power vent may be installed on the water heater.

  2.0203.2 (a, b, c, d, e, f, g) Combustion Flue Gas—*Orphaned* Water Heaters (SF)

- If a dwelling is heated by *Unvented Combustion Space Heaters* and an inoperable conventional *Heating System* is present, the conventional *Heating System* ***must*** be repaired or replaced to eliminate the need for unvented space heaters. If the need for *Unvented Combustion Space Heaters* cannot be eliminated, the sub-grantee ***must*** instruct the client regarding the dangers of carbon monoxide and excessive moisture levels, particularly if any *unvented space heaters* are left in the dwelling as a secondary *Heat Source*, or emergency back-up.

  2.0202.1 (a, b) Health and Safety – Combustion Safety – Unvented Space Heaters - Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters (SF) (MH)

- If a dwelling utilizes Unvented Combustion Space Heaters as the primary Heat Source, the Unvented Combustion Space Heaters **must** be replaced with a vented combustion Heating System.

2.0202.1 (a, b) Health and Safety – Combustion Safety – Unvented Space Heaters - Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters (SF) (MH)

- Existing unvented gas clothes dryers ***must*** be vented to the exterior. Gas dryer vent pipe ***must not*** be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.
- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection when a combustion appliance(s) is present.
- Propane gas detectors ***must*** be installed in homes and mobile homes on permanent foundations that have propane combustion appliances. The gas detectors ***must*** be permanently installed according to the manufacturer's instructions and 110 volts.

2.0203.1 (a, b) Combustion Air for Natural Draft Appliances (SF)

Deferral Requirements:

- The *building envelope* ***must not*** be weatherized if the owner or client refuses a *Safety Inspection* of the *Heating System* or until any *Heating System* deficiency has been repaired and/or the *Heating Plant* replaced.
- Mobile homes that have non-*manufactured home* combustion water heaters.
- Mobile homes that have non-*manufactured home* or incorrectly installed solid fuel combustion *Heating System*s.

Client Education:

- Provide client with combustion safety and hazards information, including the importance of using exhaust ventilation when cooking and the importance of keeping burners clean to limit the production of CO.
- Provide client with verbal and written information on the use of the CO detector.

2.0105.1 (b) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Carbon Monoxide (SF)

2.0105.4 (f) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Carbon Monoxide (MH)

2.0811 Drainage - Gutters, Down Spouts, Extensions, Flashing, Sump Pumps, Landscape, Etc.

Alleviating drainage issues is beyond the scope of the Nebraska WAP, however the following issues should be considered during the initial inspection and implementation of the work if drainage issues are encountered and presented to the client or home owner:

- A missing or malfunctioning sump pump: they are often the most effective solution when ground water continually seeps into a *Basement* or *Crawl Space* and collects there as standing water. Serious groundwater problems may require excavating and installing drain pipe and gravel to disperse accumulations of groundwater between a home and nearby hillside.
- Rainwater flowing from roofs often plays a major role in dampening foundations. Installing rain gutters with downspouts that drain roof water away from the foundation can alleviate the moisture.

- Excessive watering around the home's perimeter. Watering lawns and plants close to the house can dampen its foundation. Keeping shrubbery away from the foundation allows the wind circulation near the foundation.
- Preventing moisture problems is the best way to guarantee a building's durability and its occupant's respiratory health.

Deferral Requirements:

- Major drainage issues are beyond the scope of the Weatherization Assistance Program.
- Homes with conditions that may create a serious health concern should be deferred.

Client Education:

- Inform client of any observed conditions regarding minor drainage issues.
- Provide guidance on the importance of cleaning and maintaining gutters and drainage systems and the impact on mold and moisture issues in the home when the drainage systems are not maintained.

Electrical Issues

The two primary energy-related health and safety electrical concerns associated with weatherization work are insulating homes that contain knob-and-tube wiring and identifying overloaded electrical. Electrical safety is a basic need that impacts home weatherization and repair.

2.0812 Knob & Tube Wiring

General Information:

The State Electrical Board does not permit directly covering of knob-and-tube wiring with insulation.

- Knob-and-tube wiring in sidewalls must not be covered by new insulation. If knob-and-tube wiring in walls is covered by existing insulation, additional insulation *must not* be installed.
- Knob-and-tube wiring in attics *must not* be directly covered with insulation. Attic insulation may be installed where the knob-and-tube wiring has been concealed in a hollow space that provides adequate ventilation space (a minimum of 3 ½" clearance) to alleviate overheating issues.
- If knob-and-tube wiring is covered by existing insulation, additional insulation *must not* be installed until or unless the wiring has been located and concealed in a hollow space that provide ventilation space to alleviate overheating issues.
- Appropriate shielding materials for concealing the knob-and-tube wiring *must* include 5/8" or thicker gypsum board, plywood or oriented strand board.

2.0601.1 (a, b, c, d) Health & Safety – Electrical – Knob & Tube Wiring (SF)

2.0813 Electrical Systems

- Serious electrical hazards exist when gross overloads such as over usage, overloaded outlets and/or oversized fuses are present. Should auditors and crews find such existing problems, they should notify the owner and note the problem in the client file. Weatherization measures that involve the installation of new equipment such as air conditioners, heat pumps or electric water heaters can exacerbate previously marginal overload problems to hazardous levels. Rewiring of a home is outside the scope of the weatherization program.
- Wiring splices ***must*** be enclosed in metal or plastic electrical boxes, fitted with cover plates. Electrical boxes in attics ***must*** be marked with a flag that is visible above the insulation.

- *Type-S-Fuses* must be sized according to the smallest gauge of wire in the circuit to be protected. The following gauge wire requires the following size fuse:

Wire Gauge	Fuse Size
12 gauge wire	20 amp fuse
14 gauge wire	15 amp fuse

- If no insulation is being installed in a home the existing fuses ***must*** remain intact. In homes that utilize fuses where attic insulation is being installed the State Electrical Board recommends the use of a licensed electrician for the installation of safety *Type-S-Fuses* as indicated in the National Electrical Code.

Client Education:

- Provide information to the client on overloading circuits, electrical safety/risks.

Deferral Requirements:

- Homes with conditions that require more than incidental repair should be deferred.
- Voltage drop and voltage detection testing are not allowed.

2.0107.1 (a) Health & Safety – Safe Work Practices - Baseload – Baseload Worker Safety (SF)

2.0602.1 (a, b) Health & Safety – Electrical – Electric Hazards – Static Electric Shock (MH)

2.0602.2 (a, b, c, d) Health & Safety – Electrical – Electric Hazards – House Current Electric Hazard (MH)

2.0814 Fire Hazards

A visual inspection for determining fire hazards ***must*** be completed during the audit and while performing weatherization, and appropriately documented in the client file.

General Information:

- Insulation ***must not*** cover the pressure relief valve, the drip leg, draft hood, burner air inlet, pilot light access door, thermostat control, drain valve or the top of the water heater on natural gas or propane water heaters. Insulation ***must not*** cover the pressure relief valve, the drip leg, high limit switch, or drain valve on electric water heaters. Insulation must cover the top of electric water heaters.
- When adding additional insulation to the attic, shielding ***must*** be installed around heat and high-*Heat Sources*. Shielding ***must*** be metal and kept a minimum of 3" from any *Heat Source* and a minimum of 6" from a high-*Heat Source*. Shielding ***must*** be installed at a height to accommodate the depth of the added insulation. If a masonry chimney has an existing metal or metal asbestos flue liner, the chimney does not need to be shielded.
- Weatherization materials ***must not*** be installed over or adjacent to outlets, switches or junction boxes that contain aluminum wiring. Open wire splices ***must not*** be covered with insulation until they have been enclosed with proper junction boxes.
- If potentially dangerous creosote buildup in chimneys or wood stoves or other deficiencies is identified, up to $500 may be spent to repair the unsafe solid fuel combustion *Heating System*. Weatherization of the *building envelope* ***must not*** proceed until the system has been made safe.
- Pipe wrap ***must not*** be installed if the water heater lacks a pressure relief valve.

- Pipe wrap ***must not*** begin within 2 inches or farther than 4 inches of a flue and/or draft hood.

Client Education:

- Inform client of observed hazards.

2.0815 Formaldehyde, Volatile Organic Compounds (VOCs), and other Air Pollutants

Deferral Requirements:

- If pollutants pose a risk to workers the unit must be deferred.

Client Education:

- Inform client of observed condition and associated risks. Provide client written materials on safety and proper disposal of household pollutants.

2.0816 Injury Prevention of Occupants and Weatherization Workers

Weatherization staff ***must not*** work in unsafe and/or excessively unsanitary conditions. Occupational Safety and Health Administration (OSHA) standards, Construction Trade Safety Standards, as well as company safety standards must be observed by everyone in the NeWAP.

General Information:

- Workers must take all reasonable precautions against performing work on homes that will subject workers or occupants to health and safety risks.

Client Education:

- Inform client of the observed condition and associated risks.

2.0817 Lead Based Paint

Lead-Safe Weatherization (LSW) is a group of safe practices used by weatherization technicians when they suspect or confirm the presence of lead paint. LSW practices are rigorous dust-prevention and housekeeping precautions. LSW is required when workers disturb painted surfaces by cutting, scraping, drilling, or other dust creating activities.

On April 10, 2010, the Environmental Protection Agency (EPA) "Lead; Renovation, Repair and Painting Program" (LRRPP) Final Rule became effective in the Weatherization Program. The Rule requires Certified Renovators to be onboard with sub-grantee crews or contractors, and performing all the EPA required functions on all pre-1978 housing. The U.S. Department of Energy requires sub-grantees to follow specified EPA requirements. By adopting basic safety precautions and Lead Safe Weatherization, workers and the occupants of the homes they weatherize will be protected from lead exposure. The U.S. Department of Energy requires sub-grantees to follow specified EPA and Occupational Safety and Health Administration (OSHA) standards for worker safety.

General Information:

- Sub-grantees ***must*** follow both the EPA's Lead; Renovation, Repair and Painting Program (LRRPP) ***and*** the U.S. Department of Energy's Minimum Standards for Lead Safe Weatherization.
- Appropriate swab testing is allowed.
- Sub-grantees that complete work in homes where there is existing paint is "flaking" are responsible for the appropriate handling and cleaning the existing paint as well as any newly disturbed pain as part of jobsite cleaning. The costs associated with completing this work ***must***

be included in the costs associated with the completion of the weatherization measure and the measure *SIR*. Sub-grantees may choose not to weatherize a dwelling unit if the extent and condition of lead-based paint would potentially create further health and safety hazards.

- Job site set up and cleaning verification is required to be completed by an EPA Certified Renovator.

Training Requirements:

- Weatherization requires all weatherization crews working in pre-1978 housing to be trained in Lead Safe Weatherization (LSW).
- Sub-grantees and all weatherization contractors are required to be trained on the requirements of, and follow, the EPA Lead; Renovation, Repair and Painting Program requirements.

Deferral Requirements:

- When the extent and condition of lead-based paint in the house would potentially create further health and safety hazards, the Sub-grantee will inform the client of the of the issues associated with a deferral in the Weatherization Deferral Notice completed by the Weatherization Representative and signed by the client or building owner.

Client Education:

- Inform client of observed conditions and associated risks.
- All LRRPP Client Protection and Notification processes must be followed.

2.0818 Mold and Moisture

Water moves easily as a liquid or vapor from the ground through porous building materials like concrete and wood. A high groundwater table can channel moisture into a home. The most common ground-moisture source is water vapor rising through the soil or liquid water moving up through the soil by capillary action. To prevent this, all *Crawl Spaces* should have ground moisture barriers.

Installing or improving air barriers and *Vapor barriers* to prevent air leakage and vapor diffusion from transporting moisture into building cavities.

Adding insulation to the walls, floor, and ceiling of a home will keep the indoor surfaces warmer and less prone to condensation. During cold weather, well-insulated homes can tolerate higher humidity without condensation than can poorly insulated homes.

General Information:

Sub-grantees ***must*** ensure that weatherization work is performed in a manner that does not cause or contribute to mold problems, and when the work is performed properly, may alleviate mold conditions.

- All clothes dryers and exhaust fans ***must*** be vented to the exterior.
- A full ground laid moisture barrier ***must*** be installed in accessible *Crawl Spaces* and under mobile and modular homes.
- Mold testing is not an allowable cost.

Client Education:

- Sub-grantees **must** include some form of notification or disclaimer to the client upon the discovery of a mold condition. The notification should include what was or will be done to the house that is expected to alleviate the condition and/or that the work performed should not promote new mold growth. The notification must be signed by the client and the owner (if the

client is a renter) and placed in the client file.

Deferral Requirements:

- Where severe Mold and Moisture issues exist that pose a risk to workers, deferral is required. If serious mold conditions are discovered during the initial inspection of the home, the home should be referred to the appropriate public or non-profit agency for remedial action. Weatherization should not be undertaken until the problems have been alleviated. However, weatherization funds may be used to correct energy-related conditions to allow for effective weatherization work and/or to assure the immediate or future health of workers and clients.

  2.0401.1 (a, b, c, d) Health & Safety – Moisture – Air Sealing – Air Sealing Moisture Precautions (SF)

  2.0403.1 (a, b, c, d, e) Health & Safety – Moisture – *Vapor barriers* – Vented *Crawl Spaces*-Ground Moisture Barrier (SF)

  2.0403.2 (a, b, c, d, e, f, g, h, i) Health & Safety – Moisture – *Vapor barriers* – Closed *Crawl Spaces*-Ground Moisture Barrier (SF)

  2.0403.4 (a, b, c, d) Health & Safety – Moisture – *Vapor barriers* – Pier and Skirting Foundations-Ground Moisture Barrier (MH)

  2.0701.1 (a, b) Health & Safety – Occupant Education and Access – *Basements* and *Crawl Spaces* – *Crawl Spaces*-Providing Access (SF)

2.0819 Occupant Pre-Existing or Potential Health Conditions

All products used in Weatherization Services must be approved by the U.S. Department of Energy. Some products used may have an odor (Volatile Organic Compound or VOC) that some people may find objectionable or to which some people may experience sensitivity. If any family member or a sub-grantee believes that someone in the home may be hypersensitive to, or may otherwise object to the use in the home of any of the common weatherization building material, the issue must be documented and resolved prior to the start on the work.

General Information:

- When a person's health may be at risk and/or the work activities could constitute a health or safety hazard, the occupant at risk will be required to take appropriate action based on severity of risk.
- Require occupant to reveal known or suspected health concerns as part of initial application for weatherization.
- Screen occupants during audit using the Health & Safety Client Home Screening Questionnaire.

Client Education:

- Provide client information of any known risks.
- Provide worker contact information so client can inform of any issues.

Deferral Requirements:

- Failure or the inability to take appropriate actions must result in deferral.

2.0820 Pests

General Information:

- Screening of windows and points of access is allowed to prevent intrusion

Client Education:

- Inform client of observed condition and associated risks.

Deferral Requirements:

- Infestation of pests may be cause for deferral where it poses health and safety concern for workers.

2.0821 Radon

Radon is a natural radioactive gas found in areas of Nebraska. Radon can't be seen, smelled or tasted and has been linked to certain types of cancers.

General Information:

- In homes where radon may be present, precautions should be taken to reduce the likeliness of making radon issues worse.

Client Education:

- Sub-grantees ***must*** also provide clients with a Nebraska Radon Information Fact Sheet.

2.0822 Refrigerants

Workers facing possible exposer to refrigerants must follow guidelines regarding awareness and wear personal protective equipment such as respiratory protection and chemical protective clothing.

General Information:

- Replaced air conditioners and heat pumps must be properly disposed of and the refrigerant reclaimed in compliance with the Clean Air Act 1990, section 608, as amended by 40 CFR 82, 5/14/93. The vendor, DE manufacturing center or other entity recovering the refrigerant must possess EPA-approved Section 608 type I, II or III universal certification.

2.0823 Smoke, Carbon Monoxide Detectors, and Fire Extinguishers

Some people burn wood, wood pellets, corn or other solid fuels for heat during the winter.

General Information:

- Installation of CO detectors ***is an allowable*** Health & Safety Cost when detectors are not present or are inoperable.
- Replacement of operable CO Detectors is ***not*** an allowable cost.
- The costs associated with the installation of smoke detectors are ***not*** allowable Health & Safety Costs.
- The costs associated with providing fire extinguishers are ***not*** allowable Health & Safety Costs.
- Check for operation of existing CO detectors.

Client Education

- Provide the client with verbal and written information on the use of CO detectors.

Training

- Where to install detectors. Local code compliance.

  2.0301.1 (a, b) Health & Safety – Safety Devices – Combustion Safety Devices – Smoke Alarm (SF) (MH)

  2.0301.2 (a, b) Health & Safety – Safety Devices – Combustion Safety Devices – Carbon Monoxide Alarm or Monitor (SF) (MH)

2.0824 Solid Fuel Heating

General Information:

- Maintenance, repair and replacement of primary indoor heating units is allowed where occupant health and safety is concerned, with prior Energy Office approval.
- Maintenance and repair of secondary heating units is allowed.

Client Education:

- Provide client with safety information.

  2.0105.1 (a, b, c) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Combustion Worker Safety (SF)

  2.0105.3 (a) Health & Safety – Safe Work Practices – Heating and Cooling Equipment – Combustion Worker Safety (MH)

Space Heaters

Space heaters are self-contained devices generally used for heating a specific area. These types of heating devices are often associated with fires and carbon monoxide poisoning risks.

2.0825 Electric Space Heaters

General Information:

- Repair, replacement or installation is not allowed.
- Removal is recommended.
- Check circuitry to ensure adequate power supply for existing space heaters.

Client Education:

- Inform client of hazards and collect a signed waiver if removal is not allowed.

2.0826 Unvented Combustion Space Heaters

General Information:

- Removal is required, except as secondary heat where unit conforms to ANSI Z21.11.2.
- Units that do not meet ANSI Z21.11.2 must be removed prior to weatherization but may remain until a replacement *Heating System* is in place.
- Testing for air-free carbon monoxide (CO) is allowed.
- Check units for ANSI Z21.11.2 label.

Client Education:

- Inform client of the dangers of unvented space heaters – CO, moisture, NO2, CO can be dangerous even if CO alarm does not sound.

2.0202.1 (a, b) Health & Safety – Combustion Safety – Unvented Space Heaters – Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters (SF) (MH)

2.0827 Vented Combustion Space Heaters

General Information:

- Should be treated as furnaces.
- Venting should be tested consistent with furnaces.

2.0828 Spray Polyurethane Foams (SPF)

Polyurethane foam is applied with a gun that combines materials at its tip. When combined, these materials make an effective insulator. There are benefits to using spray polyurethane foam, but there are also disadvantages; health risks and environmental impacts when the product is not properly handled, stored, or installed.

General Information:

- Use EPA recommendations when working within the *Conditioned Space* or when SPF fumes become evident within the *Conditioned Space*.
- When working outside the *building envelope*, isolate the area where foam will be applied, take precautions so that fumes will not transfer to inside *Conditioned Space* and exhaust fumes outside the home.
- Check for penetrations in the *building envelope.*

Client Education:

- Provide notification to the client of plans to use two-part foam and the precautions that may be necessary.

2.0829 Ventilation

Ventilation is an important health and safety concern in homes where the blower door reading is low.

2.0106.1 (a) Health & Safety – Safe Work Practices – Ventilation Equipment - Ventilation Worker Safety (SF) (MH)

General Information:

- Exhaust fans must be vented to the outdoors, and never into building attics or crawlspaces. They should have tight-fitting *backdraft dampers*. Low scone (.5) fans should be installed to encourage the client to run them longer, and particularly in those cases where a continuous exhaust fan is installed.
- 2013 (or most current) ASHRAE 62.2 is required when performing weatherization activities.
- Implementing ASHRAE 62.2 is not required where acceptable indoor air quality already exists as defined by ASHRAE 62.2.
- Inadequate fans and blower systems should be updated.

Client Education:

- Provide client with information on function, use, and maintenance of ventilation system and components.
- Include disclaimer that ASHRAE 62.2 does not account for high polluting sources or guarantee indoor air quality.

2.0830 Window and Door Replacement, Window Guards

General Information:

- Replacement, repair, or installation is not an allowable Health and Safety cost but may be allowed as an incidental repair or in conjunction with an energy efficiency measure if cost justified.

Testing:

- Not applicable.

Client Education:

- Provide information on lead risks.

Training:

- Awareness of guidance.

3 Air Sealing

Air *Infiltration* can account for 30 percent or more of a home's heating and cooling costs and can contribute to additional problems with moisture, noise, dust, indoor air quality, and pests. Appropriate air sealing can reduce *Infiltration* significantly to reduce heating and cooling costs, improve building durability and longevity, and create a healthier indoor environment.

3.01 Identify the Air and Thermal Boundaries of the *Building Envelope*

To complete appropriate air sealing you ***must*** identifying the location of both the air and the thermal boundaries of the home. Generally, ceilings, walls, and floor/foundation separate the inside *Conditioned Space* from the outside or *Unconditioned Space* forming both the air barrier and the thermal barrier for the house, but that is not always the case. For example, the thermal boundary of a home's crawlspace may be insulation located in the floor cavities while the foundation walls actually provide the air barrier. A visual inspection is used to verify the thermal barrier while blower door testing of the *pressure plane*s within the home is one of the most accurate ways of identifying the air boundaries of a home.

3.02 Blower Door Testing

Blower door testing is used to determine the overall air tightness of a home. Appropriate testing can help you to locate leaks, determine approximately how big the leaks are, and whether the leaks are located in areas that may significantly impact the indoor air quality of the home and the health of its residents. Pre- and post-weatherization blower door testing ***must*** be completed on all homes weatherized through the NeWAP. Documentation of the test results ***must*** be appropriately included in all client files.

2.0103.1 (a) Health and Safety – Safe Work Practices– Air Sealing – Air Sealing Worker Safety

(SF) (MH)

Air Sealing is most effective when completed in conjunction with the blower door. Utilizing blower door guided air sealing allows you to locate and seal the largest sources of leakage and helps you to determine the effectiveness of your sealing work by providing an instantaneous reduction in the home's *CFM*^{50} reading. The *CFM*^{50} reduction should be checked at the end of each air sealing measure or step completed to determine cost effectiveness. As the air sealing work progresses the amount of CFM reduction experienced diminishes, you are able to determine the point where continued air sealing is no longer cost-effective.

Cost Effective Blower Door Guided Air sealing is air sealing guided by calculating effectiveness after each or round of *Infiltration* repair work completed. Dividing the labor and material costs incurred by the *CFM*^{50} reduction gives dollar/*CFM*^{50} savings ratio. As long as the dollar/*CFM*^{50} savings ratio is less than $40.00 per 100 CFM, continue looking for air sealing opportunities. If the dollar/*CFM*^{50} ratio is greater than $40.00 per 100 CFM, stop air sealing.

See the example below.

Example:

First Blower Door Reading:	5500 cfm-50
Air Sealing Work Done:	Close opening above and around interior pocket door and hole in the wall behind the kitchen range
Materials Used:	1/2 sheet of dry wall, ¼ roll R-11 batt, 2 tubes caulking, drywall tape, mud and screws.
Labor Cost:	2.5 hours at $25.00 = $62.50
Material Cost:	$63.00
Total:	$125.50
Second Blower Door Reading:	4100 cfm-50 a reduction of 1400 cfm
Savings Ratio:	$125.50 ÷ 1400 x 100 =$8.96 per 100cfm
The ratio is less than $40 per 100cfm. Keep looking for air sealing opportunities	

Second Blower Door Reading:	4100 cfm-50
Air Sealing Work Done:	seal around furnace flue and fire place chimney (at attic insulation line)
Materials Used:	10 SF tin, 6 tubes of high temp caulk, screws, and 1 small "L" bracket to secure tin to masonry chimney
Labor Cost:	3 hours at $25.00 = $75.00
Material Cost:	$140.00
Total:	$215.00
Third Blower Door Reading:	3450 cfm-50 a reduction of 650 cfm
Saving Ratio:	$215.00 ÷ 650 cfm x 100 = $33.07 per 100 cfm
The ratio is less than $40.00 per 100cfm. Keep looking for air sealing opportunities	

Third Blower Door Reading	3450 cfm-50
Air Sealing Work Done:	caulk interior window and door trim, install window rope pulley covers, caulk attic access trim
Labor Cost:	2-1/2 hours at $25.00 = $62.50
Material Cost:	11 tubes of caulking @$4.50, 20 pulley covers @$3.50, and 25 feet backer rod @ $1.00 total materials cost $123.50

Total:	$186.00
Fourth Blower Door Reading:	2700 cfm-50 a reductions of 750 cfm
Saving Ratio:	$186.00 ÷ 750 cfm x 100 = $24.80 per 100 cfm
The ratio is less than $40.00 per 100 cfm. Keep looking for air sealing opportunities.	

Fourth Blower Door Reading:	2700 cfm-50
Air Sealing Work Done:	Seal rim joist and seal unused coal chute.
Labor Cost:	2 hours at $25.00 = $50.00
Material Cost:	13 tubes of caulking @$4.50, 20 feet of backer rod @$1.00 = total materials $78.50
Total Measure Cost:	$128.00
Fifth Blower Door Reading:	2400 cfm a reduction of 300 cfm
Savings Ratio:	$128 ÷ 300 cfm x 100 = $42.65 per 100 cfm
The ratio is more than $40 per 100 cfm. Stop air sealing.	

- Air sealing blower door readings should be appropriately recorded in the client file.
- A maximum of $40 in material and labor per 100 *CFM^{50}* reduction in air leakage is reimbursable through the NeWAP, including the final blower door guided sealing step as indicated above. However, the total ratio for all blower door guided saving steps must not exceed $40 per 100 *$CFM^{50}$*.
- NeWAP only provides the $/CFM reduction reimbursement of the costs directly associated with blower door air sealing not with other energy savings measures (i.e. window replacements, attic insulations). Payment for blower door air sealing requires documentation verifying the *Infiltration* reduction costs being reimbursed are directly associated with blower door guided air sealing.

3.03 Primary Air Sealing Guidelines/Requirements

- Seal the largest openings first progressively working to the smaller openings. *Stack Effect* makes it most effective to start air sealing at the top of the structure and work your way down to the lower areas of the home. The following areas/building areas provide special sealing challenges and should always checked in your air sealing process:
  - Plumbing walls and wiring penetrations

    3.1001.4 (a, b, c, d, e, f) Air Sealing – Attics – Penetrations and Chases – General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting) (MH)

    3.1301.1 (a, b, c, d, e) Air Sealing – Floors – Penetrations – Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board (MH)

    3.1301.2 (a, b, c, d, e, f) Air Sealing – Floors – Penetrations – Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring (MH)

  - Chase ways around chimneys

    3.1001.1 (a, b, c, d) - High temperature application (SF)

  - Cantilevered floors
  - Kitchen or bathroom soffits

3.1001.2 (a, b, c, d, e, f) - Non-standard chase (interior walls covered with wood or paneling) (SF)

- Joints between the porch and the house
- Balloon framed exterior wall bypasses

3.1001.3 (a, b, c, d, e) Air Sealing – Attics – Penetrations and Chases - Walls Open to Attic - Balloon Framing and Double Walls (SF)

- Rim joists
- Tops and bottoms of interior walls
- Pocket Door

3.1201.4 (a, b) Backing and infill (SF)

- Dropped ceilings

3.1003.1 (a, b, c, d, e) Air Sealing – Attics – Dropped Ceilings and Soffits – New Ceiling Below Original - Old Ceiling Intact or Repairable (SF)

3.1003.2 (a, b, c, d, e) Air Sealing – Attics – Dropped Ceilings and Soffits – Ceiling Leaks Not Repairable - No Air Barrier Above (SF)

3.1003.4 (a, b, c, d, e) Air Sealing – Attics – Dropped Ceilings and Soffits – Dropped Ceilings (SF)

3.1003.5 (a, b, c) Air Sealing – Attics – Dropped Ceilings and Soffits – Dropped Ceilings with Light Boxes and Fixtures (SF)

3.1003.6 (a, b, c, d, e) Air Sealing – Attics – Dropped Ceilings and Soffits – Dropped Soffits (SF)

- Joist cavities under *Knee walls* in *Finished Attics*
- Electrical service entry point as well as wiring/conduit penetrations

3.1001.4 (a, b, c, d, e, f) Air Sealing – Attics – Penetrations and Chases – General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting) (MH)

3.1301.1 (a, b, c, d, e) Air Sealing – Floors – Penetrations – Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board (MH)

3.1301.2 (a, b, c, d, e, f) Air Sealing – Floors – Penetrations – Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring (MH)

- Outlet and switchplate insulators may be installed on exterior and interior walls.
- Insulators ***must not*** be installed if the outlet or switch has aluminum wiring.
- Bathtub and shower surrounds

3.1003.3 (a, b, c, d, e) Air Sealing – Attics – Dropped Ceilings - Above closets and tubs (SF)

- Recessed light fixtures

3.1001.4 (a, b, c, d, e, f) Air Sealing – Attics – Penetrations and Chases – General

Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting) – (MH)

- Duct boots and registers

  3.1402.1 (a, b, c) Air Sealing – *Basements* and *Crawl Spaces*- *Basements* Connected to *Crawl Spaces* – Sealing and Insulating - High Temperature Application (SF)

  3.1601.1 (h, i) Air Sealing – Ducts – Duct Preparation – Boot to Wood & Boot to Gypsum (SF)

  3.1601.5 (g, h) Air Sealing – Ducts – Duct Preparation – Preparation and Mechanical Fastening - Boot to Wood & Boot to Gypsum (MH)

- Additional challenging sealing points that you should always check in your air sealing process:

  3.1001.2 (a, b, c, d) Air Sealing – Attics – Penetrations and Chases - Chase Capping - Non-standard chase (interior walls covered with wood or paneling) & Support (SF)

  3.1004.1 (a, b, c) Air Sealing – Attics – Cathedralized Attic Ceilings – Catedralized Attic Air Sealing (Insulation Installed at Roof Deck) (SF)

  3.1005.1 (a, b, c) Air Sealing – Attics – Other Ceiling Materials - Tongue and Grove Ceilings (SF)

  3.1402.3 (a, b) Air Sealing – *Basements* and *Crawl Spaces* - Closed *Crawl Spaces*—Air Sealing Exterior Wall (SF)

  3.1501.1 (a, b, c, d, e, f, g) Air Sealing – Attached Garages – Penetrations, Cracks, and Doors Between Garage and House (SF)

  3.1101.1 (a, b, c) Air Sealing – Walls – *Manufactured* Housing Walls - Exterior Holes and Penetrations (MH)

  3.1101.2 (a, b, c) Air Sealing – Walls – *Manufactured* Housing Walls - Interior Holes and Penetrations (MH)

  3.1101.3 (a, b, c, d) Air Sealing – Walls – *Manufactured* Housing Walls – Holes, Penetrations, and Marriage Lines (MH)

3.04 Secondary Air Sealing Guidelines / Requirements

- Should be completed following the implementation of the Audit recommended Energy Efficiency Measures. As with Primary Air Sealing, seal the largest leaks and work your way down to the smaller leaks. And due to *Stack Effect*, it is also most beneficial to start sealing at the highest level of the home and work your way down. Common secondary air sealing Measures include but are not limited to:
  - Adjusting and/or installing door weather-stripping, thresholds and sweeps.

    3.1201.3 (a, b, c, d, e) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – Exterior Doors (SF)

  - Tightening and/or installing window weather-stripping.

3.1201.1 (a, b, c, d, e, f, g) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Double-Hung Wood Windows (SF)

3.1201.2 (a, b, c, d, e) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Single-Unit Window and Fixed Frame with Wood Sash (SF)

3.1201.5 (a, b, c, d, e, f, g, h) Air Sealing – Windows and Doors - Maintenance, Repair and Sealing (MH)

3.1202.1 (a, b, c, d) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing- Fixed Frame with Wood Sash—Older House (SF)

3.1202.2 (a, b, c, d) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Single-Unit Window, Mounted on Rough Opening - Newer House (SF)

3.1202.3 (a, b, c, d, e) Air Sealing – Windows and Doors – Repairing/Replacing Cracked and Broken Glass (MH)

- Installing switchplate and outlet insulators

3.05 Minor Air Sealing Requirements

- Cracks in exterior window and door frames can be sealed to keep water out.If the crack is deeper than 5/16-inch, it must be backed with an appropriately sized backer rod and then sealed with caulk. Any existing loose or brittle material **must** be removed before the crack is re-caulked.
- Joints in sill plate (mud sill) and around utility openings in foundation ***must*** be sealed.
- Holes and cracks in masonry surfaces may be sealed with a cement-patching compound or mortar mix if blower door testing indicates substantial leakage.
- Interior joints may be caulked if blower door testing indicates substantial leakage. These joints include where baseboard, crown molding and/or casing meet the wall/ceiling/floor surfaces. Gaps around surface-mounted or recessed light fixtures and ventilation fans should also be caulked if appropriate.

3.1402.1 (a, b, c) Air Sealing – *Basement*s and *Crawl Spaces - Crawl Spaces* - Sealing Floor Penetrations (SF)

Sub-grantees ***must*** complete all cost-effective air sealing opportunities and all project files ***must*** provide clear and adequate documentation of the installer's efforts to appropriately air seal the home.

Air Sealing Material Standards installed through the NeWAP ***must*** form a permanent and airtight seal, ***must*** match the existing surfaces as closely as possible, and meet the following requirements

- Caulking:
  - ***must*** be paintable and ***must*** be clear or a color complementary to the surface to which it is applied.
  - installed around heat-producing sources ***must*** be specifically manufactured for installation around *Heat Sources*.
- Openings wider than ¼ inch and deeper than 5/16-inch must be packed with material specifically designed as a packing material prior to caulking.
- Packing material ***must*** be compatible with the type of caulking used.

- Expanding and non-expanding foam sealant may be used as an air sealing material.
- If mortar or mortar patch is used, it ***must*** be a color complementary to the surface to which it is applied and be textured to match the surrounding surface as close as possible.
- *Spray-Applied Insulation* may be used as an air sealing material.

Manufactured home Air Sealing Requirements:

- Exterior water heater compartments ***must*** be sealed and isolated from the interior of the home.
- All openings from the water heater compartment into the *Conditioned Space* ***must*** be sealed with metal or 5/8" fire code gypsum board.
- Water heater compartment doors that are beyond repair ***must*** be replaced. Appropriate photo and written documentation regarding the condition of the door ***must*** be included in the client file.

3.06 Air Sealing Exceptions

Some dwellings may not reach the air sealing standards because of structural conditions or other factors. Exceptions are allowed when:

- All reasonable attempts have been made to reach the standard, or
- Further air sealing is not cost-effective

Sub-grantees **must** complete all cost-effective air sealing opportunities and all project files **must** provide clear and adequate documentation of the installer's efforts to appropriately air seal the home.

3.12 Windows and Doors

Window and door replacements can sometimes be replaced based on energy savings, generally replacement is not a cost-effective measure through the NeWAP. However replacements ***may*** be completed if the unit(s) is appropriately documented in the client file as "beyond repair". The NeWAP does cover costs associated with cost-effective repair and air sealing work on exterior doors, exterior windows, storm doors and storm windows. Repairs not specifically associated with cost-effectiveness and air sealing may be completed as an incidental repair.

3.1201 Maintenance, Repair, and Sealing

All work related to window and door repair/replacement ***must*** be completed using lead-safe weatherization practices.

3.1201.1 (a) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Double-Hung Wood Windows - Lead paint assessment (SF)

3.1201.2 (a) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Single-Unit Window and Fixed Frame with Wood Sash - Lead paint assessment (SF)

3.1202.1 (a) Air Sealing – Windows & Doors – Repairing/Replacing Cracked & Broken Glass - Fixed Frame with Wood Sash—Older House - Lead paint assessment (SF)

3.1202.2 (a) Air Sealing – Windows & Doors – Repairing/Replacing Cracked & Broken Glass - Single-Unit Window, Mounted on Rough Opening - Newer House - Lead paint assessment (SF)

3.1202.3 (b) Air Sealing – Windows & Doors – Repairing/Replacing Cracked & Broken Glass - Single-Unit Window, Mounted on Rough Opening - Newer House - Lead paint assessment (MH)

3.1203.1 (a, b, c, d, e) Air Sealing – Windows & Doors – Replacement – Replacement Windows in Existing Frame - Lead paint assessment (SF)

3.1203.2 (a, b, c, d, e, f) Air Sealing – Windows & Doors – Replacement - Single-Unit Window, Mounted on Rough Opening—Newer - Lead paint assessment House (SF)

3.1203.2 (b) Air Sealing – Windows & Doors – Replacement – Replacement of *Manufactured* Housing Windows and Doors - Lead paint assessment House (MH)

3.1202 Window and Door Repairing/Replacing Cracked and Broken Glass

Window replacements completed through the NeWAP must be shown as cost-effective through the home's Energy Audit, unless the unit(s) is documented in the client file as beyond repair. However windows in many homes are a major source of air leakage, therefore repair and air sealing work on exterior and storm windows is an eligible expenditure.

This work includes, but is not limited to:

- Replacing or repairing cracked, missing or broken glass using glazing compound and glazing points.
- Replacement window glass must not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension must not be less than "B" grade double strength.
- Window glass must be secured with glazing points and glazing compound, if necessary and the glazing must completely cover the channel.
- Damaged decorative window glass must be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the decorative window glass must be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or *Insulated Glass* and the interior or exterior pane is cracked, the cracked glass must be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass must be replaced with a thermal pane glass whenever possible.

3.1202.1 (a, b, c, d) Air Sealing – Windows & Doors – Replacement – Replacement Window in Existing Window Frame Air Sealing – Windows & Doors – Repairing/Replacing Cracked & Broken Glass - Fixed Frame with Wood Sash—Older House (SF)

3.1202.2 (a, b, c, d) Air Sealing – Windows & Doors – Repairing/Replacing Cracked & Broken Glass - Single-Unit Window, Mounted on Rough Opening—Newer House (SF)

- Applying sealants with rated adhesion and movement characteristics to prevent air leakage, condensation, and rain leakage between the window frame and other building materials.
- Replacing missing or severely deteriorated window frame components that are beyond repair.

3.1201.1 (d) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Double-Hung

Wood Windows - Replacement sills (SF)

3.1201.1 (e) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Double-Hung Wood Windows – Sash replacement (SF)

- Apply one coat of primer and one coat of exterior paint, as per manufacturer's installation requirements, to all new wood exposed to the weather.
- Adjusting window stops to reduce leakage between the stop and the jamb and ensuring that the window operates smoothly.

3.1201.1 (f) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing - Double-Hung Wood Windows – Adjust stops (SF)

- Weather-stripping sashes and sills.

3.1201.1 (b) Air Sealing – Windows & Doors – Replacement – Replacement Window in Existing Window Frame – Weather-stripping (SF)

- Replacing or repairing missing or non-functional top and side sash locks, hinges or other hardware.

Door Repair and Air Sealing

Door replacements can sometimes be replaced based on energy savings; generally replacement is not a cost-effective measure through the NeWAP. Replace doors only when the replacement provides an *SIR* of 1.0 or the door is damaged beyond repair and its condition has been appropriately documented. However doors in many homes are a major source of air leakage, therefore repair and air sealing work on exterior doors is an eligible expenditure. This work includes, but is not limited to:

- installing or removing and replacing weather-stripping, thresholds, door bottoms and door sweeps
  - Weather-strips, thresholds, door bottoms and sweeps must have a vinyl or silicone insert.
  - Weather-strips and sweeps must have the last fastener or screw no more than 2-1/2 inches from the end.
- adjusting door hardware to reduce air leakage

3.1201.3 (b) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – Exterior Doors - Door operation and fit (SF)

3.1201.5 (d) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – *Manufactured* Housing Windows and Doors – Air *Infiltration* (MH)

- applying sealants with rated adhesion and movement characteristics to prevent air leakage, condensation, and rain leakage

3.1201.3 (c, d) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – Exterior Doors (SF)

3.1201.3 (d,e) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – Exterior Doors (MH)

- installing a peephole or door light, located for client use, with the client's permission.
- repairing or replacing broken or missing storm door glass and door glass

- Replacement door glass must not be less than "B" grade single strength.
- Door glass over 40 inches in either dimension must not be less than "B" grade double strength.
- Door glass over 1 sq. ft. must be *Safety Glass*.
- Door glass must be secured with glazing points and glazing compound, if necessary and the glazing must completely cover the channel.
- Damaged decorative door glass must be replaced with a standard glass pane.
- If the client refuses a standard door glass pane, the decorative door glass must be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing door glass is a thermal pane or *Insulated Glass* and the interior or exterior pane is cracked, the cracked door glass must be repaired.
- If the interior and/or exterior panes of door glass are broken, the door glass must be replaced. Glass over 1 sq. ft. must be replaced with *Safety Glass* and 1 sq. ft. or less must be replaced with a standard glass pane.

3.1201.3 (a) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – Exterior Doors - Lead paint assessment (SF)

3.1201.5 (b) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – *Manufactured* Housing Windows and Doors – Lead paint assessment (MH)

- Water heater compartment doors, on mobile homes, that are beyond repair must be replaced. Appropriate photo and written documentation regarding the condition of the door ***must*** be included in the project file.

3.1203 Window and Door Replacement Requirements

Window Replacement Requirements

Window can sometimes be replaced based on energy savings, generally replacement is not a cost-effective measure through the NeWAP. Replace windows only when the window achieves an *SIR* of 1.0 or better when evaluated under the "Evaluate All" Replacement Option or the when the window is damaged beyond repair and its condition has been appropriately documented. Windows replaced through the NeWAP in framed or modular homes, or multifamily buildings ***must*** have:

- an NFRC (National *Fenestration* Rating Council) tested U-factor of 0.33 or lower.
- damaged framing repaired prior to the installation of the new window.
- the cavities around the window frame insulated and sealed with non-expanding foam sealant.
- the existing casing reinstalled if it is in good condition.
- all new casings matched as closely as possible to the existing in design and dimension.
- any interior and/or exterior walls damaged when replacing the window, repaired with like materials.
- new sash sections match, as closely as possible, the existing in design.
- new sash lock(s) installed, if the existing sash was equipped with a sash lock.
- a new sash lock installed, if both the upper and lower sash are replaced.
- jamb liners may be installed.

3.1201.1 (a, b, c, d, e) Air Sealing – Windows & Doors – Replacement – Replacement Window in Existing Window Frame (SF)

3.1201.2 (a, b, c, d, e, f) Air Sealing – Windows & Doors – Replacement – Single-Unit Window,

Mounted on Rough Opening - Newer House (SF)

Windows replaced in mobile homes through the NeWAP must have:

- an NFRC (National *Fenestration* Rating Council) tested U-factor of 0.33 or lower.
- existing putty tape removed and new putty tape or caulking installed.
- a drip cap installed above non-*manufactured home* replacement windows.
- all interior window casings caulked.
- damaged framing repaired prior to installing the new window.
- the cavities around the window frame insulated and sealed with non-expanding foam sealant.
- the existing casing reinstalled if it is in good condition.
- all new casings matched, as closely as possible, to the existing in design and dimension.
- any interior and/or exterior walls damaged when replacing the window, repaired with like materials.
- new sash sections match, as closely as possible, the existing in design.
- new sash lock(s) installed, if the existing sash was equipped with a sash lock.
- a new sash lock installed, if both the upper and lower sash are replaced.
- If the exterior walls in the *manufactured home* will accept house type replacement windows, they may be installed.
- jamb liners may be installed.

3.1203.3 (a, b, c, d, e, f, g) Air Sealing – Windows & Doors – Replacement – Replacement of *Manufactured* Housing Windows and Doors (MH)

Storm Window and Screen Repair and Replacement

Storm window and screen replacements are generally not cost-effective energy conservation measures. Replace storm windows only if they are indicated as cost-effective by achieving an *SIR* of 1.0 or better when evaluated under the "Evaluate All" Replacement Option.

- Storm windows repaired or replaced through the NeWAP in single family homes, *Manufactured Homes* and *Multi-family Buildings* ***must not*** be installed over fixed windows.
- Screens may be repaired or replaced as incidental repair.

Storm windows replaced through the NeWAP in mobile homes ***must*** have:

- one-light storms fastened with clips, full-length magnetic strips or using other means that completely seals the window and allow for easy attachment and/or removal.
- self-storing storms in aluminum frame combination windows.
- the storm window installed with a screen insert if the primary window lacks a screen.

3.1201.6 (a, b, c, d, e) Air Sealing – Windows & Doors – Maintenance, Repair & Sealing – Interior Storms (MH)

Door Replacement

Door replacements can sometimes be replaced based on energy savings; generally replacement is not a cost-effective measure through the NeWAP. Replace doors only when the replacement provides an *SIR*

of 1.0 or the door is damaged beyond repair and its condition has been appropriately documented. Exterior doors replaced through the NeWAP single family homes or *Multi-family Buildings* ***must*** have:

- replacement doors that are solid core wood, insulated or pre-hung metal insulated doors. Pre-hung metal insulated doors must be R-7 or greater.
- existing locksets reinstalled on the new door, if possible.
- two (2) keys provided to the client, if a new lockset is installed.
- any safety lock installed on the existing door removed and reinstalled on the new door.
- the existing casing reinstalled if it is in good condition.
- all new casings matched, as closely as possible, to the existing in design and dimension.
- the cavities around the door frame insulated and sealed with non-expanding foam sealant.
- door lights with un*Insulated Glass* not to exceed 1 square foot.
- door lights with *Insulated Glass* not to exceed 2 square feet.
- all door casings caulked.
- doors that conform to the thickness of the existing jamb.
- three hinges.
- the door bottom trimmed at a 5 degree angle, if trimming is necessary.
- weather-strips, thresholds, door bottoms and sweeps with a vinyl or silicone insert.
- weather-strips and sweeps with the last fastener or screw no more than 2-1/2 inches from the end.
- minor door adjustments such as tightening the hinges or adjusting the strike plate, completed to ensure proper operation.

3.1201.3 (a, b, c, d, e) Air Sealing – Windows & Doors – Maintenance, Repair, & Sealing – Exterior Doors (SF)

Exterior doors replaced through the NeWAP in *Manufactured Homes* ***must*** have:

- replacement doors that are solid core wood, insulated or pre-hung metal insulated doors. Pre-hung metal insulated doors must be R-7 or greater.
- a gutter, flashing or a drip cap must be installed.
- existing locksets reinstalled on the new door, if possible.
- two (2) keys provided to the client, if a new lockset is installed.
- any safety lock installed on the existing door removed and reinstalled on the new door.
- the existing casing reinstalled if it is in good condition.
- all new casings matched, as closely as possible, to the existing in design and dimension.
- the cavities around the door frame insulated and sealed with non-expanding foam sealant.
- door lights with un*Insulated Glass* not to exceed 1 square foot.
- door lights with *Insulated Glass* not to exceed 2 square feet.
- all door casings caulked.
- doors that conform to the thickness of the existing jamb.
- three hinges.
- the door bottom trimmed at a 5 degree angle, if trimming is necessary.
- weather-strips, thresholds, door bottoms and sweeps with a vinyl or silicone insert.

- weather-strips and sweeps with the last fastener or screw no more than 2-1/2 inches from the end.
- minor door adjustments such as tightening the hinges or adjusting the strike plate, completed to ensure proper operation.

3.1203.3 (a, b, c, d, e, f, g) Air Sealing – Windows & Doors – Replacement – Replacement of *Manufactured* Housing Windows and Doors (MH)

Below and Grade Level doors replaced through the NeWAP in single family*, Manufactured Homes, or Multi-family Buildings* ***shall***:

- be constructed of ¾ inch *Pressure Treated* exterior grade plywood.
- be reinforced with 1x4 inch common lumber and insulated with a minimum R-7 rigid insulation and framed with *Pressure Treated* wood, redwood or cedar.
- be attached with a minimum of 2 hinges and a minimum of one latching mechanism.
- be weather-stripped.
- have the bottom of the door appropriately air sealed.
- have a handle on both the interior and exterior of the door.
- have wood or aluminum thresholds.
- be caulked at the sill.
- the door bottom trimmed at a 5 degree angle, if trimming is necessary.
- have weather-strips, thresholds, door bottoms and sweeps with a vinyl or silicone insert.
- have weather-strips and sweeps with the last fastener or screw no more than 2-1/2 inches from the end.
- have minor door adjustments such as tightening the hinges or adjusting the strike plate, completed to ensure proper operation.

3.13 Floors

Air sealing floors separates the inside *Conditioned Space* from the outside or *Unconditioned Space* forming an appropriate air barrier. The following standards must be followed when NeWAP sub-grantees air sealing penetrations in floors:

3.1301.1 (a, b, c, d, e, f) Air Sealing – Floors - Penetrations – Electrical, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board (MH)

3.1302.1 (a, b, c, d, e) Air Sealing – Floors – Floor Framing—Bay Window (MH)

3.14 Basements and Crawl Spaces

Air sealing *Basements* and *Crawl Spaces* separates the inside *Conditioned Space* from the outside or *Unconditioned Space* forming an appropriate air barrier. The following standards must be followed when NeWAP sub-grantees air sealing penetrations in *Basements* and *Crawl Spaces* or when the following special conditions are encountered:

3.1401 Basements Connected to Crawl Spaces or Ledged Basements

3.1401.1 (a, b, c, d) Air Sealing – *Basement*s and *Crawl Spaces* – *Basement*s Connected to *Crawl*

Spaces (SF)

3.1402 Crawl Spaces

3.1402.2 (a) Air Sealing – *Basements* and *Crawl Spaces* – *Crawl Spaces* - Closed *Crawl Spaces*-Air Sealing Foundation Vents (SF)

3.1402.3 (a, b) Air Sealing – *Basements* and *Crawl Spaces* – *Crawl Spaces* - Closed *Crawl Spaces*-Air Sealing Exterior Wall (SF)

3.1402.4 (a, b) Air Sealing – *Basements* and *Crawl Spaces* – *Crawl Spaces* - Closed *Crawl Spaces*-Air Sealing Brick Curtain Walls with Piers (SF)

3.1402.5 (a, b) Air Sealing – Basements and Crawl Spaces – Crawl Spaces - Closed Crawl Spaces-Attached Crawl Spaces Under Unconditioned Spaces (SF)

3.1488 Special Considerations

3.1488.1 (a, b, c) Air Sealing – *Basements* and *Crawl Spaces* – Special Considerations - Skirting Post and Pier Foundations (SF)

3.1488.2 (a, b, c, d, e, f, g, h, i, j) Air Sealing – *Basements* and *Crawl Spaces* – Special Considerations - Skirting *Manufactured* Houses (MH)

Insulated Skirting Installation Requirements
If *Inaccessible Underbellies* or *Exposed Floors* are un-insulated and inaccessible, insulated skirting may be installed if it is determined in the Energy Audit to be cost-effective.

- The skirting must be metal, vinyl or *Pressure Treated* plywood supported by a wood frame and insulated with a minimum R-13 faced batt or a minimum R-10 foam board.
- The frame must have a *Pressure Treated*, redwood or cedar bottom plate and the vertical studs should be placed on a minimum 24 inch centers.
- Insulation must cover the top plate and extend a minimum of 24 inches on top of a ground laid moisture barrier.
- All seams and joints in the skirting must be caulked.
- The access must be constructed of ¾ inch *Pressure Treated* plywood, and be a minimum of 20 inches in width. It must be attached with 2 hinges and a latching mechanism. The access must be insulated with minimum R-13 batt or a minimum R-7 rigid insulation and weather-stripped with the last fastener or screw no more than 2-1/2 inches from the end of the weather-strip.
- A manufactured insulating skirting kit may be used. The kit must be a minimum R-8 insulation and include 1 access.

3.1488.1 (a, b, c) Air Sealing – *Basements* & *Crawl Spaces* – Special Considerations – Skirting Post and Pier Foundations (SF)

3.1488.2 (a, b, c, d, e, f, g, h, i, j) Air Sealing – *Basements* & *Crawl Spaces* – Special Considerations – Skirting *Manufactured Homes* (MH)

3.16 Ducts

Sealing, repairing and insulating existing *accessible ductwork* provides Nebraska Weatherization Assistance Program (NeWAP) clients with energy cost reductions and improved comfort. Sealing leaky ducts also help to improve indoor air quality.

3.1601 Duct Preparation

Prior to sealing and/or insulating ducts NeWAP sub-grantees ***shall***:

- Inspect and evaluate the existing system to ensure that all ducts and plenums are properly fastened, supported and sealed to reduce air leakage.

  3.1601.1 (a, b, c, d, e, f, g, h, i, j) Ducts – Duct Preparation - Preparation and Mechanical Fastening (SF)

  3.1601.2 (a, b) Ducts – Duct Preparation - Preparation for SPF Application (SF) (MH)

  3.1601.3 (a) Ducts – Duct Preparation - Support (SF)

  3.1601.4 (a) Ducts – Duct Preparation - Support for Horizontal, Suspended Ducts (MH)

  3.1601.5 (a, b, c, d, e, f, g, h, i) Ducts – Duct Preparation - Preparation and Mechanical Fastening (MH)

- Test ducts to determine the size and location of leaks.
- Consider sealing off supply and return registers in unoccupied *Basements* rooms

Prior to sealing and/or insulating ducts NeWAP sub-grantees ***must*** verify and make reasonable attempts to ensure that duct systems are providing balanced, adequate airflow to living spaces. When airflow is a problem sub-grantees ***must*** consider the following options:

- Cleaning the filter or replacing disposable filters.
- Repairing, realigning or replacing bent, damaged, missing or restricted floor registers.
- Realigning and appropriately secure disconnected duct work and floor registers.

  3.1602.4 (a, b, c, d) Ducts – Duct Sealing - Air Sealing System Components (SF)

- Moving/installing filter racks into an area that is convenient and conducive for the client to access.
- Removing obstructions to registers and ducts.
- Eliminating kinks in flex duct and replacing collapsed ducts with metal duct.
- Installing new duct work or *Hydronic pipes* to balance the system and/or provide *conditioned* air throughout the building.
- Installing a transfer grille(s) to improve airflow in the building.
- Undercutting interior doors.

3.1602 Duct Sealing

Duct Sealing

- *Accessible Ducts* ***must*** be sealed before insulating.
- *Cross over ducts* must be inspected and weatherized.
- Seal leaky joints between supply and return registers and the floor, wall, and ceiling to which they are attached.

3.1602.4 (a, b, c, d) Ducts – Duct Sealing - Air Sealing System Components (SF)

3.1602.12 (a, b, c) Ducts – Duct Sealing - Air Sealing System Components (MH)

- Seal penetrations made by wires or pipes traveling through ducts.
- Use nontoxic and water-resistant mastic.
- Use mesh tape when openings and tears are over 1/8 of an inch.

3.1602.1 (a, b, c) Ducts – Duct Sealing - Air Sealing Duct System (SF)

- Use marked Energy Code compliant (UL181 A (rigid systems) or UL181 B (flex system)) duct sealing tape when the use of mastic is not feasible.
- Install pre-manufactured or site manufactured durable filter slot covers when existing covers are missing or damaged.

3.1602.2 (a) Ducts – Duct Sealing - Duct Spray Polyurethane Foam (SPF) Installation (SF) (MH)

3.1602.5 (a, b, c) Ducts – Duct Sealing - Return—Framed Platform (SF)

3.1602.7 (a, b) Ducts – Duct Sealing - Return and Supply Plenums in *Basements* and *Crawl Spaces* (SF)

3.1602.8 (a, b, c, d, e, f) Ducts – Duct Sealing - Supply Plenum (Furnace to Trunk Duct Connection) in Both Up-flow and Down-flow Air Handler Configurations (MH)

3.1602.9 (a, b, c, d, e, f, g, h) Ducts – Duct Sealing - *Crossover-Ducts* (MH)

3.1602.10 (a, b, c, d, e, f) Ducts – Duct Sealing - Hard and Flex Branch Ducts (MH)

3.1602.11 (a, b, c, d) Ducts – Duct Sealing - Air Sealing System (MH)

3.17 Additions

The following standards must be followed when NeWAP sub-grantees air sealing additions attached to manufactured housing:

3.1701.1 (a, b, c, d, e, f, g, h, i, j, k) Air Sealing – Additions – Attached Additions - Holes, Penetrations, and Connection Seam (MH)

4 Insulation

Appropriate installation is required for insulation to provide energy savings and increase occupant comfort. The insulation ***must*** be installed:

- in conjunction with an effective air barrier.
- covering the entire area intended for insulation without voids or edge gaps.
- according to manufacturer's instructions, in the case of blown insulation, it should be installed at sufficient density to resist settling.
- observing lead-safe weatherization practices with all tasks that may disturb paint.

Fiberglass batt insulation installed in a *Living area* must be covered with paneling, plywood, chipboard, hardboard or drywall, with the exception of sill box insulation. If the installed covering is:

- drywall, it must be made paint ready.
- plywood, chipboard or hardboard is installed, the joints must be caulked.
- paneling is installed, it must be a minimum 3/16 inch and the joints must be caulked.

4.10 Attics

4.1001 General Preparation

Prior to installing attic insulation sub-grantees ***must*** inspect for, prepare for and document the following issues/concerns:

Air Sealing

- Complete and document in the client file air-leakage (*pressure plane*) testing to verify that all attic planes in the home have been appropriately sealed to provide an effective air barrier that allows the attic insulation to be effective.

  4.1001.6 (a, b, c, d) Insulation – Attics — General Preparation — Preparation for Spray Polyurethane Foam (SF)

  4.1001.7 (a, b, c, d) Insulation – Attics — General Preparation — Preparation for SPF (SF)

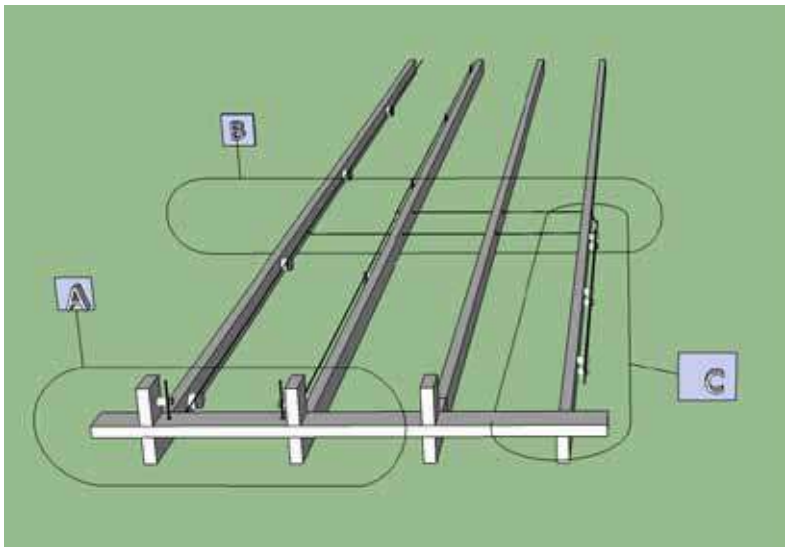
  4.9901.1 (a, b, c) Insulation – Additional Resources — General Information on Spray Polyurethane Foam (SPF) (SF) (MH)

Knob & Tube Wiring

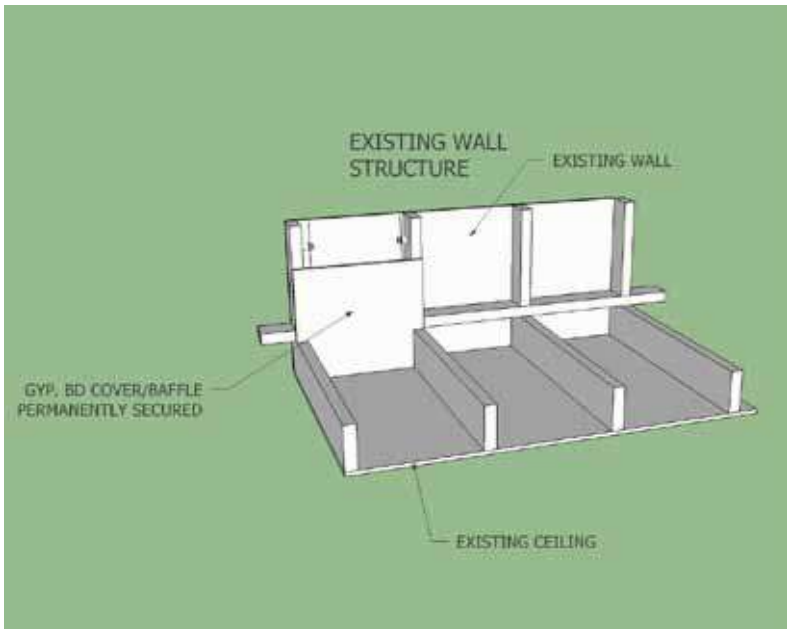
- Complete appropriate shielding procedures of any active Knob & Tube Wiring. The Nebraska State Electrical Board does not permit directly covering knob and tube wiring with insulation. Sub-grantees *must* comply with the following fire and electrical safety procedures before insulating.

  4.1001.2 (a, b, c) - Insulation – Attics — General Preparation — Knob and Tube Wiring (SF)

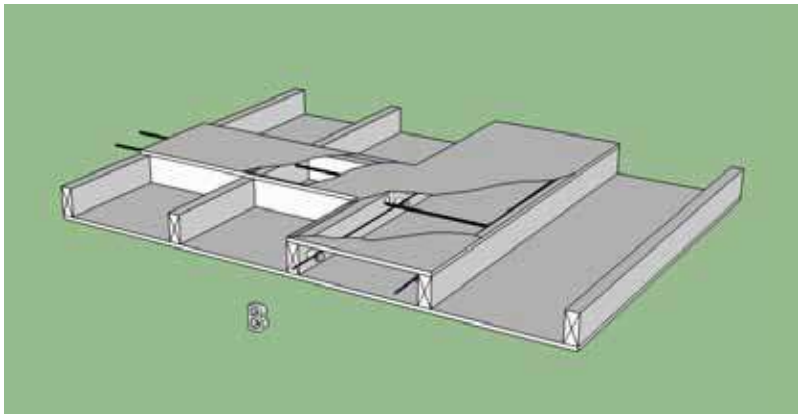
- Inspect all attic areas for knob-and-tube wiring.
- Attic areas with knob-and-tube wiring that are indicated as cost-effective for implementation on the Energy Audit *must* be insulated after the wiring has been appropriately covered to prevent direct contact with the insulation and to provide adequate air space (a minimum of 3 ½" clearance) for "cooling" of the wire. The costs associated with covering the knob and tube wiring should be included in the cost, the *SIR* calculation, and the invoicing of the Measure so that the costs associated with the shielding can be included as an Energy Efficiency Measure in the BCJO. In situations where the additional costs associated with shielding the knob-and-tube wiring impacts the *SIR*, making the Measure ineligible, those costs may also be invoiced as a Health and Safety cost. (See Details B & C below)
- Appropriate shielding materials for concealing the knob-and-tube wiring *must* include gypsum board (5/8" or thicker), plywood or oriented strand board.



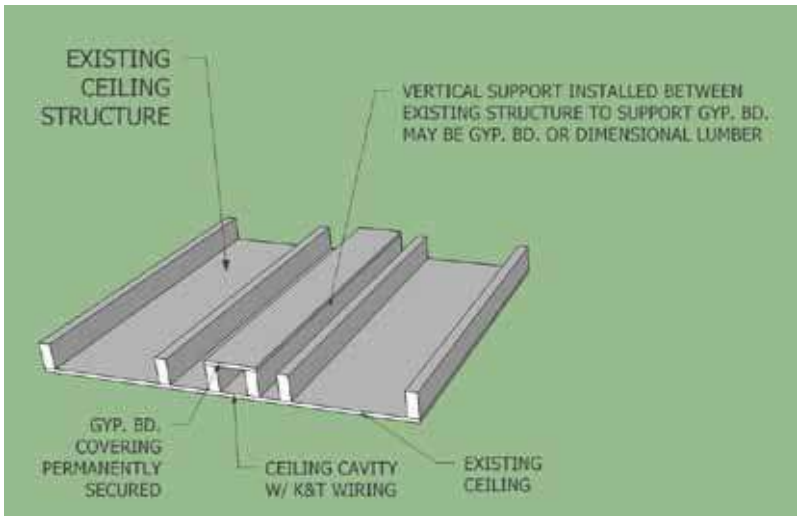
Knob and tube critical wiring points



Detail A



Detail B



Detail C

- Attics where Knob-and-Tube Wiring has been previously covered with insulation and the Energy Audit indicates that it is cost-effective to install additional insulation, can be insulated when it has been determined where the wiring is located and that it is actually still "active". This determination may be completed by:
  - a licensed electrician
  - the use of a thermal imager/scanner
  - visually or physically locating the wires or
  - another verifiable option determined by the sub-grantee and approved by the Nebraska Energy Office

  Once the determination of the wire locations is documented in the client file, the wiring may be appropriately shielded as indicated above to prevent direct contact with the additional insulation and to provide adequate air movement space for cooling of the wire. Following appropriate shielding, insulation may be installed over the shielding.
- In attic areas where knob-and-tube wiring penetrates the plane of the attic and extends up into a side or *Knee wall*, a fire resistant baffling *must* be installed around the wire to provide sufficient space for air movement around the wire to provide adequate air space to accommodate the cooling of the wire. (See Detail A)
- If attic installation is being installed as per the directive above, the Nebraska State Electrical Board recommends the use of a licensed electrician for the installation of safety fuses as is indicated in the National Electrical Code.
- Existing fuses must remain intact if no insulation is being completed in the home.

Recessed Lighting

- Air seal existing recessed light fixtures by following manufacturer's instructions concerning clearance to combustibles for recessed light fixtures. If there are no instructions available, construct a box from fire code gypsum that is two foot square, two feet high and enclosed (notches may have to be cut to accommodate attic floor joists) and air seal the box.

  4.1001.1 (a, b, c, d) Insulation – Attics— General Preparation— Non-Insulation Contact (IC) Recessed Light (SF)

Shielding, Damming and Junction Boxes

- When adding additional insulation to the attic, install shielding around heat and high-*Heat Sources*.

  4.1001.3 (a, b, c, d) Insulation – Attics— General Preparation— Fireplace Chimney and Combustion Flue Vents (SF)

- In attics where no additional insulation will be installed, Sub-Grantees ***must*** install shielding around heat and high-*Heat Sources* with costs incurred being charged to Health and Safety.
  - Shielding must be kept a minimum of 3" from any *Heat Source* and a minimum of 6" from a *High Heat Source*.
  - Sheet metal shielding around heat producing devices or chimneys, must be fastened securely so the barrier won't collapse.
  - All shielding must be installed at a height to accommodate the depth of the added insulation.
- Install damming around attic accesses, exhaust fans, soffit vents and uninsulated attics adjacent to insulated attics.
  - All damming must be installed at a height to accommodate the depth of the added insulation.
  - Damming must be installed to ensure insulation will be full depth over all exterior top plates of the wall if possible.
- Install chutes, dams, tubes, or other blocking materials to prevent blown insulation from plugging air channels between soffit vents and the attic. These devices maximize the amount of insulation installed over top plates and help to prevent the wind-washing of insulation caused by cold air entering soffit vents.

  4.1001.4 (a) Insulation – Attics— General Preparation— Venting Eave of Soffit Baffles (SF)

- All junction boxes must have approved covers, and their location must be marked with a flag or other visible marker.

  4.1001.5 (a) Insulation – Attics— General Preparation — *Dense pack* Preparation (SF)

Attic Accesses and Hatch Standards

- Provide an access to all *accessible attics* over 100 square feet.
- Install new attic accesses in an area agreeable to the client and conducive to adding insulation.
- Install new attic accesses as per state and local codes.
- Install new attic hatch covers, as needed, on new and/or existing accesses.

  4.1006.2 (a, b, c, d, e) Insulation – Attics— Attic Openings— Access Doors and Hatches (SF)

- New and existing attic accesses adjacent to *conditioned* areas must be weather-stripped and insulated with rigid insulation board to match the R-value of the adjacent ceiling surface and the insulation must fit snug to the damming boards. The insulation must be attached to the access door.
- Attic and attic access insulation must be installed to provide continuous insulation coverage. Batt insulation may need to overlap the opening.

- The access must be caulked with a paintable clear caulking or with a color complementary to the surface to which it is applied.
- The access must be finished to match the ceiling where installed as closely as possible.
- Attic accesses must be dammed with 1 inch common lumber or ¾ inch plywood fastened securely to the ceiling joists so the damming won't collapse or move.
- The new hatch must be properly framed and should have a minimum opening of 13 inches x 20 inches and boxed with 1 inch thick common lumber or ¾ inch plywood at a height to accommodate the added insulation.
- The hatch casing must be caulked with a paintable clear caulk or with a color complementary to the surface to which it is applied.
- The hatch cover must be constructed of ¾ inch plywood or particle board.
- If a walk-up attic access is present, the access must be weather-stripped and insulated with rigid insulation board to match the R-value of the adjacent ceiling surface and be hinged. Access insulation must be installed to provide continuous insulation coverage. Insulation may need to overlap the opening.
- If a pull-down ladder hatch is present it must be dammed with 1-inch common lumber or ¾ inch plywood with a hinged ¾ inch plywood lid, weather-stripped and insulated with rigid insulation board to match the R-value of the adjacent ceiling surface. Access insulation must be installed to provide continuous insulation coverage. Insulation may need to overlap the opening and cover the sides.
- Weather-stripping for all interior attic accesses must have the last fastener of the weather-stripping located within 2-1/2 inches from the end of the weather-strip.

Special Considerations

- If a standpipe is installed, insulation may be installed over the exhaust fan. The standpipe must be attached with screws.

Worker and Client Safety

- Wear OSHA approved respirators or dust masks while blowing insulation or installing batts.

  2.0104.1 (a, c) Health & Safety – Safe Work Practices— Insulation— Insulation Worker Safety (SF) (MH)

- Inspect ceilings to ensure that the weight of the added insulation can be supported.
- Ensure that leaks in the roof and penetrations in the ceilings have been repaired prior to insulating the attic (utilizing incremental repair cost requirements). If roof leaks cannot be appropriately repaired, don't insulate the attic.

  2.0401.1 (a) Health & Safety – Moisture— Air Sealing— Air Sealing Moisture Problems (SF) (MH)

Ventilation/Attic Ventilation Installation Standards

- All fans ***must*** be checked for proper damper operation.
- All kitchen and bath fans ***must*** be vented to the exterior of the building.

  6.6005.1 (a, b, c, d, e) Ventilation – Exhaust – Appliance Exhaust Vents - Clothes Dryer (SF) (MH)

  6.6005.2 (a, b, c, d, e, f, g) Ventilation – Exhaust – Appliance Exhaust Vents - Kitchen Range

(SF) (MH)

- Venting ***must not*** be installed on metal roofs.
- Attics with metal roofs that cannot be properly vented ***must not*** be insulated.

4.1088.1 (a, b, c, d, e) Insulation – Attics— Special Considerations – Attic Ventilation (SF)

4.1088.3 (a, b, c) Insulation – Attics— Special Considerations – Skylights (SF)

- Attics with no *Vapor retarder* must have a minimum of 1 square foot of net free vent area for every 150 square feet of attic area.
- Attics with a *Vapor retarder* must have a minimum of 1 square foot of net free vent area for every 300 square feet of attic area.
- In attics with over 300 square feet of attic area, vents must be located to provide the most adequate venting opportunity.
- Roof vents should not be installed over framing members. If vents must be installed over framing members, care must be taken to insure that the rafters are not cut. The roof vent opening is to be framed.
- Soffit vents must be installed with the fins facing towards the house with rust proof, pan-headed screws.
- Gable vents must be set in caulking and nailed or screwed in place using rust proof fasteners and be trimmed.
- Gable vents installed in siding without wood sheathing behind it must have the vent framed.
- Roof, turbine and ridge vents must be sealed with roofing tar and attached with large headed roofing nails.
- Roof vents must be centered within 2 feet of the ridge or peak of the roof.
- The shingles must overlap the top half of the roof vent flange. The bottom half of the vent's flange must be exposed on top of the shingles.
- Venting should be evenly spaced and should be divided evenly between high and low or intake and exhaust vents.
- Roof, turbine and ridge vents are considered to be high or exhaust vents, while soffit and gable vents are considered to be low or intake vents.
- Exhaust fans without operating *backdraft dampers* must be retrofitted with *backdraft dampers*, or the fan must be replaced.
- PVC, rigid metal, metal flexible or galvanized pipe must be used for venting.
- Exhaust fan vent pipes may be insulated to prevent condensation.
- Flexible plastic ducting must not be used to vent exhaust fans.
- Metal flexible duct used for exhaust fan ventilation must not extend more than 6 feet.

4.1003 Attic Ceilings

Installing attic insulation appropriately is critical to ensure energy cost savings and client comfort. Insulation should be installed according to manufactures installation standards. Generally, in the NeWAP, blown-in insulation is installed in attics because it provides a more continuous coverage and it has the capability of easily filling existing holes and insulation gaps. To avoid settling, the insulation must be installed based on manufacturer's specification, to a uniform depth and density for proper coverage. The following standards must be met by NeWAP sub-grantees installing attic insulation:

- Blown insulation specifications ***must*** be stapled near the attic access of each *accessible attic.*
- The insulation specifications ***must*** include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation.
- Insulation ***must*** be installed to extend over the top of all exterior plates and be the full R-value.
- Cellulose insulation ***must*** be installed over existing batt insulation whenever possible.

4.1005.4 (a, b, c, d) Insulation – Attics— Attic Floors— Accessible Floors – Loose Fill Over Existing Insulation (SF)

- Insulation ***must*** be installed using the *Tube-fill method* to a minimum of 3.5 pounds per cubic foot in enclosed ceilings.
- Enclosed ceilings ***must*** be insulated to the full cavity depth.

4.1003.1 (a, b, c, d) Insulation – Attics— Attic Ceilings— Pitched/Vaulted/Cathedralized Ceilings – Loose Fill (SF)

4.1003.2 (a, b) Insulation – Attics— Attic Ceilings— Pitched/Vaulted/Cathedralized Ceilings – *Dense pack* Over (SF)

4.1003.3 (a, b, c) Insulation – Attics— Attic Ceilings— Unvented Flat Roof with Existing Insulation (SF)

4.1003.4 (b, c, d, e) Insulation – Attics— Attic Ceilings— Cape Cod Side Attic – *Dense pack* Installation (SF)

4.1003.8 (a, b, c, d, e, f, g) Insulation – Attics— Attic Ceilings— Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceiling (via Roof Side Lift) (MH)

4.1003.9 (a, b, c, d, e, f, g) Insulation – Attics— Attic Ceilings— Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceiling (via Exterior Access from Top of Roof) (MH)

4.1003.10 (a, b, c, d, e, f, g, h) Insulation – Attics— Attic Ceilings— Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceiling (via Interior Access Through the Ceiling) (MH)

4.1003.11 (a, b) Insulation – Attics— Attic Ceilings— Installing Fiberglass Insulation in Roof-Over Construction (MH)

4.1005.2 (a, b, c, d) Insulation – Attics— Attic Floors— Accessible Floors – Loose Fill Insulation (SF)

4.1005.6 (a, b, c) Insulation – Attics— Attic Floors— Enclosed Attic Storage Platform Floors – *Dense pack* Installation (SF)

- If additional batt insulation must be installed, the new batt ***must*** be unfaced and installed perpendicular to the existing batt insulation.

4.1005.1 (a, b, c) Insulation – Attics— Attic Floors— Accessible Floors – Batt Insulation (SF)

4.1005.3 (a, b, c, d, e) Insulation – Attics— Attic Floors— Accessible Floors – Batt Insulation Over Existing Insulation (SF)

- Spray Polyurethane Foam Insulation Standards

4.1003.5 (a, b, c)- Insulation – Attics— Attic Ceilings— Unvented Roof Deck – Spray Polyurethane Foam Installation (SF)

4.1003.6 (a, b, c) Insulation – Attics— Attic Ceilings— Vented Roof Deck – Spray Polyurethane Foam Installation (SF)

4.1005.7 (a, b, c, d, e) Insulation – Attics— Attic Floors— Accessible Floors – Preparation and Installation of Spray Polyurethane Foam (SF)

- Special Consideration Installation Standards

4.1006.3 (a, b, c, d, e) Insulation – Attics— Attic Openings— Whole House Fan (SF)

4.1004 Knee Walls

Preparation and Installation Standards
In *Knee wall* attics or attics in one-and-a-half story homes Sub-Grantees ***shall***:

- Insulate both the attic-joist area and the *Knee wall* ***or*** insulate the entire sloped roof and attic end walls.

4.1004.1 (a, b) Insulation – Attics— Knee Walls— Preparation for *Dense pack*ing (SF)

4.1004.3 (a, b, c, d) Insulation – Attics— Knee Walls— Strapping for Existing Insulation (SF)

4.1004.4 (a, b, c, d) Insulation – Attics— Knee Walls— Knee Wall Without Framing (SF)

4.1004.5 (a, b, c) Insulation – Attics— Knee Walls— Knee Walls and Gable Ends – Preparation for and Installation of Spray Polyurethane Foam (SF)

- Insulate *Knee wall*s with either batt or blown insulation or *Spray*-Applied *Insulation*.
  - *Knee wall* insulation must be held in place with staples, twine, wire, hex netting or wire expanders and must be covered with an *air Infiltration barrier*.

4.1004.2 (a, b, c) Insulation – Attics— Knee Walls— Preparation for Batt Insulation (SF)

- Tightly pack the floor cavities at the base of the *Knee wall*s with batt, blown, rigid or *Spray-Applied Insulation*.
  - If batt insulation is used to seal the base of the *Knee wall*s, the batt must be sealed in an enclosed *Vapor barrier*.
  - Materials used must form an airtight seal.
  - If Spray-Applied Insulation is used, an air Infiltration barrier is not needed.

- Provide *accessible Knee walls* with a minimum of one access.
  - Locate new access door(s) in an area agreeable to the client and conducive to the installation of the insulation.

- Accesses adjacent to *conditioned* areas must be weather-stripped and insulated with R-13 batt or a minimum R-7 rigid insulation attached to the access door. The last fastener on the weather-stripping must be within 2-1/2 inches from the end of the weather-strip.
- The trim of the access must be caulked with clear caulking or caulking that is a color complementary to the surface to which it is applied.
- New accesses must be properly framed and be a minimum of 13 inches wide and 20 inches in height.
- New access covers or doors must be minimum ¾ inch plywood and attached with a minimum of 2 hinges and 2 latching mechanisms.
- New accesses must be finished to match the wall as closely as possible.

4.1005 Attic Floors

- Accessible *Exposed Floors* that have an existing covering ***must*** be insulated with blown insulation installed at a minimum of 3.5 pounds per cubic foot. Entry holes must be plugged with wood or plastic plugs and sealed appropriately.

  4.1005.5 (a, b, c, d) Insulation – Attic Floors— Enclosed Bonus Room Floor Over *Unconditioned Space – Dense pack* Installation (SF)

4.1006 Attic Openings

Walk-Up Stair Attic Insulation Preparation and Installation Standards
In attics with walk-up stairs and door Sub-Grantees ***shall***:

- Establish a continuous insulation and air barrier over the top of the stairwell ***or*** by sealing and insulating the walls of the stairwell and the angled plane of the stair treads/risers and weatherizing the stairwell door.

  3.1002.1 (a, b, c, d, e, f) Air Sealing – Attic - Open Stairwells - Interior with Sloped Ceilings (SF)

  3.1002.2 (a, b, c, d, e, f) Air Sealing – Attic - Open Stairwells - Stairwell to Attic – Door at Bottom with No Ceiling Above (SF)

  3.1002.3 (a, b, c, d, e) Air Sealing – Attic - Open Stairwells - Stairwell to Attic – Door at Top with Finished Ceiling Above (SF)

Attics With Retractable Stairs - Insulation Preparation and Installation Standards
In attics with retractable stairways Sub-Grantees ***shall***:

- Build or purchase a cover that air seals the access and accommodates insulating.

  4.1006.1 (a, b, c, d) Insulation – Attics— Attic Openings— Pull-Down Stairs (SF)

4.1088 Special Considerations

The following standards must be followed when NeWAP sub-grantees insulate attic areas that incorporate the following special construction considerations:

4.1088.1 (a, b, c, d, e) Insulation – Attics – Special Considerations — Attic Ventilation (SF)

4.1088.3 (a, b, c) Insulation – Attics – Special Considerations — Skylights (SF)

4.1088.6 (a, b, c, d, e, f, g, h) Insulation – Attics – Special Considerations — Installing Insulation at Flat and Cathedral Ceiling Transition Wall (MH)

4.11 Walls

4.1101 Preparation

Prior to installing wall insulation sub-grantees must inspect for, repair and document the following issues/concerns:

- Evidence of moisture damage, if condition of the siding, sheathing, or interior wall finish indicates an existing moisture problem, no sidewall insulation should be installed until the moisture problem has been identified and corrected.
- Seal gaps in external window trim and other areas that may permit water into the wall.
- Ensure that the interior and exterior surfaces of the walls are capable of withstanding the force of insulation blowing.
- Complete minor surface repair on interior and exterior surfaces prior to insulating.

4.1101.1 (a, b) Insulation – Walls— Preparation – Exterior Wall *Dense pack*ing (SF)

4.1101.5 (a, b) Insulation – Walls— Preparation – Exterior Wall *Dense pack*ing (MH)

- Locate and seal interior openings from which insulation may escape, such as pocket doors, balloon framing, un-backed cabinets, interior soffits, and closets.
- Verify the exterior walls do not have active knob-and-tube wiring. Exterior walls that have active knob-and-tube wiring must not be insulated. Walls in additions on these homes that do not have active knob-and-tube wiring must be insulated if the Energy Audit of the home indicates the insulation is cost–effective for implementation. To ensure appropriate heating and cooling sizing calculations are completed by the program for the sizing of the mechanical equipment, the NEAT Audit of the home must include appropriate areas/size calculations of the active knob-and-tube walls with NONE selected as the "added insulation" option in the program.

4.1102 Accessible Walls

In homes with accessible, open wall cavities Sub-Grantees ***shall***:

- Insulate with batt, blown or Spray-Applied Insulation and cover the cavity.
- If the covering of an open wall cavity is drywall, the drywall must be taped with one coat of drywall mud applied.
    - If the covering of an open wall cavity is plywood, chipboard or hardboard the joints must be caulked.
- Fill the entire cavity.
- If faced batt insulation is installed in an open wall cavity, the *Vapor barrier* must be installed to the warm side and fit snugly between the studs and wall.
- Cut the batt insulation to the exact length of the cavity.
- Install the insulation around wiring, piping, etc. by splitting the batt, not by compression.
- Removal of siding containing Asbestos must comply with federal, state and local regulations.

4.1102.1 (a, b, c, d) Insulation – Walls— Accessible Walls – Open Wall Insulation – General (SF)

4.1102.2 (a, b, c, d) Insulation – Walls— Accessible Walls – Open Wall Insulation – Spray Polyurethane Foam (SPF) (SF)

4.1103 Enclosed Walls

Exterior, Exterior Wall Insulation Installation Standards

Appropriate installation of wall insulation is essential to ensuring energy cost savings and client comfort. Insulation should be installed according to manufactures installation standards. In homes where exterior wall cavities are being blown Sub-Grantees shall:

- Remove or drill siding and fill all enclosed wall cavities. Wall cavities that are less than 3 feet in height or where it is not possible to tube fill, may be insulated through a minimum 1 inch entry holes.
- Slate siding that may contain asbestos may be removed as long as the siding material does not become friable.
- Metal or vinyl siding may be removed with the aid of a zip tool.
    - Removed siding must be reinstalled using the original fastening system whenever possible. The seam tabs on slate siding must be reinstalled.
    - The entry holes must be sealed with plastic or wood plugs, or covered with felt paper prior to reinstalling the siding if the siding was removed.
    - Seal and plug holes before replacing siding.
- In homes insulated from the inside, holes will be plugged and taped or sealed with an appropriate material and made ready for paint.
- Asbestos shingled siding may be carefully removed by pulling the nails holding them to the sheathing or else nipping off the nail heads. Dampening the tiles helps to keep dust down. Refer to your company policy and procedures when working with asbestos materials.
- Probe all wall cavities through holes, as they are drilled, to identify fire blocking, diagonal bracing, and other obstacles. After probing, drill whatever additional holes are necessary to ensure complete coverage.
- Insulate stucco walls through either interior or exterior access.
    - Entry holes in stucco or masonry siding must be sealed with mortar or a material specifically manufactured to repair stucco or masonry.
    - Interior entry holes must be made ready for paint.
    - Interior entry holes in drywall or plaster must be plugged and taped or sealed with a material specifically manufactured to repair drywall or plaster.
- Document in the client file back-plastered (two layer) walls that are too difficult to insulate properly.
- Verify and document in the client file the need to practice lead-safe weatherization procedures.
- Drill 2-to-3-inch diameter holes to access stud cavity.
- To prevent settling, cellulose insulation must be installed using the *Tube-fill method* to a minimum density of 3.5 pounds per cubic foot.

- *Dense*-pack wall insulation is best installed using a blower equipped with separate controls for air and material feed.
- Wall repairs must be durable and permanent and match the existing area as closely as possible.
- Materials used in areas of high moisture or areas exposed to the weather must be of suitable grade.
- Whenever plastic or wood plugs are used on the exterior of the siding, the plugs must be painted to match the existing siding color.
- All sealing material must completely seal the opening and be textured and painted to match the surrounding surface.
- Seal floor cavities in balloon framed walls by installing insulation plugs (i.e. plastic bags filled with insulation or rigid insulation/air blocks)

4.1103.1 (a, b) Insulation – Walls— Enclosed Walls – *Dense pack* Exterior Walls (SF)

4.1103.2 (a, b, c, d, e, f) Insulation – Walls— Enclosed Walls – Additional Exterior Wall Cavities (SF)

4.1104 Manufactured Housing Walls

Exterior, Exterior Wall Insulation Installation Standards
Appropriate installation of wall insulation is essential to ensuring energy cost savings and client comfort. Insulation should be installed according to manufactures installation standards and the following standards:

4.1104.1 (a, b, c, d, e, f, g) Insulation – Walls – *Manufactured* Housing Wall Insulation - Stuffing Wall Cavities with Fiberglass Batts (MH)

4.1104.2 (a, b, c, d, e, f, g) Insulation – Walls – *Manufactured* Housing Wall Insulation - Fiberglass Blown Insulation Installation (Lifting Siding) (MH)

4.1104.3 (a, b, c, d, e, f, g) Insulation – Walls – *Manufactured* Housing Wall Insulation - Fiberglass Blown Insulation Installation (via Penetrations through or Behind the Siding) (MH)

4.1104.4 (a, b, c, d, e) Insulation – Walls – *Manufactured* Housing Wall Insulation - Spray Foam Insulation Installation in Cavities above Doors and Windows (MH)

4.13 Floors

Preparation and Inspection Requirements
In homes where a floor serves as an air/thermal boundary, prior to installing floor insulation sub-grantees ***must*** inspect for, prepare for and document the following issues/concerns:

- Sealing of stud cavities if the walls are balloon framed prior to insulating floors.
- Inspection of ceilings of garages to ensure that the weight of the added insulation can be supported.

4.1301 Accessible Floors

Floor Insulation Installation Standards

- Batt insulation ***must*** be appropriately cut to reduce voids and gaps in the insulation.

  4.1301.1 (a, b, c, d) Insulation – Floors— Accessible Floors – Standard Floor System – Batt Insulation (SF)

  4.1301.3 (a, b, c, d, e) Insulation – Floors— Accessible Floors – Pier Construction Subfloor Insulation Batt Insulation with Rigid Barrier (SF)

  4.1301.5 (a, b, c, d, e) Insulation – Floors— Accessible Floors – Standard Floor System – Cantilevered Floor—Batt Installation (SF)

- Floor insulation ***must*** be installed to fit tightly to the subfloor and securely fastened to ensure the contact is maintained.

  4.1301.2 (a, b, c, d) Insulation – Floors— Accessible Floors – Standard Floor System – Loose Fill with Netting (SF)

  4.1301.3 (a, b, c, d) Insulation – Floors— Accessible Floors – Standard Floor System – Loose Fill with Rigid Barrier (SF)

  4.1301.4 (a, b, c, d) Insulation – Floors— Accessible Floors – *Dense pack* Floor System with Rigid Barrier (SF)

- *Exposed Floors*, except over garages, ***must*** be insulated and covered with exterior grade plywood or tar impregnated fiberboard. All seams must be caulked.

  4.1301.3 (a, b, c, d) Insulation – Floors— Accessible Floors – Standard Floor System – Loose Fill with Rigid Barrier (SF)

  4.1301.4 (a, b, c, d) Insulation – Floors— Accessible Floors – *Dense pack* Floor System with Rigid Barrier (SF)

- *Exposed Floors* over garages ***must*** be insulated and covered with fire code drywall as per state and/or local code. The drywall ***must*** be taped and receive one coat of joint compound or the joints and seams must be caulked to form an airtight seal.
- Accessible *Exposed Floors* that have an existing covering ***must*** be insulated with blown insulation installed at a minimum of 3.5 pounds per cubic foot. Entry holes must be sealed with wood or plastic plugs.

  4.1005.5 (a, b, c, d) Insulation – Attic Floors— Enclosed Bonus Room Floor Over *Unconditioned Space – Dense pack* Installation (SF)

  4.1301.5 (a, b, c, d, e) Insulation – Floors— Accessible Floors – Cantilevered Floor – Batt Installation (SF)

  4.1301.6 (a, b, c, d, e) Insulation – Floors— Accessible Floors – Pier Construction Subfloor Insulation – Batt Insulation with Rigid Barrier (SF)

  4.1301.7 (a, b, c, d) Insulation – Floors— Accessible Floors – Pier Construction Subfloor Insulation – Loose Fill with Rigid Barrier (SF)

  4.1301.8 (a, b, c, d) Insulation – Floors— Accessible Floors – Pier Construction Subfloor

Insulation – *Dense pack* with Rigid Barrier (SF)

4.1301.9 (a, b, c, d) Insulation – Floors— Accessible Floors – Open Floors Over *Unconditioned Space* and Cantilevered Floors, Floors Over Garages, Floors Over *Unconditioned Crawl Spaces* – Spray Polyurethane (SF)

4.1303 Manufactured Housing Floor Cavity Insulation

Preparation and Inspection Requirements
In *Manufactured Homes* where a floor serves as an air/thermal boundary, prior to installing floor insulation sub-grantees ***must*** complete an inspection of the floor assembly and document any issues/concerns found.

4.1302.1 (a, b) Insulation – Floors— *Manufactured* Housing Belly Preparation – Prepare Belly Floor Cavity for Insulation (MH)

4.1303.1 (a, b, c, d, e) Insulation – Floors— *Manufactured* Housing Floor Cavity Preparation – Insulation of Floor Cavity with Blown Material (MH)

4.1303.2 (a, b, c, d, e) Insulation – Floors— *Manufactured* Housing Floor Cavity Preparation – Insulation of Floor Cavity with Batt Materials (MH)

4.1303.3 (a, b, c, d, e, f, g) Insulation – Floors— *Manufactured* Housing Floor Cavity Preparation – Insulation of Floor Cavity with Spray Foam Material (MH)

4.14 Basements and Crawl Spaces

4.1401 Band/Rim Joists

Preparation Requirements
Prior to installing rim joist insulation sub-grantees ***must*** inspect for, prepare for and document the following issues/concerns:

- Sealing of floor cavities in balloon framed walls by installing insulation plugs (i.e. plastic bags filled with insulation or rigid insulation/air blocks).
- Sealing of all penetrations in the rim prior to installing insulation.
- Rim sealing insulation products that are reimbursable through the NeWAP include:
  - two-part spray foams or
  - Polystyrene or polyurethane rigid insulation board sealed on all edges.

Insulation Installation Requirements

- Rim joist insulation ***must*** be installed in all accessible cavities with a depth of 2 inches or more.

4.1401.1 (a, b, c, d) Insulation – *Basements* & *Crawl Spaces* — Band/Rim Joists – Spray Polyurethane Foam (SPF) (SF)

4.1401.2 (a, b, c) Insulation – *Basements* & *Crawl Spaces* — Band/Rim Joists – Insulation other than Spray Polyurethane Foam (SF)

- Rim Joist insulation ***must*** be a minimum R-10.

4.1402 Basements and Crawl Space Walls

Insulating *accessible foundations* and sealing the thermal boundary(s) in the lower levels of buildings, can provide significant comfort and energy savings. Sealing at the lower level helps to reduce *Stack Effects* that can impact ductwork leakage in lower levels and indoor air quality.

Preparation and Air Sealing Requirements
Prior to installing foundation insulation sub-grantees ***must*** inspect for, prepare for and document the following issues/concerns:

- The location of walls between an *Unconditioned Crawl Space* and *conditioned Basement* areas must be weatherized.
- Appropriated accessibility to Crawlspaces /*accessible foundation*:
  - Accesses ***must*** be installed in all accessible crawlspaces.
  - A minimum of one access ***must*** be installed.
  - New *Crawl Space* accesses ***must*** be located in an area agreeable to the client and conducive to insulating.
  - New access cover and/or hardware ***must*** be installed if necessary.
- Appropriate air sealing and insulation of exterior accesses to crawlspaces:
  - Existing exterior accesses ***must*** be weather-stripped and insulated with minimum R-11 batt or a minimum R-7 rigid insulation. The last fastener of the weather-stripping must be located within 2-1/2 inches from the end of the weather-strip.
  - Hardware may be added if necessary.
  - Accesses adjacent to *conditioned* areas where the common walls are treated ***must*** be weather-stripped and insulated. The last fastener of the weather-stripping must be located within 2-1/2 inches from the end of the weather-strip.
  - New exterior accesses ***must*** be constructed of ¾ inch *Pressure Treated* plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism and be weather-stripped and insulated with minimum R-11 batt or a minimum R-7 rigid insulation. The last fastener of the weather-stripping must be located within 2-1/2 inches from the end of the weather-strip.
  - Existing accesses that do not provide 16" x 24" (thru crawlspace wall) and 18" x 24" (thru floors) access ***must*** be reframed to provide a minimum opening of 20 inches to accommodate the insulation and access.
- Any new framing ***must*** be *Pressure Treated*, redwood or cedar.
- New floor accesses ***must*** be properly supported.

General Foundation Insulation Installation Requirements

- Foundation wall insulation products that are reimbursable through the NeWAP include:
  - two-part spray foams,
  - polystyrene or polyurethane rigid insulation board sealed on all edges, or
  - draped batt insulation sealed appropriately, in limited cases when no moisture threats are present.
- Foundation insulation in *Basements* ***must*** be installed as per local and state Code requirements.
- Installed insulation must have no significant voids or edge gaps.

Basement Wall Installation Requirements

- If batt insulation is used the wall must be framed to adequately support the insulation.
- If foam board is used the insulation must be attached to the foundation wall with construction adhesive or masonry nails or a combination of the two.
- Insulation must be covered as required by local or state code jurisdiction requirements.
- *Basement* wall insulating systems must be installed according to manufacturer's instructions and be a minimum R-10.

4.1402.2 (a, b, c) Insulation – *Basements* & *Crawl Space* Walls – *Basement* Wall Insulation – No Groundwater Leakage (SF) (MH)

Crawl Space and Ledged Basement Walls Installation Requirements

- Crawlspace and *Ledged Basement* wall must be insulated with faced batt foam board or *Spray-Applied Insulation*.
- The insulation must fill the sill box, extend down the foundation wall and lay a minimum of 24 inches on top of a ground laid moisture barrier.
- To ensure there are no gaps in the wall insulation, standard 24 inch wide batts must be used in areas of 16 inch floor joist spacing and standard 16 inch batts must be used in areas of 24 inch joist spacing.
- If faced batt insulation is installed, the *Vapor barrier* must be to the warm side.

4.1402.1 (a, b, c, d, e, f, g) Insulation – *Basements* & *Crawl Space* Walls – Closed *Crawl Spaces* – Wall Insulation (SF)

4.16 Ducts

Sealing, repairing and insulating existing *accessible duct* work provides Nebraska Weatherization Assistance Program (NeWAP) clients with energy cost reductions and improved comfort. Sealing leaky ducts also help to improve indoor air quality.

Prior to sealing and/or insulating ducts NeWAP sub-grantees ***shall***:

- Inspect and evaluate the existing system to ensure that all ducts and plenums are properly fastened, supported and sealed to reduce air leakage.

3.1601.1 (a, b, c, d, e, f, g, h, i, j) Ducts – Duct Preparation - Preparation and Mechanical Fastening (SF)

3.1601.2 (a, b) Ducts – Duct Preparation - Preparation for SPF Application (SF) (MH)

3.1601.3 (a) Ducts – Duct Preparation - Support (SF)

3.1601.4 (a) Ducts – Duct Preparation - Support for Horizontal, Suspended Ducts (MH)

3.1601.5 (a, b, c, d, e, f, g, h, i) Ducts – Duct Preparation - Preparation and Mechanical Fastening (MH)

- Test ducts to determine the size and location of leaks.
- Consider sealing supply and return registers in unoccupied *Basements*/rooms.

Prior to sealing and/or insulating ducts NeWAP sub-grantees ***must*** verify and make reasonable attempts to ensure that duct systems are providing balanced, adequate airflow to living spaces. When airflow is a problem sub-grantees ***must*** consider the following options:

- Cleaning the filter or replacing disposable filters.
- Repairing, realigning or replacing damaged, missing or restricted floor registers.
- Realigning and securing disconnected duct work.
- Moving/installing filter racks into an area that is convenient and conducive for the customer to access.
- Removing obstructions to registers and ducts.
- Eliminating kinks in existing flex duct and replacing collapsed ducts with metal duct.
- Installing new duct work or *Hydronic pipes* to balance the system and/or provide conditioned air throughout the building.
- Installing a transfer grille(s) to improve airflow in the building.
- *Under-cutting* interior doors.

4.1601 Insulating Ducts

Duct Insulation

- Insulate supply ducts that run outside the thermal boundary with a minimum of R-8 vinyl, foil faced insulation or two part foam insulation.
- Do not insulate ducts that run through *Conditioned Space* unless they cause overheating in winter or condensation in summer.
- Seal the duct work before insulating.
- Cover all exposed supply ducts, leaving no areas of uninsulated duct.
- Fasten the insulation by mechanical means such as plastic straps, cord, wire, plastic or nylon bands.
- Use only tape, specifically manufactured for covering and securing joints.
- Install *Vapor barriers* the exterior sealing the joints with duct sealing tape, caulking or mastic.

4.1601.2 (a, b, c, d) Ducts – Insulating Ducts - Insulating Metal Ducts (SF)

4.1601.3 (a, b, c) Ducts – Insulating Ducts - Insulation and *Vapor barrier* (MH)

4.1601.5 (a, b, c, d, e) Ducts – Insulating Ducts - Insulating Metal Ducts (MH)

5 Heating and Cooling

5.30 Forced Air

5.3001 Design and Replacement

Heating System Replacement Requirements

- The following standards must be followed when furnaces are replaced/installed through the Nebraska Weatherization Assistance Program:
- Eligible unsafe *Heating Plants* in single family and *Manufactured Homes* that cannot be repaired, as determined by a *Qualified Heating Technician or*, *Certified Weatherization Staff* must be replaced.

- If a *Qualified Heating Technician* determines that a unit must be replaced, the unit must receive a second inspection by *Certified Weatherization Staff,* a second *Qualified Heating Technician* or gas utility company.
- Units that contain *Heating Plants* that are *inoperable* or red-tagged at the time of the initial inspection must not be weatherized until the *Heating Plant* has been repaired or replaced.
- With Nebraska Energy Office approval, multiple *Heating Plants* or motorized dampers may be installed to provide zone heating.
- Unsafe space heaters may be replaced with a forced air system.
- With Nebraska Energy Office approval, the *Heating Plant* may utilize a new fuel source.
- Unvented Combustion Space Heaters are not an eligible Heating System and must not be replaced with new Unvented Combustion Space Heaters.
- Existing Unvented Combustion Space Heaters may remain as secondary Heat Sources.

Replacement Heating System General Requirements

- All locations where equipment is to be installed or replaced must be appropriately prepared for the installation of the new equipment.

  5.3002.1 (a, b, c, d, e) Heating & Cooling – Forced Air – Site Preparation – Preparation for New Equipment (SF)

- Forced air furnaces must have a minimum AFUE of 90 percent, boilers a minimum of 85 percent and wall and console heaters, a minimum of 80 percent.
- Efficiency ratings for forced air furnaces and boilers must be listed in the most current edition of the Gas Appliance Manufacturers Association (GAMA) Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment.
- Heat exchangers in all replacement *Heating Plants* must have a minimum 10 year manufacturer's warranty and a minimum 1-year warranty for materials, workmanship, and serviceability.

  2.0702.1 (a, b, c) Health and Safety – Occupant Education and Access – Installed Equipment - Warranty and Service Agreement (SF)

- The replacement *Heating Plant* must be competitively bid and properly sized using the post-weatherization characteristics of the home.

  5.3001.1 (a, b, c) Heating & Cooling – Forced Air - Design – Load Calculation and Equipment Selection (SF)

- A service label must be placed on or near the *Heating Plant* containing the name, business address and phone number of the company or agency performing the work, any repairs that were completed and the date the work was performed.
- Unvented gas and liquid-fueled space heaters that remain in a completed single-family house after weatherization must not have an input rating in excess of 40,000 Btu/hour and must not be located in, or obtain combustion air from sleeping rooms or storage closets.
- Air conditioner evaporator coils of operable air conditioning units must be replaced if they will not fit the new *Heating Plant.*
- Drip pans in poor condition may be replaced.
- Heat rise (supply temperature minus return temperature) must be within manufacturer's specifications.

- High limit should stop fuel flow within 10% of 200° F. Furnace must not cycle on high limit.
- Fan control should be set to activate fan at 130° to 140° F and deactivate it at 95° to 105° F. Slightly higher settings are acceptable if these recommended settings cause a comfort complaint.
- Static pressure, measured in both supply and return plenums should be within manufacturer's specifications.
- Blower should not be set to operate continuously.
- Seal holes through the jacket of the air handler with mastic or foil tape.
- Check clearances of heating unit and its vent connector to nearby combustibles, according to the International Fuel Gas Code (IFGC).
- Clock gas meter to insure correct gas input.
- Test gas water heater to insure that it vents properly after installation of a sealed-combustion, 90+ AFUE furnace. Install a chimney liner if necessary.
- Ensure proper sediment trap on gas line. (dirt leg)

Replacement Heating System Venting, Piping and Ducting General Requirements

- The replacement *Heating Plant* must use the existing *Distribution* System.
- New ductwork or *Hydronic pipes* may be installed to properly balance the system.

5.3001.2 (a, b, c) Heating & Cooling – Forced Air - Design – Ductwork and Termination Design (SF)

- *Hydronic pipes* must be insulated with 1 inch material having a minimum R-4 pipe insulation specifically manufactured as *hydronic pipe* insulation. Joints and elbows must be insulated.
- Flexible ductwork must be no more than 4 lineal feet per run if possible.
- The replacement *Heating Plant* must be properly vented and use outside air for combustion if the unit will accept dedicated combustion air.
- If the replacement *Heating Plant* is installed with existing central air conditioning, the air conditioner evaporator coil should be a cased coil or be raised and made accessible for periodic service and cleaning.
- The condensate line must not be drained to the exterior of the home but to a code approved drain.
- If a new forced-air furnace or boiler is installed that will not be vented through the masonry chimney but the water heater will still be vented through that chimney, a properly sized flue liner must be installed.
- As an alternative, a power vent may be installed on the water heater.
- Furnace filter racks on new *Heating Systems* must be installed in an area that is convenient and conducive for the customer to access. The replacement *Heating Plant* must be properly vented. If the new *Heating Plant* will not be vented through the masonry chimney, but the water heater will still be vented through that chimney, a properly sized flue liner must be installed. As an alternative, a power vent may be installed on the water heater.
- In some instances with prior Nebraska Energy Office approval the installer may add return ducts or supply ducts as part of furnace replacement to improve air distribution, to eliminate duct-induced house pressures, and to establish acceptable values for static pressure and heat rise.
- Supply and return plenums must be mechanically fastened with screws and sealed to air handler with mastic and fabric mesh tape to form an essentially airtight connection on all sides of these important joints.

- All ducts must be sealed.
- Filters should be held firmly in place and provide complete coverage of blower intake or return register. Filters should be easy to replace. (filter racks are to be installed not just a hole cut in the return duct)

Cooling System Replacements Requirements

Cooling system replacements completed through the NeWAP ***must*** be shown as cost-effective through the home's Energy Audit, with appropriate documentation included in the client file, and ***must not*** be charged to the health and safety line item. The following standards ***must*** be followed for air conditioner or heat pump replacements to be reimbursed as eligible expenditures:

- Replacement central air conditioners ***must*** be a minimum 14-SEER (Seasonal Energy Efficiency Factor).
- Replacement heat pumps ***must*** be a minimum 14-SEER and 8.2HSPF (Heating Seasonal Performance Factor). Heat pumps must be installed with ramp-up type thermostats designed to bring backup heat in stages, and only when the heat pump can no longer keep up with demand, and must be able to differentiate between a demand call and a 'return from setback' call for heat.
- The replacement central air conditioner or heat pump ***must*** be properly sized using the post weatherization characteristics of the home with system sizing documentation included in the client file.

  5.3001.1 (a, b, c) Heating & Cooling – Forced Air - Design – Load Calculation and Equipment Selection (SF)

- Replacement central air conditioners and heat pumps ***must*** be replaced by a *Qualified Heating Technician*.
- A service label ***must*** be placed on or near the furnace plenum containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed.

Ductwork Replacement Requirements

New ductwork installed through the NeWAP ***must*** meet the following requirements:

- Flexible duct work ***must*** be no more than 4 lineal feet per run, if possible with appropriate documentation included in the client file.
- New ducts ***must not*** be installed in *Unconditioned Space*s unless absolutely necessary with appropriate justification located in the client file.
- New ducts, excluding jump ducts, ***must*** be physically connected to the existing *Distribution System* or to the furnace.

  5.3001.2 (a, b, c) Heating and Cooling – Forced Air – Design – Ductwork and Termination Design (SF)

  5.3001.3 (a, b, c, d, e) Heating and Cooling – Forced Air – Design – Replace Return Air Systems that Incorporate Floor Cavity (Belly) and/or Attic as the Return Air Pathway (MH)

Replacement Heating System Thermostat General Requirements

- Programmable Thermostat/Setback Thermostats may be installed.

- Mercury thermostats may be replaced with digital thermostats.
- New thermostats must be calibrated and adjusted and any operable accessories that were installed on the existing *Heating System* must be removed and reinstalled on the new *Heating System*, if possible. If a new thermostat is installed, the wire hole in the wall behind the thermostat must be sealed.
- Mercury thermostats must be properly disposed.

5.3003.9 (a, b, c, d, e, f, g, h, i, j, k, l, m) Heating & Cooling – Forced Air – System Assessment & Maintenance – Heating and Cooling Controls (SF)

5.3003.11 (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o) Heating & Cooling – Forced Air – System Assessment & Maintenance – Heating and Cooling Controls (MH)

5.3003 System Assessment/Inspection and Maintenance

Heating System Assessment/Inspection Requirements

Prior to weatherizing the *building envelope*, all *Eligible Heating Plants* over two (2) years of age that have not received a *Safety Inspection* during the twelve (12) months prior to the initial Weatherization inspection must be inspected by a *Qualified Heating Technician*, utility company or *certified weatherization staff*. During testing, make appropriate efforts to repair and adjust the existing furnace or boiler, before deciding to replace it. Replacement parts like gas valves and controls for older heating units are commonly available.

- If the *Safety Inspection* was performed by a *Qualified Heating Technician*, the need for replacement must be confirmed by a utility company, a second *Qualified Heating Technician* or *certified weatherization staff*.
- The *building envelope* must not be weatherized if the owner or client refuses a *Safety Inspection* of the *Heating System* or until any *Heating System* deficiency has been repaired and/or the *Heating Plant* replaced.
- Combustion (*CAZ*) safety testing is required when combustion *Heating Systems* are present.
- Inspect venting of combustion *Heating Systems* and confirm adequate clearances.
- The State of Nebraska's annual heating degree day normal, over the thirty year period from 1971-2000 is 6525, with January Mean °F temperatures that range from 23.2 in the warmest areas of the state to 22.8 in the coldest areas. Clients in units that contain *Heating Plants* that are inoperable or red-tagged are in danger of frost bite, hypothermia and other life threatening issues. Therefore units that contain *Heating Plants* that are inoperable or red-tagged at the time of the initial inspection must not be weatherized until the *Heating Plant* has been repaired or replaced.
- *Eligible Heating Plants* that cannot be repaired must be replaced.
- If a dwelling is heated by *Unvented Combustion Space Heaters* and an inoperable conventional *Heating System* is present, the conventional *Heating System* must be repaired or replaced to eliminate the need for unvented space heaters. If the need for *Unvented Combustion Space Heaters* cannot be eliminated, the sub-grantee must instruct the client regarding the dangers of carbon monoxide and excessive moisture levels, particularly if any *unvented space heaters* are left in the dwelling as a secondary *Heat Source*, or emergency back-up.
- If a dwelling utilizes *Unvented Combustion Space Heaters* as the primary *Heat Source* over 40,000 BTU, the *Unvented Combustion Space Heaters* must be replaced with a vented

combustion *Heating System*.

Safety Inspection Requirements

The *Safety Inspection* must include all of the following that apply to the *Heating System* being inspected:

- Conduct a fuel leakage test of the appliance piping and control system downstream of the meter to the appliance. Natural gas and propane piping systems may leak at their joints and valves. An electronic combustible gas detector (gas sniffer) will find all significant gas leaks if used carefully. Remember that natural gas rises from a leak and propane falls, so position the sensor accordingly.

  5.3003.15 (a, b, c, d, e, f, g, h, i, j) Heating and Cooling – Forced Air - System Maintenance - Combustion Analysis of Oil-Fired Appliances (MH)

  - Sniff all valves and joints with the gas sniffer.

    2.0105.1 (a, b, c) Health and Safety – Safe Work Practices– Heating & Cooling Equipment – Combustion Worker Safety (SF)

  - Accurately locate leaks using a non-corrosive bubbling liquid, designed for finding gas leaks.
  - All gas leaks should be repaired. If gas leak is detected have occupant notify the fuel supplier or a qualified technician.

    2.0105.1 (a, b, c) Health and Safety – Safe Work Practices– Heating & Cooling Equipment – Combustion Worker Safety (SF)

    2.0105.3 (a) Health and Safety – Safe Work Practices– Heating & Cooling Equipment – Combustion Worker Safety (MH)

- Visually inspect the venting system for proper size and horizontal pitch and determine that there is not blockage, vent size reduction or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.
- Inspect burners and crossovers for blockage and corrosion.
- Determine that the pilot is burning properly and that main burner ignition is satisfactory.
- Test the pilot safety device to determine that it is operating properly.
- Visually determine that main burner gas is burning properly.
- If the appliance is equipped with a high and low flame control or flame modulator, check for proper main burner operation at low flame.
- Test for spillage at the draft hood relief opening.
- On furnaces and console heaters, test the heat exchanger for cracks and openings and visually inspect the heat exchanger for excessive corrosion.

  - Look for rust at exhaust ports and vent connector.
  - Look for flame impingement on the heat exchanger during firing.
  - Observe flame movement, change in chimney draft, or change in CO reading as blower is turned on and off.
  - Look for flame-damaged areas near the burner flame.
  - Measure the flue-gas oxygen concentration before the blower starts and just after it has started. There should be no more than a 1% change in the oxygen concentration.

- Examine the heat exchanger, shining a bright light on one side and looking for light traces on the other using a mirror to peer into tight locations.

- On furnaces and console heaters, check the fan control for proper operation.

  5.3003.9 (a, b, c, d, e, f, g, h, i, j, k, m, n) Heating & Cooling – Forced Air – System Assessment & Maintenance – Heating and Cooling Controls (SF)

- Test and confirm the furnace efficiency operating standards.
  - Check heat rise after 5 minutes of operation. Refer to manufacturer's nameplate for acceptable heat rise (supply temperature minus return temperature).
  - The fan-off temperature should be between 90° and 95° F, with the lower end of the scale being preferable for maximum efficiency.
  - The fan-on temperature should be less than 120° F.
  - The high-limit controller should shut the burner off before the furnace temperature reaches 250°F.
  - On time-activated fan controls, verify that the fan is switched on within two minutes of burner ignition and is switched off within 2.5 minutes of the end of the combustion cycle.

- On boilers, inspect for evidence of water or combustion product leaks.
- On boilers, determine that the water pumps and automatic controls are in operating condition.
- If accessible, inspect the central air conditioner coils.
- Check the fan and belt condition.
- Inspect for exposed wiring.

  5.3003.4 (a, b, c, d, e, f, g, h) Heating & Cooling – Forced Air – System Assessment & Maintenance – Evaluating Electrical Service (SF)

  5.3003.16 (a, b, c, d, e, f, g, h, i) Heating and Cooling – Forced Air – System Assessment and Maintenance - Evaluating Electrical Service (MH)

- Inspect the refrigerant lines

  5.3003.5 (a, b, c, d, e) Heating & Cooling – Forced Air – System Assessment & Maintenance – Refrigerant Line Inspection (SF) (MH)

The following additional standards must be followed when *Heating Systems* are designed, inspected, repaired, tune and cleaned and/or replaced through the *Nebraska Weatherization Assistance Program*:

5.3003.1 (a) Heating & Cooling – Forced Air – System Assessment & Maintenance – Data Plate Verification (SF) (MH)

5.3003.3 (a, b, c, d, e, f, g, h) Heating & Cooling – Forced Air – System Assessment & Maintenance – Evaluating Air Flow (SF) (MH)

5.3003.7 (a, b, c, d, e, f, g, h, i) Heating & Cooling – Forced Air – System Assessment & Maintenance – Occupant Education (SF) (MH)

5.3003.10 (a, b, c, d, e, f, g, h) Heating & Cooling – Forced Air - Systems Assessment & Maintenance – Condensate Drainage of Heating and Air Conditioning Equipment (SF)

5.3003.14 (a, b, c, d, e, f) Heating & Cooling – Forced Air - Systems Assessment & Maintenance

– Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas) (SF) (MH)

Heating System Clean & Tune and Maintenance Requirements

The following standards must be followed when *Heating Systems* are repaired and/or tuned and cleaned through the Nebraska Weatherization Assistance Program:

- A tune and clean may be performed on *Eligible Heating Plants*, excluding baseboard and/or cove heat.
- In owner occupied homes, if the material and labor to correct deficiencies in *Eligible Heating Plants* exceeds $500, the unit must be replaced. However, unique situations may be dealt with on a case by case basis.
- In renter occupied homes, if the material and labor to correct deficiencies in *Eligible Heating Plants* exceeds $400, the owner must repair or replace the *Heating Plant*. However, if replacement is made in accordance with the requirements of these installation standards, the Weatherization Assistance Program may contribute a maximum of $500, for the replacement of the *Heating Plant* and flue liner, if one is necessary.
- Weatherization of the *building envelope* must not proceed until the unit has been repaired or replaced.
- A maximum of $500 may be spent to repair unsafe solid fuel combustion *Heating Systems*.
- If a dwelling is heated by *Unvented Combustion Space Heaters* and an inoperable eligible *Heating System* is present, the eligible *Heating System* must be repaired or replaced to eliminate the need for unvented space heaters.
- If the need for *Unvented Combustion Space Heaters* cannot be eliminated, the sub-grantee must instruct the client regarding the dangers of carbon monoxide and excessive moisture levels, particularly if any unvented space heaters are left in the dwelling as a secondary *Heat Source*, or emergency back-up.
- Existing furnaces that will accept dedicated combustion air should be retrofitted.

Gas Fired Furnace Clean and Tune Requirements:

- must be completed by a *Qualified Heating Technician* and must include the following:
  - Lubricating all moving parts
  - Calibrating and adjusting the thermostat
  - Cleaning or replacing the furnace filter
  - Adjusting the *conditioned* air flow, high limit control, fan control and temperature rise
  - Cleaning and adjusting the burners
  - Removing and cleaning the blower
  - Cleaning and vacuuming the return air and furnace cabinet, filter rack, exhaust port and draft hood
  - Cleaning the heat exchanger
  - Adjusting the belt tension or replace the belt
  - Sealing the thermostat wire penetration
  - Testing the furnace for CO and adjusting or repairing the furnace as needed
  - If accessible, inspecting and cleaning the central air conditioner coils.

Electric Furnace Clean and Tune Requirements:

- must be completed by a *Qualified Heating Technician* and must include the following:

- Lubricating all moving parts
- Calibrating and adjusting the thermostat
- Cleaning or replacing the furnace filter
- Adjusting the *conditioned* air flow, high limit control, fan control and temperature rise
- Removing and cleaning the blower
- Cleaning and vacuuming the return air and furnace cabinet, filter rack and electric elements
- Adjusting the belt tension or replacing the belt
- Sealing the thermostat wire penetration
- Testing the heating elements and sequencers
- Inspecting the interior and exterior wiring inside the cabinet on electric units
- If accessible, inspecting and cleaning the central air conditioner coils.

Cooling System Maintenance
The NeWAP provides limited funding to complete repair and/or maintenance on existing central cooling systems including:

- A maximum $500 may be spent to repair heat pumps and central air conditioning systems.
- In renter occupied homes, if the cost to repair the central air conditioner or heat pump exceeds $500, the owner may repair or replace the unit. However, if the central air conditioner or heat pump is replaced in accordance with the requirements of this Field Guide and Installation Standards, the Nebraska Weatherization Assistance Program (NeWAP) may contribute a maximum of $500 to the replacement cost.
- Drip pans in poor condition may be replaced.
- Air conditioner evaporator coils in existing operable units must be replaced if they do not fit in new *Heating Plants* installed as part of NeWAP services.
- Prior to completing repair and/or maintenance on existing central cooling systems the existing unit must be inspected and evaluated with appropriate documentation included in the client file.

5.3003.1 (a) Heating & Cooling – Forced Air – System Assessment & Maintenance – Data Plate Verification (SF) (MH)

5.3003.3 (a, b, c, d, e, f, g, h) Heating & Cooling – Forced Air – System Assessment & Maintenance – Evaluating Air Flow (SF) (MH)

5.3003.7 (a, b, c, d, e, f, g, h, i) Heating & Cooling – Forced Air – System Assessment & Maintenance – Occupant Education (MH)

5.3003.7 (a, b, c, d, e, f, g, h, i) Heating & Cooling – Forced Air – System Assessment & Maintenance – Occupant Education (SF)

5.3003.10 (a, b, c, d, e, f, g, h) Heating & Cooling – Forced Air - Systems Assessment & Maintenance – Condensate Drainage of Heating and Air Conditioning Equipment (SF)

5.31 Hydronic Heating (Hot Water and Steam)

The following standards must be followed when hydronic *Heating Systems* are designed, repaired and/or tuned and cleaned through the Nebraska Weatherization Assistance Program:

5.3101 Design

5.3101.1 (a, b) Heating and Cooling – Hydronic Heating (Hot Water and Steam) – Design – Heat Load Calculation — Whole House (SF)

5.3101.2 (a) Heating and Cooling – Hydronic Heating (Hot Water and Steam) – Design – Space Load Calculation — Heat Emitter Sizing (SF)

5.3104 Equipment Maintenance, Testing, and Repair

5.3104.1 (a, b, c, d, e, f) Heating and Cooling – Hydronic Heating (Hot Water and Steam) – Equipment Maintenance, Testing, and Repair - Controls—Thermostat Replacement (SF)

5.3104.2 (a, b, c, d, e, f, g, h, i) Heating and Cooling – Hydronic Heating (Hot Water and Steam) – Equipment Maintenance, Testing, and Repair - Maintenance: Gas Boiler Service Inspection (SF)

5.3104.3 (a, b, c, d, e, f, g, h, i, j, k, l, m) Heating and Cooling – Hydronic Heating (Hot Water and Steam) – Equipment Maintenance, Testing, and Repair - Maintenance: Checklist (SF)

6 Ventilation

6.60 Exhaust

6.6002 Components

Achieving effective exhaust in all buildings requires appropriate the design, configuration, connection, insulation (depending on location), equipment and terminations. NeWAP sub-grantees *must* utilize the following standards for implementing exhaust ventilation.

6.6002.1 (a, b, c, d) Ventilation – Exhaust – Components - Ducts (SF)

6.6002.2 (a, b, c, d, e, f, g) Ventilation – Exhaust – Components – Terminations (SF)

6.6002.3 (a, b) Ventilation – Exhaust – Components - Exhaust-Only Ventilation (SF) (MH)

6.6002.4 (a, b, c, d, e, f) Ventilation – Exhaust – Components - Ducts (Exhaust Fans) (MH)

6.6003 Fans

NeWAP sub-grantees *must* adhere to the following standards for the purchase and installation of exhaust fans.

6.6003.1 (a, b, c, d, e, f, g, h, i, j) Ventilation – Exhaust – Fans - Surface-Mounted Ducted (SF) (MH)

6.6003.2 (a, b, c, d, e, f, g, h, i) Ventilation – Exhaust – Fans - Inline (SF) (MH)

6.6003.3 (a, b, c, d, e, f, g, h, i, j, k) Ventilation – Exhaust – Fans - Through the Wall (SF)

6.6003.6 (a, b, c, d, e, f) Ventilation – Exhaust – Fans - Fan Placement (Whole House/Common Space Exhaust Only) (MH)

6.6005 Appliance Exhaust Vents

Dryer Vents
Venting dryers indoors, into an attic or other areas of a home can lead to mold to growth, respiratory or more serious health conditions. NeWAP Sub-Grantees *must* vent existing unvented or improperly vented clothes dryers to the exterior of the home using the following installation standards:

- Dryer vent pipe should not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.
- Acceptable fasteners include clamps, straps and duct mastic with mesh tape.
- Dryer vent pipe must be metal and the termination cap must be dampered and attached with rust proof fasteners.
- Dryer vent ductwork must be smooth surfaced and whenever possible, not exceed 14 feet in length.
- No more than two 90 degree elbows may be used in the vent system.
- Relocation of dryers may need to be considered to meet this vent pipe length limitation.
- Flexible metal vent pipe may be used if it does not exceed 8 feet in length. The dryer vent pipe must not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.

6.6003.3 (a, b, c, d, e, f, g, h, i, j, k) Ventilation – Exhaust – Fans - Through the Wall (SF)

6.6005.1 (a, b, c, d, e) Ventilation – Exhaust – Appliance Exhaust Vents - Clothes Dryer (SF) (MH)

Kitchen Range Vents
Venting kitchen range vent indoors, into an attic or other areas of a home can lead to mold to growth, respiratory or more serious health conditions. NeWAP Sub-Grantees *must* vent existing unvented or improperly vented kitchen range vents to the exterior of the home.

6.6003.3 (a, b, c, d, e, f, g, h, i, j, k) Ventilation – Exhaust – Fans - Through the Wall (SF)

6.6005.2 (a, b, c, d, e, f, g) Ventilation – Exhaust – Appliance Exhaust Vents - Kitchen Range (SF) (MH)

6.61 Supply

6.6102 Components

Successfully supplying air into a building with appropriate the design, configuration, connection, insulation (depending on location), equipment and terminations help to improve indoor air quality and prevent condensation. NeWAP sub-grantees *must* utilize the following standards for providing supply air in a home.

6.6102.1 (a, b, c, d, e, f) Ventilation – Supply – Components - Outside Air Ventilation Supply Ducts (SF)

6.6102.2 (a, b, c, d, e, f, g, h) Ventilation – Supply – Components - Intakes (SF)

6.6102.3 (a, b, c, d, e, f) Intake for Ventilation Air to Forced Air System Used for Heating or cooling (SF)

6.6102.4 (a, b, c, d, e, f, g, h) Ventilation – Supply – Components - Intake for Ventilation Air to Forced Air System Used for Heating or Cooling (MH)

6.6188 Special Considerations

NeWAP sub-grantees *must* utilize the following standards regarding supply air in conjunction with garages.

6.6188.1 (a, b, c, d, e, f) Ventilation – Supply – Special Considerations - Removing Supply Vents from Garages (SF)

6.6188.2 (a, b, c, d, e, f, g) Ventilation – Supply – Special Considerations - Removing Supply Vents from Garages (MH)

6.62 Whole Building Ventilation

Mechanical Ventilation to Ensure Acceptable Indoor Air Quality
NeWAP sub-grantees *must* implement the latest version of ASHRAE 62.2 to ensure acceptable indoor air quality in weatherized homes and all project files *must* include appropriate ventilation sizing documentation.

- Complete pre- and post-weatherization ASHRAE 62.2 evaluations to ensure that the home meets the *Standard for Acceptable Indoor Air Quality* and include both evaluations in the client file.
- Install *Continuous Ventilation* as required utilize the following standards air flow requirements, components, sound limitations and client education.

6.6201 Air Flow Requirements

6.6201.1 (a, b, c) Ventilation – Whole Building Ventilation – Air Flow Requirements - Installed System Air Flow (SF)

6.6201.2 (a) Ventilation – Whole Building Ventilation – Air Flow Requirements - Primary Ventilation Air Flow between Rooms (SF)

6.6202 Components

6.6103.1 (a, b, c, d, e, f, g, h) Ventilation – Whole Building Ventilation – Air Flow Requirements Inline or Multi-Port (SF)

6.6202.1 (a, b, c, d, e) Ventilation – Whole Building Ventilation – Air Flow Requirements - Controls (SF)

6.6205 Exhaust-Only Strategies for Manufactured Housing System

6.6205.1 (a, b, c, d, e, f, g) Ventilation – Whole Building Ventilation – Exhaust-Only System - *Manufactured* Housing Exhaust-Only Strategies (MH)

6.6288 Special Considerations

6.6288.1 (a, b) Ventilation – Whole Building Ventilation – Special Considerations - Air Flow Requirements Sound-Rating Limits (SF)

6.6288.2 (a, b) Ventilation – Whole Building Ventilation – Special Considerations - Sound Ratings—New Fan Installation (MH)

6.99 Additional Resources

6.9901 Codes and Standards Resources

6.9901.1 (a) Ventilation – Additional Resources – Special Considerations Supplemental Ventilation Information—ASHRAE 62.2 (SF) (MH)

7 Baseload

Base load is the energy consumed in the home that is not related to heating and/or cooling the home. Base loads include the energy used for lighting, appliances, and water heating, but also includes plug loads for televisions, radios, computers, etc. and they are generally consistent from month to month.

7.80 Plug Load

7.8003 Lighting

Lighting upgrades are one of the most cost-effective options available for reducing a buildings base load. Replacing traditional lights and upgrading switching can save 75% or more on your client's lighting energy costs. Lighting Measures that are indicated as cost-effective in the Energy Audit ***must*** be implemented.

- Lumen output should be matched as closely as possible to the lighting that was removed.

  7.8003.1 (a, b) Baseload – Plug Load – Lighting – Lighting Upgrade (SF) (MH)

- Electro-luminescent or LED nightlights may be installed to replace existing incandescent night lights.

7.81 Water Heating

Water Heating is generally the second highest source of energy usage in a home. The costs associated with water heater repair and/or replacements are eligible for reimbursement through the NeWAP. Water Heating Measures that are indicated as cost-effective in the Energy Audit ***must*** be implemented.

7.8101 Water Use Reduction

Water Saving Showerheads, Faucet Aerators, and Leaky Faucets; don't just consider the water they waste; they also waste the energy that was used to heat the water being lost.

Inspection Requirement

- Inspect faucets for hot-water leaks.
- Showerhead Replacements that are indicated as cost-effective in the Energy Audit ***must*** be implemented.

  7.8101.1 (a, b, c, d) Baseload – Water Heating – Water Use Reduction – Shower Head and Faucet Aerator (SF) (MH)

7.8102 Water Heater Installation and Replacement Requirements

- *Unsafe water heaters* that cannot be repaired ***must*** be replaced. Weatherization of the building must not proceed until the water heater has been repaired or replaced.
- ***With Nebraska Energy Office approval***, replacement water heaters may utilize a new fuel source.
- In owner occupied homes, the replacement of water heaters for energy efficiency reasons may not be charged to the Health & Safety line item.
- New gas water heaters ***must*** have a minimum efficiency of .59 and new electric water heaters ***must*** have a minimum efficiency of .91.
- All repairs and replacements ***must*** be performed by a qualified heating or plumbing technician or utility company.
- A service label ***must*** be placed on or near the water heater containing the name, business address and phone number of the company or agency performing the work, any repairs that were completed and the date the work was performed.

7.8102.1 (a, b) Baseload – Water Heating – Installation & Replacement – Water Heater Selection (SF) (MH)

7.8102.1 (a, b, c, f, g, h, i, j, k, m, n) Baseload – Water Heating – Installation & Replacement – Storage-Type Appliances (SF) (MH)

7.8102.1 (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q) Baseload – Water Heating – Installation & Replacement – On-Demand Appliance (SF) (MH)

7.8103.1 (a, b, c, d, e, f, g, h) Baseload – Water Heating – Maintenance/Inspection – Storage-Type Appliance (SF) (MH)

7.8103.2 (a, b, c, d, e, f, g, h, i, j, k, l, m) Baseload – Water Heating – Maintenance/Inspection – On-Demand Appliance (SF) (MH)

Manufactured Home specific work standards

- Replacement gas water heaters in *manufactured homes* must be specifically designed as *manufactured home* water heaters.

7.8103 Water Heater Maintenance/Inspection/Repair Requirements

- Existing unvented gas water heaters ***must*** be vented to the exterior.
- Missing or damaged drip legs ***must*** be replaced as per local, state and national codes and be plumbed within 6 inches of the floor.
- A ***maximum*** of $250 in material and labor may be spent to correct deficiencies in water heaters. If the material and labor exceeds $250, the unit ***must*** be replaced in owner occupied homes.
- In renter occupied homes, the owner ***must*** repair or replace the water heater. If the replacement is made in accordance to these installation standards the Weatherization Assistance Program may contribute a maximum of $150. Weatherization of the building ***must not*** proceed until the water heater has been repaired or replaced.
- All water heaters ***must*** have working pressure relief valves with drip legs without threaded bottoms.

7.8102.2 (a, b, c, f, g, h, i, j, k, m, n) Baseload – Water Heating – Installation & Replacement – Storage-Type-Appliance (SF) (MH)

7.8103.1 (a, b, c, d, e, f, g, h) Baseload – Water Heating – Maintenance/Inspection – Storage-Type Appliance (SF) (MH)

7.8103.2 (a, b, c, d, e, f, g, h, i, j, k, l, m) Baseload – Water Heating – Maintenance/Inspection – On-Demand Appliance (SF) (MH)

Safety Inspection Standards

The *Safety Inspection* ***must*** include all of the following that apply to the water *Heating System* being inspected:

- Conduct a fuel leakage test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.

  2.0201.1 (b) Health & Safety – Safe Work Practices – Combustion Safety Testing-General – *Combustion Appliance Zone* – Fuel Leak Detection (SF)

- Visually inspect the venting system for proper size and horizontal pitch and determine that there is not blockage, vent size reduction or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.

  2.0201.1 (c) Health & Safety – Safe Work Practices – Combustion Safety Testing-General – *Combustion Appliance Zone* - Venting (SF)

- Inspect burners and crossovers for blockage and corrosion.
- Determine that the pilot is burning properly and that main burner ignition is satisfactory.
- Test the pilot safety device to determine that it is operating properly.
- Visually determine that main burner gas is burning properly.
- Test for spillage at the draft hood relief opening.
- Determine that water heater has a pilot access door, pressure relief valve with drip leg and draft hood.
- Inspect for evidence of water or combustion product leaks.
- Inspect for exposed wiring.

  2.0105.1 (a) Health & Safety – Safe Work Practices – Baseload – Baseload Worker Safety (SF)

  2.0201.1 (a) Health & Safety – Safe Work Practices – Combustion Safety Testing-General – *Combustion Appliance Zone* - Assessment (SF)

7.8104 Water Heating *Distribution System* Requirements

Water Heater Tank and Pipe Insulation and *Distribution System* improvements help to reduce heat loss. These types of improvements can also help to reduce the amount of time that people wait for hot water after they turn on the faucet or shower.

Tank and Pipe Insulation Requirements

- Water heater tank insulation ***must*** be a minimum R-11 blanket secured with tape and bound with a minimum of 2 wire, cord, plastic, or nylon bands on the tank.
- Insulation ***must not*** be installed on water heaters if doing so voids the warranty of the unit.

- Insulation ***must not*** cover the pressure relief valve, end of the drip leg, draft hood, burner air inlet, pilot light access door, thermostat control, drain valve or the top of the water heater on natural gas or propane water heaters.
- Electric water heaters ***must*** have the top insulated and the thermostat control access panels accessible or marked and labeled.
- Insulation ***must not*** cover the pressure relief valve, the drip leg, high limit switch, and plumbing pipes or drain valve on electric water heaters.
- Water lines ***must*** be insulated a minimum of 18 feet of hot and 6 feet of cold in all directions from the water heater, using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.
- *Accessible Hydronic pipes* ***must*** be insulated with 1 inch material having a minimum R-4 pipe insulation specifically manufactured as hydronic pipe insulation. Joints and elbows ***must*** be insulated.
- Each section of preformed pipe wrap ***must*** be fastened with a minimum of 3 wire, cord, plastic or nylon bands.
- Joints and elbows ***must*** be insulated.
- Duct tape ***must not*** be used as a means of fastening pipe wrap.
- Pipe wrap ***must not*** be installed within 3 inches or farther than 4 inches of a flue and/or draft hood.
- Water lines that have asbestos pipe wrap ***must not*** be insulated or sealed in the area containing the asbestos.
- In *Manufactured Homes*: All accessible water lines in the water heater compartment ***must*** be insulated using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.

7.8102.2 (i) Baseload – Water Heating – Installation & Replacement – Storage-Type-Appliance (SF) (MH)

8 Definitions

A

Accessible Attic: An attic with a minimum 24 inch clearance measured from the bottom of the top cord or ridge board to the top of the ceiling joists.

Accessible Ductwork/Hydronic pipes: Ductwork or *Hydronic pipes* with a minimum twenty four (24) inch clearance on a minimum of two (2) sides of the ductwork or *Hydronic pipes*.

Accessible Foundation: A foundation with a minimum 24 inch clearance measured from the bottom of the floor joist to the ground.

Air Infiltration Barrier: A covering that will allow moisture out and not allow air into a space or wall cavity.

Accessible Knee walls: A *Knee wall* with a minimum 36 inch clearance measured from the top of the floor joist to the bottom of the rafters and a minimum 36 inch clearance measured from the *Knee wall* to the exterior wall.

Atmospherically Vented Combustion Appliance:
The most common type of gas appliances are atmospherically vented. They use a natural way to move the flue gases from the unit out with a vertical metal pipe, sometimes connected to the chimney, where the hot flue gases rise through the draft hood and flue pipe, and out into the atmosphere. The advantage of these types of appliances is the lower cost of the units and installation; however they also generally have a lower efficiency rate than the other systems.

B

Backdraft Damper: A damper that allows air to flow in only one direction.

Basement: The bottom full height story of a building below the first floor. A *Basement* may be partially or completely below grade.

Building Envelope: The elements of a building between the interior and exterior environments that includes a combination of both the air and thermal barrier.

C

Certified Weatherization Staff: A sub-grantee staff person who has successfully completed appropriate training to perform a task in the weatherization program.

cfm^{50}: Cubic feet per minute of airflow at a 50 Pascal pressure difference between the interior and exterior of a structure.

Combustion Appliance Zone (*CAZ*): An area containing one or more atmospherically vented combustion appliances.

Conditioned Space: A space that contains a source intended specifically to heat or cool that space.

Continuous Ventilation: The process of mechanically removing stale air from a building or room by providing fresh air on a slow, continuous basis.

Cost Effective Blower Door Guided Air sealing: The process of using a blower door to pressurize a home or building to determine the energy savings ratio between the calculated air sealing cost and *Infiltration* reduction.

Crawl Space: A space below the first floor of a conditioned or *Unconditioned* building that is less than full story height.

Crossover-Duct: Enclosed air pathway to move conditioned air from one side of a double-wide *manufactured home* to the other side or from a *manufactured home* to a frame edition.

D

Dense pack: The process of installing loose-fill insulation at a density that allows it to reduce air flow and perform to a stated R-value.

Distribution System: The enclosed pathway for conditioned air to travel to and from the heating/cooling plant. It ***must*** include but is not limited to the metal or fiber duct, panned floor cavity, designated wall cavity and the point where funnels and boots meet the wall or floor.

Direct Vent Appliances:
Direct vent units are generally newer units designed to supply outdoor air directly to the sealed combustion chamber and then exhaust the flue gases to the outside of the home. Direct vent units include most condensing furnaces, *manufactured home* furnaces, *manufactured home* water heaters and some space heaters.

Disabled/Inoperable Heating Plants: *Heating Plants* that have had the fuel source disconnected and/or capped and the flue disconnected.

E

Egress window: A window that people can escape through in an emergency. The location, size and clearance requirements are dictated by the local building jurisdiction.

Eligible Heating Plant: A furnace or boiler that utilizes natural gas, propane, fuel oil or electricity as the fuel/energy source. *Eligible Heating Plants* include forced air, gravity, wall, floor, electric baseboard, furnaces, heat pumps and boilers. Gravity furnaces that have been retrofitted with a blower or that have been converted from one fuel source or another are also eligible.

Exposed Floors: A floor that is in direct contact with the outside air (i.e. cantilevers, floors of bay or bow windows, garage ceilings, etc.).

F

Finished Attic: An attic space in a home that has been converted into an additional living space.

Fenestration: Openings in the walls of a building structure (i.e. windows, doors, etc.).

H

Hard Wired Alarms: Alarms (Smoke, Propane, CO, Moisture) that are wired directly into the building's electrical system.

Heating Plant: A boiler or furnace, not including the flue, fuel piping, thermostat, *Distribution System*, etc.

Heating System: A *Heating Plant* and the associated connections necessary for operation including, but not limited to, the flue, fuel piping, thermostat, *Distribution System*, etc.

Heat Source: Type-B vent, masonry chimneys that vent natural gas or propane and exhaust fans.

High Heat Source: Heat produced through the combustion process by solid fuel and/or fuel oil combustion appliances. Recessed lighting is also considered a *High Heat Source*.

Hydronic pipes: Piping system used to distribute water or steam to and from water boilers or steam *boilers*.

I

Inaccessible Underbellies: A *manufactured home* underbelly with less than 24 inches clearance, measured from the *Weatherboard* to the ground at the area to be weatherized.

Incidental Repair Cost: Repair costs related to ensuring the effective performance or preservation of a new or existing weatherization measure.

Infiltration: The uncontrolled passage of outside air into a building through leaks in the *building envelope*.

Insulated Glass: The combination of two or more panes of glass sealed with air or inert gas between the panes.

K

Knee wall: A vertical wall between an attic and a *Conditioned Space*.

L

Ledged Basement: A *Basement* constructed with a concrete or dirt ledge less than 6 feet front to back, around the perimeter of the foundation. The ledge may be only around a portion of the foundation wall. Ledges more than 6 feet front to back are considered a *Crawl Space*.

Living area: An area within the conditioned envelope that is used on a regular basis for sleeping, eating, bathing etc.

M

Manufactured Homes: Commonly known as mobile homes, is a type of prefabricated home that is assembled in a factory and transported to a site.

MERV (Minimum Efficacy Reporting Value) Filter: A filter that is tested, and rated, for its ability to filter and remove different size partials (pollutants) from the air. Basically, the higher the *MERV* rating, the higher the filtering performance.

Multi-family Buildings: The U.S. Department of Energy defines multifamily buildings based primarily on building size and heating characteristics:

- Small Multifamily: 5-25 units individually heated/cooled, ≤ 3 stories in height
- Large Multifamily: 25+ units, ≥ 4 stories in height
- 5-25 units centrally heated/cooled, any height

O

Orphaned Equipment: A smaller combustion appliance (e.g., water heater) that remains in place after a larger appliance, that was commonly vented with the remaining unit, is removed or replaced and no longer utilizes the common vent. The larger exhaust flue or chimney that the unit continues to utilize is generally larger than necessary for the remaining smaller appliance.

P

Perm rating: The measurement of a material's ability to allow the transfer of water vapor through the material.

Pressure Treated: Lumber that has been commercially treated under pressure with a wood preservative to prevent damage from moisture, insects, fungi and other forms of biological decay.

Programmable Thermostat/Setback Thermostat/Setback Thermostat: A thermostat designed to adjust temperature settings according to a series of programmed settings that take effect at different set times of the day.

Q

Qualified Heating Technician: An individual or company that is specifically involved in the installation and/or servicing of residential heating/ cooling systems.

Quality Control Inspection: An inspection that verifies that the work completed on the home complies with quality work standards and program regulations as defined by the Nebraska Energy Office and the U.S. Department of Energy.

S

Safety Glass: A type of glass that is designed to resist breaking, and to break in a way that minimizes the risk of injuries in the event the glass cannot withstand the forces on it.

Safety Inspection: An inspection performed by a *Qualified Heating Technician*, a natural gas utility, a propane supplier or *certified weatherization staff*.

SIR (*Savings to Investment Ratio*): A ratio of economic performance as calculated by NEAT MHEA and TREAT audits. An *SIR* of 1.0 indicates the weatherization measure will pay for itself one time during its life.

Spray-Applied Insulation: Insulation manufactured specifically to be spray-applied.

Stack Effect: The tendency for warm air to move upwards in a building or chimney, creating pressure differentials.

T

Tempered Glass: Toughened type of *Safety Glass* processed by control thermal or chemical treatments to increase its strength compared with normal glass.

Tube-fill method: An insulation technique developed to install high density blown insulation in enclosed cavities.

Type-S-Fuse: A non-removable adapter that is screwed into the fuse socket permitting only one size fuse to be installed.

U

Unconditioned: An area having no source of heating or cooling.

Under-cut: To cut the bottom of an interior door to allow return air to flow from that area to the furnace compartment or common return.

Unsafe water heater: A unit that 1) has been red tagged by a utility company/supplier or a building code jurisdiction, 2) shows visual signs of deterioration such as scorch marks indicating past backdrafting occurrences 3) shows signs of compromised water tank integrity as evidenced by signs of leakage 4) when tested exceeds 100-ppm as measured in the flue gases or 0-ppm in the ambient air and the CO levels cannot be reduced.

Unvented Combustion Space Heater: An unvented gas heating unit generally intended to supply heat to a small area.

V

Vapor barrier: A material that retards the passage of water vapor and contains a *Perm rating* of less than 1.

Vapor retarder: A material that slows the passage of water vapor and contains a *Perm rating* above 1.

W

Weatherboard: A covering consisting of a minimum # 30 felt paper, exterior grade plywood, fiberboard, an *air Infiltration barrier* or a material specifically manufactured as *manufactured home Weatherboard* installed on the underside of a *manufactured home* to support and protect the floor insulation.

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2 Health and Safety

2.01 Safe Work Practices

2.0100 Safe Work Practices

2.0100.1 Global Worker Safety

2.0100.1b – Hand protection

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

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

Objective(s):

Minimize skin contact with contaminants

Protect hands from sharp objects

Unsafe
Recognize potential risks

Safe
Wear appropriate hand protection

GOOD:
Wear nitrile gloves when handling mastic

Inspect gloves for holes and damage to minimize risk

2.0100.1c – Respiratory protection

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

If the risk of airborne contaminants cannot be prevented, proper respiratory protection will be provided and worn (e.g., N-95 or equivalent face mask)

When applying low pressure 2-component spray polyurethane foam, air purifying masks with an organic vapor cartridge and P-100 particulate filter will be used

When applying high-pressure SPF insulation, supplied air respirators (SARs) will be used

Consult MSDSs for respiratory protection requirements

Objective(s):

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

Unsafe
Workers need to properly protect their airways when retrofitting

Best Practice
Retrofits can have multiple different respiratory protection requirements

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

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

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

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

When unsure what level of protection is necessary, check the MSDS

2.0100.1d – Electrical Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

An electrical safety assessment will be performed

All electric tools will be protected by ground-fault circuit interrupters (GFCI)

Three-wire type extension cords will be used with portable electric tools

Worn or frayed electrical cords will not be used

Water sources (e.g., condensate pans) and electrical sources will be kept separate

Metal ladders will be avoided

Special precautions will be taken if knob and tube wiring is present

Aluminum foil products will be kept away from live wires

For arc flash hazards, NFPA 70E will be consulted

Objective(s):

Avoid electrical shock and arc flash hazards

Unsafe

Inspect house for unsafe electrical situations

Attics and crawl spaces should be inspected closely for electrical safety before work begins

Use GFCIs and three-wire extension cords for all power tools

Electrical wiring should not be located near a water source

Use fiberglass ladders in place of metal

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

Follow NFPA 70E 2012 guidelines for arc flash hazards

2.0100.1e – Carbon monoxide (CO)

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

All homes will have a carbon monoxide alarm

Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm)

Objective(s):

Protect worker and occupant health

Unsafe
STOP WORK if CO levels are higher than 35ppm!!

Best Practice
Install carbon monoxide alarms

Tools:

1. CO meter

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home.

2.0100.1f – Protective clothing

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

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

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

Objective(s):

Protect worker from skin contact with contaminants

Minimize spread of contaminants

Before

After

Workers should be aware of work required and dress appropriately

Ensure workers have proper protective equipment for work environment

2.0100.1g – Confined space Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Access and egress points will be located before beginning work

Inspection will be conducted for frayed electrical wires

Adequate ventilation will be provided

Use of toxic material will be reduced

Objective(s):

Prevent build-up of toxic or flammable contaminants

Provide adequate access and egress points

Prevent electrical shock

After

Locate all access and egress points of confined spaces before entering

Perform visual inspection of confined spaces before beginning work

Check for frayed or worn electrical wires

In confined spaces, use a ventilator

Check GHS labels and Safety Data Sheets for all materials to minimize hazards

2.0100.1h – Power tool Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Power tools will be inspected and used in accordance with manufacturer specifications and OSHA regulations to eliminate hazards such as those associated with missing ground prongs, ungrounded circuits, misuse of power tools, noise, and improper or defective cords or extension cords

All devices used will be verified as GFCI protected or double insulated

Exhaust gases from compressors and generators will be prevented from entering interior space

Objective(s):

Prevent power tool injuries

2.0100.1i – Chemical Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Hazardous materials will be handled in accordance with manufacturer specifications or MSDS standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers

Appropriate personal protective equipment (PPE) will be provided

Workers will be trained on how to use PPE

Workers will be expected to always use appropriate PPE during work

Objective(s):

Prevent worker exposure to toxic substances

- The costs associated with the handling of, or the training associated with the handling of, Hazardous materials are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0100.1j – Ergonomic Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Appropriate PPE will be used (e.g., knee pads, bump caps, additional padding)

Proper equipment will be used for work

Proper lifting techniques will be used

Objective(s):

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

Unsafe
Workers will take precautions to protect themselves on the job site

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

2.0100.1k – Hand tool Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Hand tools will be used for intended purpose

Objective(s):

Prevent hand tool injuries

2.0100.1l – Slips, trips, and falls

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Caution will be used around power cords, hoses, tarps, and plastic sheeting

Precautions will be taken when ladders are used, when working at heights, or when balancing on joists

Walk boards will be used when practical

Appropriate footwear and clothing will be worn

Objective(s):

Prevent injuries due to slips, trips, and falls

2.0100.1m – Heat and thermal stress

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Appropriate ventilation, hydration, rest breaks, and cooling equipment will be provided

911 will be dialed when necessary

Objective(s):

Prevent heat stroke, heat stress, and cold stress related injuries

Attics and crawl spaces can be dangerous work places in the heat

Keep workers comfortable with hydration and cool vests

2.0100.1n – Fire Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Ignition sources will be identified and eliminated (e.g., turn off pilot lights and fuel supply)

Use of flammable material will be reduced and fire-rated materials will be used

Objective(s):

Prevent a fire hazard

2.0100.1o – Asbestos-containing materials (ACM)

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Assess potential asbestos hazard; if unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material and to sample and test as needed

If suspected ACM is in good condition, do not disturb

If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s)

For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair in accordance with federal, state, and local requirements; only a licensed or trained professional may abate, repair, or remove ACM

When working around ACM, do not:

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

Asbestos abatement or repair work should be completed prior to blower door testing; exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing) unless the material has been tested and found not to contain asbestos

Objective(s):

Protect workers and occupants from potential asbestos hazards

- The costs associated with asbestos testing, remediation or removal are not eligible expenditures in the *Nebraska Weatherization Assistance Program*. If the presence of asbestos has been previously confirmed or if the Sub-grantee believes that asbestos is present:
- The sub-grantee shall take precautionary measures as if asbestos is present such as using personal air monitors,
- Performing blower door testing using pressurization instead of depressurization, and
- In the case of asbestos siding, use precautions during removal to not damage the siding.
- Asbestos siding should never be cut or drilled. When possible, insulate the exterior walls of the home through the home interior.

2.0100.1p – Lead paint assessment

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

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

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

Objective(s):

Protect workers and occupants from potential lead hazards

2.0103 Air Sealing

2.0103.1 Air Sealing Worker Safety

2.0103.1a – Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

All worker safety specifications in Global Worker Safety section will be followed

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0104 Insulation

2.0104.1 Insulation Worker Safety

2.0104.1a – Worker Safety

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

Follow all worker safety specifications in Global Worker Safety section

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0104.1b – Vermiculite

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

OSHA asbestos abatement protocol 29 CFR 1926.1101 will be followed if vermiculite insulation is present

If unsure whether material contains asbestos, a qualified asbestos professional will be contacted to assess the material and to sample and test as needed

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

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

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

Objective(s):

Protect workers from toxic exposure

Before
Material identified as vermiculite may contain asbestos

After
If asbestos is suspected, call an EPA-accredited professional

- Observe OSHA 29CFR 1926.1101 abatement protocol when asbestos is suspected.
- The costs associated with the sampling and testing suspected Vermiculite materials are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

Do not disturb vermiculite by vacuuming, dusting, or sweeping

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

2.0104.1c – Respiratory protection

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

All materials will be handled in accordance with manufacturer specifications or Material Safety Data Sheet (MSDS) standards to eliminate hazards associated with incorrect, defective, or improperly used respirator and personal protective equipment (PPE)

Objective(s):

Protect workers from toxic exposure

2.0104.1d – Lead paint assessment

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

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

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

Objective(s):

Protect worker and occupant from potential lead hazards

2.0105 Heating and Cooling Equipment

2.0105.1 Combustion Worker Safety

2.0105.1a – Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

All worker safety specifications in Global Worker safety section will be followed

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0105.1b – Carbon monoxide (CO)

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient

CO level inside the home or work space exceeds 35 parts per million (ppm)

Objective(s):

Protect worker and occupant health

Before

After

STOP WORK if CO levels measure above 35ppm!!

Install carbon monoxide alarm if none are found.

Tools:

1. CO meter

2.0105.1c – Raw fuel

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Raw fuel leaks will be monitored for before entering building spaces

If leaks are found, testing will be discontinued and condition reported to occupant immediately

Objective(s):

Protect worker and occupant health

Before
Fuel leaks need to be repaired by appropriate professional

After
Notify occupant of any leaks

Tools:

1. Gas sniffer
2. Bubble solution

Check all raw fuel lines for leaks

Use multiple methods to test for leakage--bubble solution

If bubbles develop, leak is present. Notify occupant

Any leaks found should be reported to occupant and work stopped

Any leaks found should be reported to occupant and work stopped

2.0105.2 Heating and Cooling Worker Safety

2.0105.2a – Worker safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Follow all worker safety specifications in Global Worker safety section

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0105.2b – Mercury

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

When replacing existing thermostats, identify and dispose of any mercury containing thermostats in accordance with Environmental Protection Agency (EPA) guidance

Objective(s):

Protect workers and occupants from mercury exposure

Unsafe
Mercury thermostats should be replaced and disposed of properly

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

- Paraphrased from 40 CFR 273.14: A universal waste mercury-containing thermostat or container containing only universal waste mercury-containing thermostats should be labeled or marked clearly with any of the following phrases: "Universal Waste-Mercury Thermostat(s)," "Waste Mercury Thermostat(s)," or "Used Mercury Thermostat(s)." **Contact thermostat-recycle.org or earth911.org for recycling options.

2.0105.2c – Asbestos

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Identify asbestos hazards in boiler and pipe insulation and remediate in accordance with EPA guidelines

Objective(s):

Protect workers and occupants from asbestos exposure

Unsafe
Suspicious pipe insulation may contain asbestos

When asbestos is suspected, call in EPA-accredited professionals.

- The costs associated with the testing and remediation of Asbestos materials are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0105.2d – Protective clothing

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Long sleeves and long pants should be worn as additional protection from liquid refrigerants and other skin hazards

Objective(s):

Protect worker from skin contact with liquid nitrogen

Unsafe
When working with refrigerants, short sleeves are inappropriate

Safe
When working with refrigerants, workers should dress appropriately

2.0106 Ventilation Equipment

2.0106.1 Ventilation Worker Safety

2.0106.1a – Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Follow all worker safety specifications in Global Worker safety section

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0107 Baseload

2.0107.1 Baseload Worker Safety

2.0107.1a – Worker Safety

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

All worker safety specifications in Global Worker safety section will be followed

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0110 Material Safety

2.0110.1 Material Selection, Labeling, and Material Safety Data Sheets (MSDSs)

2.0110.1a – Material selection

Desired Outcome:

Occupant and worker risk from hazardous materials minimized

Specification(s):

Materials that do not create long-term health risks for occupants and workers will be used

Objective(s):

Improve indoor air quality in the living space

2.0110.1b – Material labels

Desired Outcome:

Occupant and worker risk from hazardous materials minimized

Specification(s):

Manufacturer specifications will be followed

Objective(s):

Reduce risk of exposure to harmful substances

Follow safety procedures

2.0110.1c – Material Safety Data Sheets (MSDSs)

Desired Outcome:

Occupant and worker risk from hazardous materials minimized

Specification(s):

MSDSs will be provided onsite and available during all work

Objective(s):

Assess exposure risk

Prepare a response in case of emergency

2.0111 Basements and Crawl Spaces

2.0111.1 Basements and Crawl Spaces Worker Safety

2.0111.1a – Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

All worker safety specifications in Global Worker safety section will be followed

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0111.2 Crawl Spaces—Pre-Work Qualifications

2.0111.2a – Fuel Leaks

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Fuel leaks will be repaired and inspected in accordance with the 2012 IRC

Objective(s):

Ensure site is safe and ready for upgrade

Unsafe
Fuel leaks need to be repaired

Safe
Repairs need to be tested and verified to no longer leak

Tools:

1. Combustion gas detector
2. Testing solution

- The costs associated with the repair of fuel leaks are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- If extensive fuel leaks are discovered sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status.
- Paraphrased from 2012 IRC G2417: Leakage will be located using an approved combustible gas detector, a noncorrosive leak detection fluid or an equivalent nonflammable solution. Matches, candles, open flames or other methods that could provide a source of ignition cannot be used. Where leakage or other defects are located, the affected portion of the piping system will be repaired or replaced and retested.

1
Fuel leaks discovered during initial audit should be flagged

2
Use approved combustion gas sniffer to see if repaired line still leaks

3
Repeatedly test repair site for leakage over a 10 min period

4
Allow testing solution to sit on newly repaired pipe joint for 10 min

5
Confirm repair and remove flag

2.0111.2b – Electrical hazards

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Electrical hazards will be eliminated and inspected in accordance with NFPA 70 National Electric Code

Objective(s):

Ensure site is safe and ready for upgrade

- The costs associated with eliminating electrical hazards are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- If the electrical hazards are extensive, sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status.

2.0111.2c – Mold

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Appropriate remediation will be completed before upgrade

Objective(s):

Ensure site is safe and ready for upgrade

- The costs associated with moisture remediation are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- In the case of extensive mold concerns sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status.

2.0111.2d – Plumbing and water leaks

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Plumbing leaks will be repaired before crawl space upgrade in accordance with the 2012 IRC

Objective(s):

Prepare site for upgrade

- The costs associated with repairing plumbing leaks are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- When extensive plumbing and water leaks are discovered sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status.

2.0111.2e – Pest and termite work

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Pest and termite treatment will be completed before crawl space upgrade and inspected in accordance with the 2012 IRC

Objective(s):

Prepare site for upgrade

- The costs associated with pest and termite remediation are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

- If extensive pest issues are discovered sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status

2.0111.2f – Structural repairs, modifications

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Structural repairs and modifications will be inspected and completed before crawl space upgrade in accordance with the 2012 IRC

Objective(s):

Prepare site for upgrade

- The costs associated with structural repair or modification are not eligible expenditures in the Nebraska *Weatherization Assistance Program*.
- If structural issues are discovered sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status

2.0111.2g – Appliance and heating, ventilation, and air conditioning (HVAC) system repairs and change outs

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Crawl space upgrades (e.g., sealing and insulation) are to be undertaken after appliance and HVAC system work has been completed and inspected

Objective(s):

Prepare site for upgrade

2.0111.3 Crawl Spaces — Debris Removal

2.0111.3a – Debris removal

Desired Outcome:

Clean, safe, and easily accessible crawl space created

Specification(s):

Under-floor grade will be removed of all vegetation and organic material

Debris that can cause injury or puncture ground covers (e.g., nails, glass, sheet metal screws, etc.)

will be removed from the crawl space

Objective(s):

Minimize punctures in ground liner

Minimize habitat for pests (Integrated Pest Management—IPM) and contaminant sources

Before
Crawl spaces with trash and overgrowth need to be made clean and safe.

After
Rake up and clear away trash and overgrowth.

Tools:

1. Rake
2. Shop vacuum
3. PPE

- The costs associated with debris removal are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- If excessive debris is discovered sub-grantees are expected to use good judgment in dealing with the situation. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status

2.0111.3b – Debris disposal

Desired Outcome:

Clean, safe, and easily accessible crawl space created

Specification(s):

Debris will be properly disposed of according to type and jurisdiction

Objective(s):

Protect environment from damage

- The costs associated with debris removal and disposal are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

- Sub-grantees are expected to use good judgment in dealing with these difficult situations. The client shall be advised of the problem, and if possible, may be referred to other service organizations that may be able to assist in solving the problem. The client shall be informed in writing as to why the dwelling cannot be weatherized. If there are conditions that the client must correct before weatherization services are provided those conditions must also be stated in writing. The Sub-grantee shall clearly indicate in the client file why the dwelling was given "deferral" status

2.0111.4 Negative Pressure Contamination Control

2.0111.4c – Pressure

Desired Outcome:

Contaminants prevented from entering house during work process

Specification(s):

A negative pressure will be maintained in the crawl space with reference to the house while work is being performed in the crawl space

Objective(s):

Prevent contaminants from entering house

2.02 Combustion Safety

2.0201 Combustion Safety Testing-General

2.0201.1 *Combustion Appliance Zone* (*CAZ*) Testing

2.0201. 1a – Assessment

Desired Outcome:

Accurate information about appliance safe operation is gathered

Specification(s):

Emergency problems (e.g., gas leak, ambient CO levels that exceed 35 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested

Determine if combustion and dilution air is adequate for proper combustion and venting of all equipment within the *CAZ*

Examine appliance for signs of damage, misuse, improper repairs, and lack of maintenance

Objective(s):

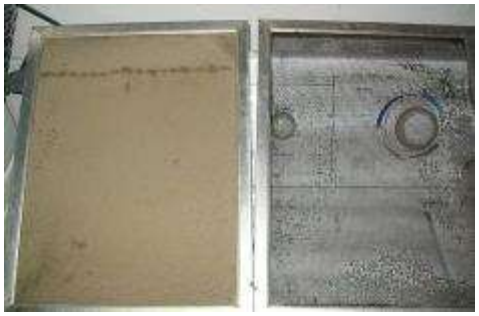
Ensure system does not have fatal problems

Ensure combustion appliance has adequate combustion and dilution air

Before
Unsafe combustion appliances indicate need for repair or replacement

After
In cases of replacement, ensure new appliance is safe and sized properly

Assess existing combustion appliances for damage and replace when necessary



When a simple filter cleaning or replacement will help, make it happen

Ensure there is adequate make-up air -- combustion air inlet in closet

Stop the misuse of combustion appliances -- camp heater in bedroom

Keep occupant apprised of any health or safety concerns

2.0201.1b – Fuel leak detection

Desired Outcome:

Accurate information about appliance safe operation is gathered

Specification(s):

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

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

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

Objective(s):

Detect fuel gas leaks

Determine and report need for repair

Before
Fuel lines should be inspected for leakage

After
If leaks are found, notify occupant immediately to facilitate repair

Tools:

1. Gas sniffer
2. Spray bottle

Materials:

1. Bubble solution

- The costs associated with the repair of exterior gas and oil line leaks and/or damage may not be eligible for reimbursement through the *Nebraska Weatherization Assistance Program*.

Inspect exterior gas and oil lines for leaks and damage

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

2.0201.1c – Venting

Desired Outcome:

Accurate information about appliance safe operation is gathered

Specification(s):

Combustion venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards

Objective(s):

Determine if a draft regulator is present and working and if vent system is in good condition and installed properly

Unsafe
If ventilation system puts occupants at risk, it needs immediate attention

Safe
Properly vented appliances make a house healthier and more efficient

Determine if a draft regulator is installed and working

Inspect ventilation systems for damage

Inspect ventilation systems for disconnected pipes

Inspect ventilation systems for inadequate slope

Inspect for missing draft diverter

2.0201.1d – Base pressure test

Desired Outcome:

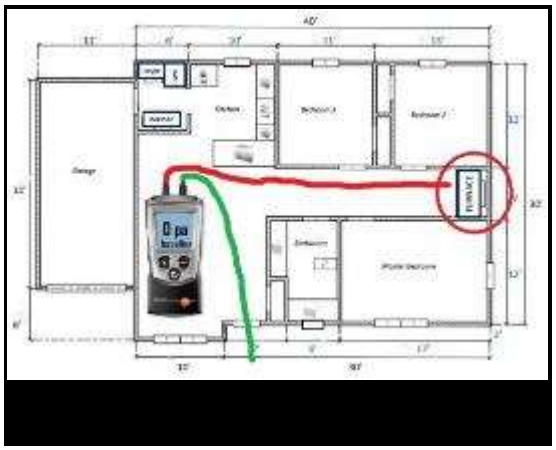
Accurate information about appliance safe operation is gathered

Specification(s):

Baseline pressure will be measured in *Combustion Appliance Zone* with reference to outdoors

Objective(s):

Measure pressure difference between combustion zone and the outside under natural conditions



Best Practice

Natural conditions--Winter set-up,
Exhaust fans off, Interior doors open

Tools:

1. Manometer

2.0201.1e – Depressurization test

Desired Outcome:

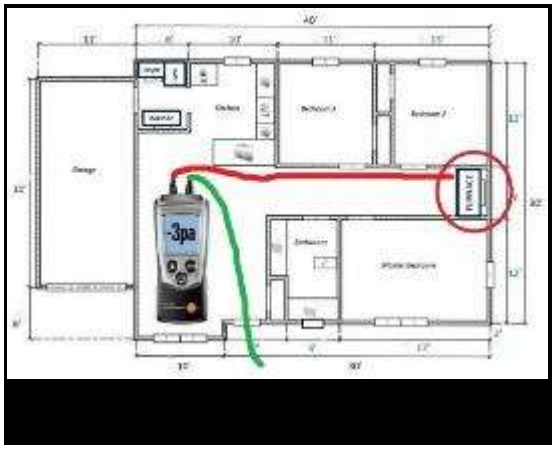
Accurate information about appliance safe operation is gathered

Specification(s):

Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof, and will not be more negative than -3 pascals accounting for base pressure

Objective(s):

Measure combined effect of mechanical system fans on combustion zone



Best Practice
Exhaust fans on, Check interior doors, Air handler on?

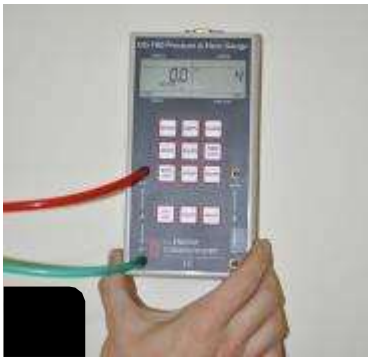
Tools:

1. Manometer

1
Place manometer reference hose to exterior of house

2
Attach test hose to be used in the interior of the house

3
Place test hose by combustion appliance



4
Take baseline reading

5
Turn on interior exhaust fans, including any clothes dryers

6
Is the air handler on?

7
Check interior doors for pressure differential either using smoke pencil or hand

8
Manometer reading should not be more negative than -3pa

9
If reading is within allowable limit, all is well

2.0201.1f – Spillage test

Desired Outcome:

Accurate information about appliance safe operation is gathered

Specification(s):

If a combustion appliance spillage exceeds two minutes during pressure testing, specify measures to mitigate

Objective(s):

Detect excessive spillage of combustion gasses

Unsafe
Test natural draft furnace or water heater for spillage in excess of 1min

Best Practice
Test all sides of natural draft flues since draft may be uneven

Tools:

1. Smoke pencil
2. Timer

- Measures shall be specified to mitigate if a combustion appliance spillage exceeds one minute during pressure testing.

2.0201.1g – Carbon monoxide (CO) test in appliance vent

Desired Outcome:

Accurate information about appliance safe operation is gathered

Specification(s):

CO will be tested for in undiluted flue gases of combustion appliances

If CO levels exceed 200 ppm as measured, or 400 ppm air-free measurement, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)

If the outlet of the exhaust is accessible, include a CO test on all sealed-combustion, direct vent, and power-vented appliances (without atmospheric chimneys)

Objective(s):

Measure CO and report excessive levels

Unsafe
CO levels cannot exceed 100ppm as measured, unless to manufacturer specs

Best Practice
Test CO levels in undiluted flue gases and exhaust outlets, when accessible

Tools:

3. Combustion analyzer with probe

- Sealed combustion units shall be tested at the exterior exhaust vent in the undiluted flue gases. The tested flue gas CO will be divided by the number of burner chambers in the unit to determine the average ppm CO per chamber. If CO levels exceed 100 ppm as measured in the undiluted flue gases service will be provided to reduce CO levels (unless CO measurement is within manufacturer specifications)

CO levels cannot exceed 100ppm, according to Nebraska WAP Standards

Test undiluted flue gases in induced- draft furnaces

Test undiluted flue gases in natural draft furnaces

Test undiluted flue gases in natural draft water heaters.	Test accessible exhaust outlets for direct-vent appliances	Test accessible exhaust outlets for power-vented appliances

2.0201.1i – Combustion safety testing at completion of retrofitting home

Desired Outcome:

Accurate information about appliance safe operation is gathered

Specification(s):

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

Objective(s):

Ensure work completed in home has not adversely affected the operation of combustion appliances

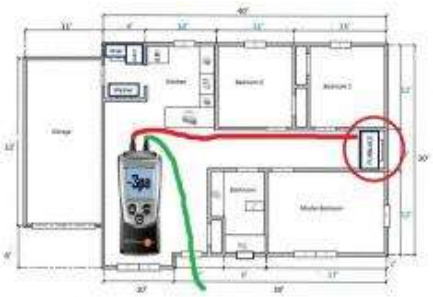
Unsafe

Conduct spillage and depressurization testing at the end of the work day

Tools:

1. Manometer
2. Smoke pencil
3. Timer

- Backdraft testing shall be performed on all vented naturally drafting combustion appliances at the time of Initial Inspection, the Quality Control Inspection and at the end of each work day if the project will require more than one day.
- Backdraft testing shall not be performed on solid fuel burning appliances.



Run depressurization test at the end of the work day

Complete spillage test using chemical smoke pencil

Test for spillage on all sides of draft diverter

Complete spillage testing on all combustion appliances

Complete carbon monoxide testing using a CO detector

2.0201.2 Combustion Safety

2.0201.2a – Outside combustion make-up air

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

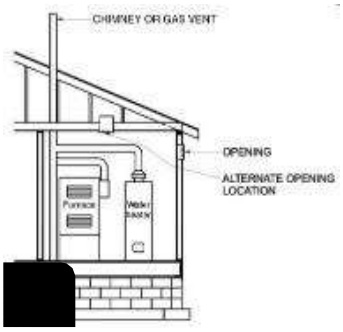
Specification(s):

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

Objective(s):

Prevent combustion byproducts from entering the house

- Image 1: For homes with one permanent opening, see 2012 IRC: G2407.6.2 (304.6.2): a minimum free area of 1 in2 per 3,000 Btu/h (734 mm2/kW) of total input rating of all appliances
- Image 2: For homes with two permanent vertical duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in2 per 4,000 Btu/h (550 mm2/kW) of total input rating of all appliances
- Image 3: For homes with two permanent horizontal duct openings, see 2012 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in2 per 2,000 Btu/h (1,100 mm2/kW) of total input rating of all appliances



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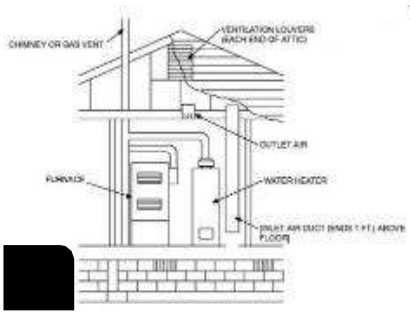

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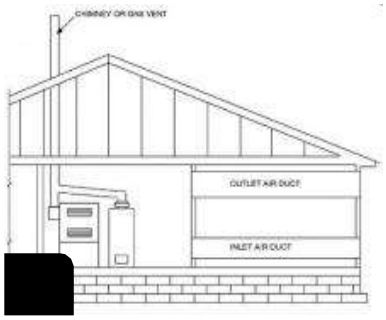


3

min free area of 1 sq. in per 3,000 Btu/h (734 mm2/kW) of total input rating	min free area of 1 sq. in per 4,000 Btu/h (550 mm2/kW) of total input rating	min free area of 1 sq. in per 2,000 Btu/h (1100 mm2/kW) of total input rating

2.0201.2b – New appliances

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):

New appliance will be installed in accordance with manufacturer specifications, 2012 IRC G2427.8, and additional applicable codes

Replacement equipment venting will be assessed to ensure other existing equipment is not adversely affected

Objective(s):

Prevent combustion byproducts from entering the house

Before
Damaged combustion appliances beyond repair should be replaced

After
Sealed-combustion, direct-vent appliances should replace unsafe appliances

Two-pipe 90% efficiency furnaces are viable replacement appliances

Direct vent combustion appliances are also viable replacements

2.0201.2c – CO detection and warning equipment

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

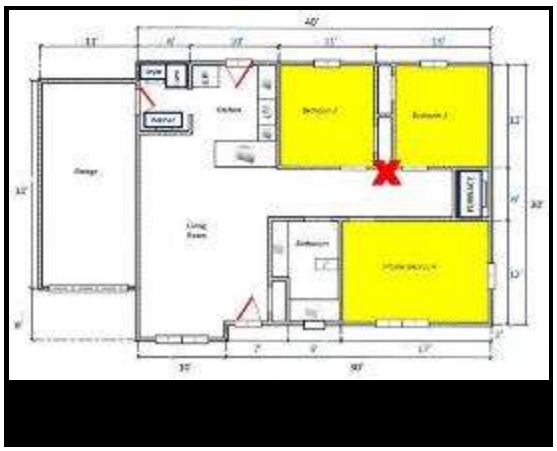
Specification(s):

CO detection or warning equipment will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in accordance with ASHRAE 62.2 and authority having local jurisdiction

Objective(s):

Alert occupant to CO exposure

Best Practice
Carbon Monoxide alarms should be installed according to local codes



Best Practice
Alarms should be mounted near sleeping areas--such as the one marked in red

Tools:

1. Drill

Materials:

1. CO alarm
2. Fasteners

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

2.0201.2d – Gas ovens

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

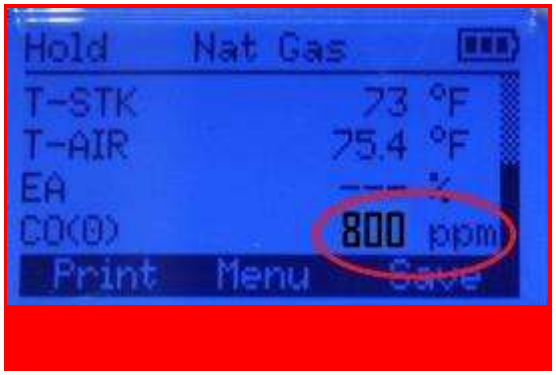
Specification(s):

Gas ovens will be tested for CO

A clean and tune will be conducted if measured CO in the undiluted flue gases of the oven vent at steady state exceeds 200 ppm or 800 ppm by air-free measurement

Objective(s):

Ensure clean burn of gas ovens



Unsafe
If air-free CO reading exceeds 800ppm, order a clean and tune

Best Practice
Test gas oven for carbon monoxide using a combustion gas analyzer

Tools:

1. Combustion analyzer with probe

2.0201.2e – Gas range burners

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):

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

Objective(s):

Ensure clean burn and operation of gas range burners

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

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

- The costs associated with tuning and cleaning ranges and ovens are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

Yellow, uncontrolled flames indicate the need for a clean and tune

Gas ranges should be cleaned and tuned if improper operation is evident

Blue, even flames indicate burners are working properly

2.0201.2f – Solid fuel burning appliances

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):

If the solid fuel burning appliance is the primary heat source and has signs of structural failure replace solid fuel burning appliance with UL-listed and EPA - certified appliances if the existing appliance is not UL-listed

Objective(s):

Ensure safe operations of solid fuel burning appliances

Unsafe
Unsafe solid fuel burning appliances should be replaced

Safe
New appliances should be UL-listed and EPA-certified

- Since 1988, the EPA has regulated particulate emissions from wood heaters. The limit is 7.5 grams per hour for non-catalytic appliances, and 4.1 grams per hour for catalytic appliances.
- The costs associated with the replacement of solid fuel burning appliances are not eligible expenditures in the *Nebraska Weatherization Assistance Program*. In some instances, with prior Energy Office approval, these costs may be reimbursable.

Locate data plate to find out appliance ratings

Check appliance rating plates for EPA and UL markings (or CSA, ETL, or WH markings)

2.0202 Unvented Space Heaters

2.0202.1 Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters

2.0202.1a – Removal

Desired Outcome:

Elimination of combustion byproducts

Specification(s):

With the occupant's permission, unvented heaters will be removed except when used as a secondary heat source and when it can be confirmed that the unit is listed to ANSI Z21.11.2

Units that are not being operated in compliance with ANSI Z21.11.2 should be removed before the retrofit but may remain until a replacement heating system is in place

Failure to remove unvented space heaters serving as primary heat sources has the potential to create hazardous conditions and thus any further weatherization services will be re-evaluated in the context of potential indoor air quality risks

Objective(s):

Eliminate sources of combustion byproduct within a living space

2.0202.1b – Occupant education

Desired Outcome:

Elimination of combustion byproducts

Specification(s):

Occupant will be educated on potential hazards of unvented combustion appliances (primary or secondary) within a living space

Objective(s):

Inform occupant about possible hazards associated with combustion byproducts and moisture

2.0203 Vented Gas Appliances

2.0203.1 Combustion Air for Natural Draft Appliances

2.0203.1a – Required combustion air

Desired Outcome:

Sufficient air provided in the *Combustion Appliance Zone* (*CAZ*)

Specification(s):

The required volume of indoor air will be determined in accordance with 2012 IRC Section G2407.5.1 or G2407.5.2 and authority having jurisdiction, except that where the air infiltration rate is known to be less than 0.40 air changes per hour (ACH), 2012 IRC Section G2407.5.2 will be used

Objective(s):

Determine if existing conditions meet the combustion air calculation

2.0203.1b – Additional combustion air (if action is required)

Desired Outcome:

Sufficient air provided in the *Combustion Appliance Zone* (*CAZ*)

Specification(s):

Additional combustion air will be provided in accordance with 2012 IRC G2407 and authority having jurisdiction

Objective(s):

Ensure adequate combustion air for operation of the appliance

2.0203.2 Combustion Flue Gas — Orphaned Water Heaters

2.0203.2a – Spillage testing

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

If a combustion appliance spillage exceeds two minutes during pressure testing, specify measures to mitigate

Objective(s):

Ensure appliance is not spilling longer than two minutes

Unsafe
Orphaned water heaters have oversized flues after a furnace is removed

Unsafe
Spillage should not exceed 2 minutes, if present

Tools:

1. Smoke pencil

2.0203.2b – Flue gas removal (chimney liner)

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

A chimney liner will be installed in accordance with the 2012 IRC or applicable NFPA standard

Objective(s):

Allow water heater to vent properly

Prevent damage to the chimney

2.0203.2c – Retesting spillage

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

If a combustion appliance spillage exceeds two minutes during pressure testing, specify measures to mitigate

Objective(s):

Ensure appliance is not spilling longer than two minutes

Before
If spillage continues to exceed 2 min, additional repairs are required

After
The elimination of the oversized chimney should prevent spillage

Tools:

1. Smoke pencil

Retest for spillage. If spillage remains, more repair is needed.

Repipe the flue to eliminate the oversized chimney

When repairs have been completed, no spillage should occur

2.0203.2d – Required combustion air

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with 2012 IRC G2407.5.1 and authority having jurisdiction

Objective(s):

Determine if existing conditions meet the combustion air calculation

2.0203.2e – Additional combustion air (if action is required)

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

Additional combustion air will be provided in accordance with 2012 IRC G2407 or other authority having jurisdiction

Objective(s):

Ensure adequate combustion air for operation of the appliance

2.0203.2f – Occupant health and safety

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

All homes will have a functioning CO alarm

If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair or replace improperly operating combustion appliances; apply weather-stripping or conduct air sealing between the garage or crawl space and the home)

Objective(s):

Ensure occupant health and safety

Ensure indoor CO levels do not exceed outdoor CO levels

- All homes where combustible appliances are present and/or the home has an attached garage will have a functioning Carbon Monoxide Detector.

2.0203.2g – Occupant education

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

Occupants will be educated on the operation and maintenance of the CO alarm

Completed work on combustion appliances and recommended maintenance will be reviewed with occupant

Occupant will be provided information regarding the health effects and risk of high CO concentrations; EPA describes possible expanded actions, and offers client education information in an appendix to the protocols

Objective(s):

Ensure occupant can operate and maintain installations

Inform occupant regarding possible CO hazards

2.0203.3 Draft Regulation—Category I Appliance

2.0203.3a – Assessment

Desired Outcome:

Build-up of flue gasses prevented with proper drafting

Specification(s):

The presence of an operable draft regulator will be verified

Combustion venting systems will be inspected for damage, leaks, disconnections, and other **Safe**ty hazards

Objective(s):

Determine if a draft regulator is present and working and if vent system is in good condition and installed properly

2.0203.3b – Installation (if action is required)

Desired Outcome:

Build-up of flue gasses prevented with proper drafting

Specification(s):

A draft regulator will be installed, if necessary

Manufacturer specifications for installation will be followed (e.g., size, type, location)

Objective(s):

Install regulator in accordance with manufacturer specifications

2.0203.3c – Retesting spillage

Desired Outcome:

Build-up of flue gasses prevented with proper drafting

Specification(s):

If a combustion appliance spillage exceeds two minutes during pressure testing, specify measures to mitigate

Objective(s):

Ensure appliance is not spilling longer than two minutes

- Measures be shall specified to mitigate if a combustion appliance spillage exceeds **one** minute during pressure testing.

2.0203.3d – Occupant health and safety

Desired Outcome:

Build-up of flue gasses prevented with proper drafting

Specification(s):

All homes will have a functioning CO alarm

If CO levels in interior living spaces exceed outdoor levels, potential sources will be investigated and appropriate action taken to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weather-stripping or conduct air sealing between the garage or crawl space and the home)

Objective(s):

Ensure occupant health and safety

Ensure indoor CO levels do not exceed outdoor CO levels

- All homes where combustible appliances are present and/or the home has an attached garage will have a functioning Carbon Monoxide Detector.

2.0203.3e – Occupant education

Desired Outcome:

Build-up of flue gasses prevented with proper drafting

Specification(s):

Occupants will be educated on the operation and maintenance of the CO alarm

Completed work on combustion appliances and recommended maintenance will be reviewed with occupant

Occupant will be provided information regarding the health effects and risk of high CO concentrations; EPA provides possible expanded actions and offers client education information in an appendix to the protocols

Objective(s):

Ensure occupant can operate and maintain installations

Inform occupant regarding possible CO hazards

2.0299 Additional Resources

2.0299.1 Combustion Appliance Depressurization Limits Table

2.0299.1a – Atmospheric water heater only (Category I, natural draft), open-combustion

appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

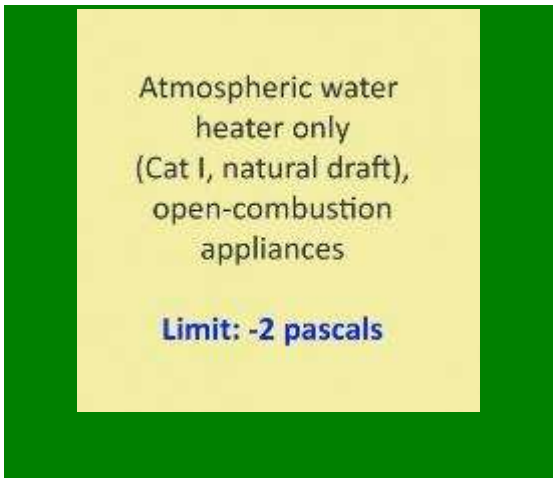
Manufacturer's certified negative pressure tolerance rating:

- Limit -2 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

A natural draft water heater with indicative flue highlighted



Best Practice

Tools:

1. Manometer

2.0299.1b – Atmospheric water heater (Category I, natural draft) and atmospheric furnace (Category I, natural draft), common-vented, open-combustion appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

Manufacturer's certified negative pressure tolerance rating:

- Limit -3 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Natural draft water heater and natural draft furnace with common vent

Best Practice

Tools:

1. Manometer

Common vent of natural draft appliances highlighted

2.0299.1c – Gas furnace or boiler, Category I or Category I fan- assisted, open-combustion appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

Manufacturer's certified negative pressure tolerance rating:

- Limit -5 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Category I 70% efficiency gas furnace with intake vent highlighted

Best Practice

Tools:

1. Manometer

Cat I 80% efficiency furnace

Oil boiler

2.0299.1d – Oil or gas unit with power burner, low- or high-static pressure burner, open combustion appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

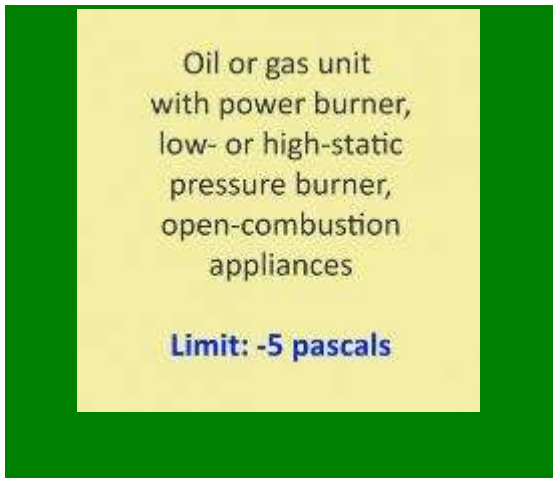
Manufacturer's certified negative pressure tolerance rating:

- Limit -5 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Oil burner



Best Practice

Tools:

1. Manometer

2.0299.1e – Closed, controlled wood-burning appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

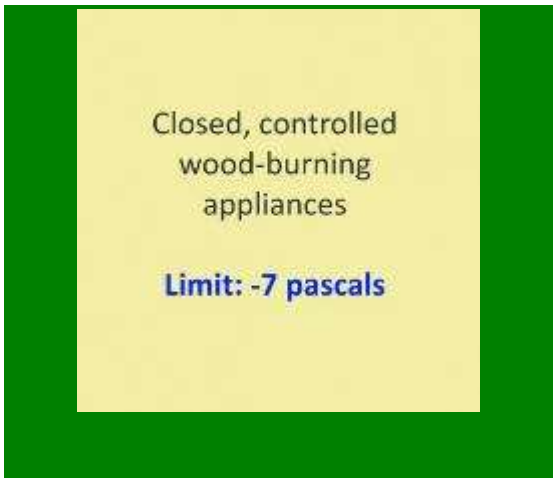
Manufacturer's certified negative pressure tolerance rating:

- Limit -7 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Wood-burning stove



Best Practice

Tools:

1. Manometer

2.0299.1f – Induced-draft appliances (fan at point of exit at wall), Category I with induced draft, open-combustion appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

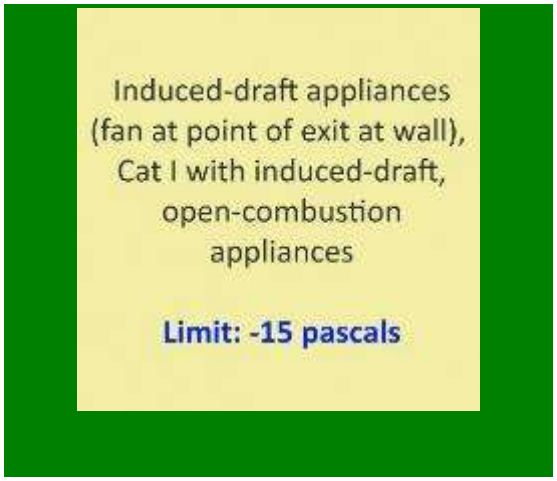
Manufacturer's certified negative pressure tolerance rating:

- Limit -15 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Induced draft furnace



Best Practice

Tools:

1. Manometer

2.0299.1g – Pellet stoves with exhaust fan and sealed vent

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

Manufacturer's certified negative pressure tolerance rating:

- Limit -15 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Pellet stove

Best Practice

Tools:

1. Manometer

2.0299.1h – Gas appliances, Category III vented though the wall, forced draft, open-combustion appliances

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

Manufacturer's certified negative pressure tolerance rating:

- Limit -15 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Single-pipe 90% efficiency furnace with forced draft

Best Practice

Tools:

1. Manometer

Power-vented water heater

2.0299.1i – Direct-vent, sealed combustion appliances with forced draft

Desired Outcome:

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Specification(s):

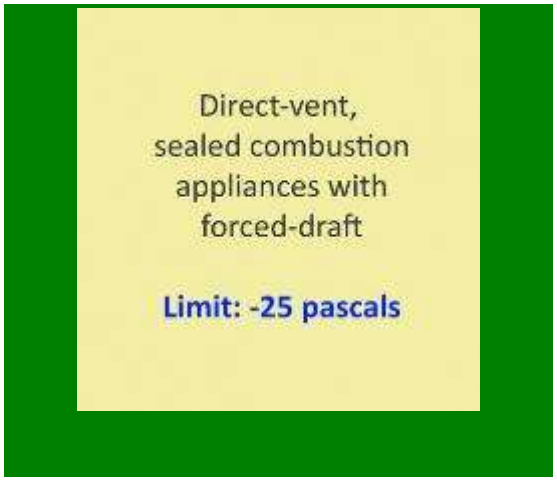
Manufacturer's certified negative pressure tolerance rating:

- Limit -25 pascals

Objective(s):

Ensure appliances meet manufacturer's certified negative pressure tolerance rating

Forced draft appliance with sealed combustion



Best Practice

Tools:

1. Manometer

Two-pipe 90% efficiency furnace	Direct-vent Rinnai	Exterior vent for Rinnai

2.03 Safety Devices

2.0301 Combustion Safety Devices

2.0301.1 Smoke Alarm

2.0301.1a – Smoke alarm (hardwired)

Desired Outcome:

Properly installed smoke alarms

Specification(s):

Smoke alarms will be listed and labeled in accordance with UL 217 and installed (hardwired) in accordance with the 2012 IRC or as required by the authority having jurisdiction

Objective(s):

Ensure proper installation

Before
Hard-wired smoke alarm mount with alarm missing

After
Installation of hard-wired smoke alarm

- Paraphrased from 2012 IRC R314: Smoke alarms will receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, will receive power from a battery. Wiring will be permanent and without a disconnecting switch other than those required for overcurrent production. Smoke alarms will be installed in the following locations: 1. In each sleeping room; 2. Outside each separate sleeping area in the immediate vicinity of the bedrooms; 3. On each additional story of the dwelling, including basements and habitable attics.
- Per WPN 14-01, compliance with NFPA 72 is also required.
- The costs associated with installing hardwired smoke alarms are not eligible expenses under the *Nebraska Weatherization Assistance Program*.

Smoke alarms should be UL-217 rated and comply with NFPA 72

Homes should have hard-wired smoke alarms in all sleeping areas

2.0301.1b – Smoke alarm (battery operated)

Desired Outcome:

Properly installed smoke alarms

Specification(s):

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

Objective(s):

Ensure proper installation

Best Practice

All homes should have UL-217 rated smoke alarms

- The costs associated with installing battery operated smoke alarms are not eligible expenses under the *Nebraska Weatherization Assistance Program*.
- Paraphrased from 2012 IRC R314: Smoke alarms will be permitted to be battery operated when installed in buildings without commercial power or when alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure to provide access for hard-wiring, unless there is an attic, crawl space, or basement available with could provide access.

Ceiling mounted smoke alarms can be battery-operated

Wall mounted smoke alarms must be mounted within 12 inches of the ceiling

2.0301.2 Carbon Monoxide Alarm or Monitor

2.0301.2a – CO detection and warning equipment (hardwired)

Desired Outcome:

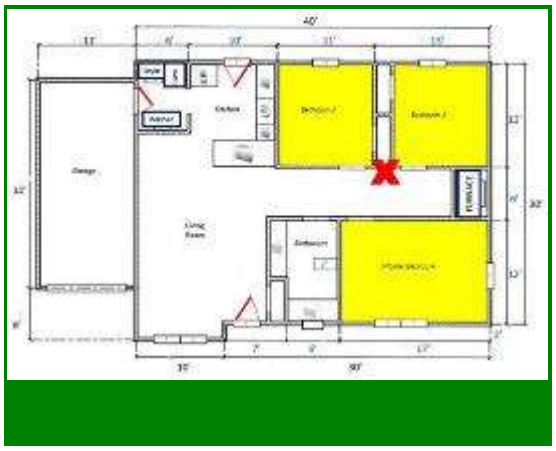
Properly installed CO alarms or monitors

Specification(s):

Hardwired CO detection or warning equipment will be installed in accordance with ASHRAE 62.2 or as required by the authority having jurisdiction

Objective(s):

Ensure proper installation



After

Alarms should be mounted in sleeping areas--such as the one marked in red

Tools:

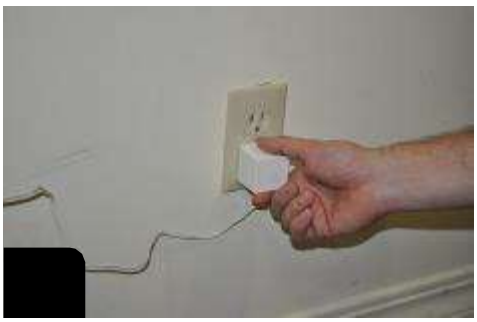
1. Hammer

Materials:

1. Nails

- Per WPN 14-01, full compliance with ASHRAE 62.2.2013 and NFPA 720 is required.
- The costs associated with hard-wiring CO detectors is not an eligible expenditure in the *Nebraska Weatherization Assistance Program*.

1
Mount alarm to wall close to bedrooms



2
Plug alarm into outlet. In addition, cord can be stapled into place

2.0301.2b – CO detection and warning equipment (battery operated)

Desired Outcome:

Properly installed CO alarms or monitors

Specification(s):

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

Objective(s):

Ensure proper installation

Unsafe
ALL houses should have carbon monoxide monitors installed near sleeping areas

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

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.
- Per WPN 14-01, full compliance with ASHRAE 62.2.2013 and NFPA 720 is required.

2.04 Moisture

2.0401 Air Sealing

2.0401.1 Air Sealing Moisture Precautions

2.0401.1a – Moisture precautions for attics

Desired Outcome:

Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

Specification(s):

Roof leaks will be repaired before performing attic air sealing or insulation

Moisture sources in the house that can generate moisture into the attic will be identified and removed or reduced

Objective(s):

Ensure durability of repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards

Prevent moisture from communicating from within the conditioned space into unconditioned attic space when economically feasible

- The costs associated with roof leak repairs shall be encompassed in the homes overall $500 incidental cost limit for the home.

2.0401.1b – Moisture precautions for crawl spaces

Desired Outcome:

Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

Specification(s):

Exposed earth will be covered with a continuous, durable, sealed Class 1 vapor retarder a minimum of 6 mils in thickness

Plastic, foil or any other Class 1 vapor barrier/retarder will not be used in hot-humid climates

All accessible penetrations between the crawl space or basement and outside will be sealed

Holes between the crawl space or basement and the living space will be sealed

Objective(s):

Ensure durability of repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards

2.0401.1c – Moisture precautions for the living space

Desired Outcome:

Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards

Specification(s):

Moisture sources in the home will be identified and removed or reduced

Local ventilation will be installed where appropriate (e.g., baths, kitchens) and vented to outside

according to ASHRAE 62.2-2010

Unvented combustion appliances that are not listed to ANSI Z21.11.2 will be removed

Objective(s):

Ensure durability of repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards

- Costs associated with the installation of moisture precautions for exterior water are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- Clothes dryers and exhaust fans shall be vented to the exterior.

2.0403 Vapor Barriers

2.0403.1 Vented Crawl Spaces—Ground Moisture Barrier

2.0403.1a – Material integrity

Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

Specification(s):

Care will be taken to prevent punctures during installation

Objective(s):

Protect ground moisture barrier from damage during other crawl space work

2.0403.1b – Coverage

Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

Specification(s):

A ground moisture barrier that covers 100% of the exposed crawl space floor will be installed

Objective(s):

Reduce ground moisture entering the crawl space

Before
Uncovered crawl space floors can cause moisture damage

After
Ground moisture barrier to cover 100% of floor is installed last

Materials:

1. Plastic sheeting (at least 6 mil)
2. Furring strips
3. Fasteners

2.0403.1c – Material specification

Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

Specification(s):

A ground moisture barrier with a rating of no more than 0.1 perm will be used

A ground moisture barrier will be used that meets tear and puncture resistance standard ASTM E1745

Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home (5 years), and it will need replacing to remain effective

Objective(s):

Ensure crawl space is accessible for service and maintenance without damaging the integrity of the ground moisture barrier

After

Barrier must be at least 6 mil, able to withstand puncture and last 10 years

Materials:

1. Plastic sheeting (at least 6 mil)
2. Furring strips
3. Fasteners

- The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of <0.5 (which translates to 4mil or thicker). From 2007 IRC definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).

2.0403.1d – Overlap seams

Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

Specification(s):

When seams exist, they will be overlapped a minimum of 12" using reverse or upslope lapping technique

Objective(s):

Keep water under the liner

Reduce the likelihood of damage at seams

Before
Ground moisture barriers help keep moisture from permeating floor.

After
Ground moisture barrier overlaps at least 12 in and is securely fastened

Tools:

1. Stapler
2. Utility knife
3. Drill

Materials:

1. Ballast
2. Plastic sheeting (at least 4mil)
3. Furring strips
4. Seam tape - moisture resistant

Securely fasten moisture barrier to wall at least 6 inches from ground

Overlap seams at least 12 inches, using a shingle method to keep water out

2.0403.1e – Fastening

2.0403.1e – Approved Variance

Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

Specification(s):

Ground moisture barrier will be fastened to ground with durable fasteners or ballast(s) and extend a minimum of 6" up the foundation wall

Objective(s):

Prevent movement of the ground moisture barrier

Before
Fastening of moisture barrier is required and must last at least 10 years

After
Ground moisture barrier should extend up the wall at least 12" and be held in place

Tools:

1. Stapler
2. Drill

Materials:

1. Plastic sheeting (at least 6 mil)
2. Furring strips
3. Fasteners

- The ground moisture barrier shall extend a minimum of ***12"*** up the foundation wall and all support barriers.

Seams can be taped to prevent water leakage

Ballast or fasteners can hold barrier in place securely

2.0403.2 Closed Crawl Spaces—Ground Moisture Barriers

2.0403.2a – Material integrity

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

Care will be taken to prevent punctures during installation

Objective(s):

Protect ground moisture barrier from damage during other crawl space work

2.0403.2b – Coverage

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

An air barrier and ground moisture barrier, covering 100% of the exposed crawl space floor, will be installed and sealed to the wall's air and moisture barrier in accordance with ASTM E1643 and manufacturer's recommendations

Ground moisture barrier will be fastened to ground in accordance with manufacturer's recommendations and extend a minimum of 6 inches up the foundation wall

Objective(s):

Reduce ground moisture entering the crawl space

Create a continuous and durable connection between the wall and ground air and moisture barriers

Before
Uncovered crawl space floors can lead to moisture issues

After
Ground moisture barrier should cover 100% of floor and at least 12" of walls

Materials:

1. Plastic sheeting (at least 6 mil)
2. Furring strips
3. Fasteners

- The Nebraska WAP Standard states: The ground moisture barrier shall extend a minimum of ***12"*** up the foundation wall and all support barriers.

2.0403.2c – Material specification

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

A ground moisture barrier with a rating of no more than 0.1 perm will be used

A ground moisture barrier will be used that meets tear and puncture resistance standard ASTM E1745

Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home (5 years), and it will need replacing to remain effective

Objective(s):

Reduce ground vapor entering the crawl space

Ensure crawl space is accessible for service and maintenance without destroying the integrity of the moisture barrier

Best Practice
Barrier must be at least 4 mil, able to withstand puncture and last 10 yrs.

Materials:

1. Plastic sheeting (at least 4 mil)
2. Furring strips
3. Fasteners

- The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of <0.5 (which translates to 4mil or thicker). From 2007 IRC definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).

2.0403.2d – Overlap seams

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

When seams exist, they will be overlapped a minimum of 12" with reverse or upslope lapping technique

For wall to floor connection, the wall moisture barrier will be installed under the ground moisture barrier

Objective(s):

Keep water under the liner

Before
Ground moisture barriers help keep moisture from permeating floor

After
Ground moisture barrier overlaps at least 12 in and is securely fastened

Tools:

1. Stapler
2. Utility knife
3. Drill

Materials:

1. Ballast
2. Plastic sheeting (at least 4mil)
3. Furring strips
4. Moisture-resistant adhesive tape

Securely fasten moisture barrier to wall at least 6 inches from ground

Overlap seams at least 12 inches, using a shingle method to keep water out

2.0403.2e – Fastening

2.0403.2e Approved Variance

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize

ground vapor

Specification(s):

The air barrier and ground moisture barrier will be fastened to the ground to prevent movement in accordance with ASTM E1643 and manufacturer's recommendations

Objective(s):

Prevent movement and uplift of the air barrier and ground moisture barrier

Before
Moisture barrier needs to be held in place with more permanent fasteners

After
Ballast or fasteners should be used to hold barrier in place securely

Tools:

1. Drill
2. Stapler

Materials:

1. Plastic sheeting (at least 4 mil)
2. Furring strips
3. Fasteners

2.0403.2f – Sealing seams

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

A durable sealant compatible with the air barrier and ground moisture barrier will be used

Objective(s):

Maintain continuous air barrier and ground moisture barrier

Before
Crawl spaces lacking moisture barrier risk moisture penetration of floor

After
Ground moisture barriers in unvented spaces should be sealed

Tools:

1. Utility knife

Materials:

1. Moisture-resistant adhesive tape

Tape wall seams and press to ensure airtight bonding of adhesive

Tape (overlapped) floor seams to prevent movement and water leakage

2.06 Electrical

2.0601 Knob and Tube Wiring

2.0601.1 Knob and Tube Wiring

2.0601.1 Approved Variance

2.0601.1a – Knob and tube identification

Desired Outcome:

Live unsafe wiring identified and brought to local codes

Specification(s):

Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring

Objective(s):

Ensure occupant safety

Preserve the integrity and safety of the house

Knob and tube wiring should be identified before work begins

Distinctive "knobs" are highlighted. This wiring can be a safety hazard

- The costs associated with updating unsafe wiring to local code requirements are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0601.1b – Live wire testing

Desired Outcome:

Live unsafe wiring identified and brought to local codes

Specification(s):

Non-contact testing method will be used to determine if wiring is live

Objective(s):

Protect occupant safety

Preserve the integrity and safety of the house

Before
Knob & tube wiring needs to be tested to determine if still live. Red=live

After
Live wiring should be dammed or professionally disabled before insulating

Tools:

2. Non-contact wire tester

- The costs associated with updating unsafe wiring to local code requirements are not eligible

expenditures in the *Nebraska Weatherization Assistance Program*.

2.0601.1c – Isolation and protection

Desired Outcome:

Live unsafe wiring identified and brought to local codes

Specification(s):

Live knob and tube will not be covered or surrounded; required by the National Electrical Code (NEC) or authority having jurisdiction

A licensed electrical contractor will inspect and certify wiring to be safe and place a warning at all entries to the attic about the presence of knob and tube wiring

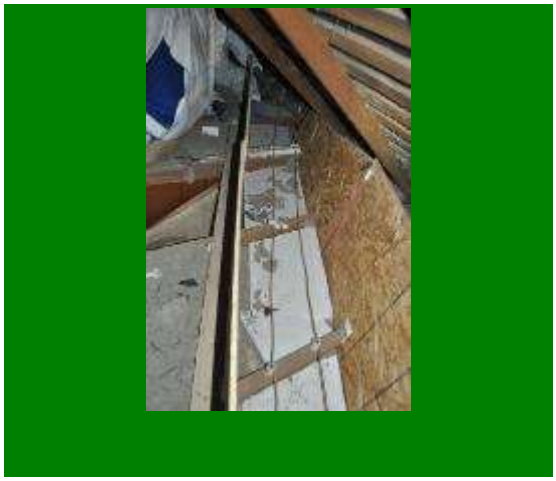
A dam that does not cover the top will be created to separate insulation from the wire path

Objective(s):

Ensure occupant safety

Preserve the integrity and safety of the house

Before
Live knob & tube wiring may get hot and should not be insulated over



After
Dams should be installed to hold back loose fill insulation

Tools:

1. Drill
2. Tape measure
3. Non-contact wire tester

Materials:

1. Plywood
2. Drywall
3. Fasteners

- The costs associated with updating unsafe wiring to local code requirements are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- NEC guidelines and local jurisdictions are very particular on the treatment of knob & tube wiring. Check your local codes.

1
Have a certified electrician verify that wiring is safe to work around

2
A sign should be posted at all entrances to warn of knob & tube wiring

3
Warning sign should remind to contact certified electrician for repairs

4
Many jurisdictions require a sign in Spanish as well

5
Damming should extend above installed height of insulation

6
With dams in place, insulation can begin

2.0601.1d – Replacement

Desired Outcome:

Live unsafe wiring identified and brought to local codes

Specification(s):

Exposed wiring will be replaced with new appropriate wiring in accordance with the NEC and local codes

Old wiring will be rendered inoperable by licensed electrician in accordance with the NEC and local codes

Objective(s):

Ensure occupant safety

Preserve the integrity and safety of the house

Before
Knob and tube wiring may get hot and cannot be insulated over

After
If possible, k&t wiring should be disabled and replaced with modern wiring

Tools:

1. Non-contact wire tester

Materials:

1. Romex as needed

- The costs associated with replacing wiring and updating unsafe wiring to local code requirements are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- NEC guidelines and local jurisdictions have many codes dealing with the treatment of knob & tube wiring. Check your local codes.

1
The entire knob and tube system should be disabled

2
Many electricians will remove old exposed wiring to prevent reactivation

3
Exposed knob and tube should be replaced with modern wiring

4
With modern wiring in place and old k&t disabled, insulation can begin

2.07 Occupant Education and Access

2.0701 Basements and Crawl Spaces

2.0701.1 Crawl Spaces—Providing Access

2.0701.1a – Access

Desired Outcome:

Access to the closed crawl space is controlled and the ground moisture barrier is protected to maintain the integrity of the system

Specification(s):

Crawl space will be accessible in accordance with 2012 IRC R408.4

Access to mechanical equipment located in the crawl space will be in accordance with 2012 IRC M1305.1.4

Service and maintenance of the crawl space and equipment will be performed without risk of damage to the thermal barrier, air barrier, and ground moisture barrier in accordance with 2012 IRC N1102.2.4 and 2012 IRC AF103.4.10

Objective(s):

Provide crawl space access

Maintain integrity of the crawl space system

2.0701.1b – Lock

Desired Outcome:

Access to the closed crawl space is controlled and the ground moisture barrier is protected to maintain the integrity of the system

Specification(s):

A lockable access will be provided if access is from the exterior

Objective(s):

Control access and prevent intruders

2.0701.2 Crawl Space Information Sign

2.0701.2a – Sign specifications

Desired Outcome:

Posted signs inside of the crawl space provide essential safety and maintenance information to occupant and users of the crawl space

Specification(s):

A durable, easily seen sign will be installed at all accesses inside of the crawl space (minimum 8 ½" x 11")

A minimum expected service life of 10 years will be ensured

Objective(s):

Prevent damage to the crawl space after upgrade

Crawl space access points should have signage to alert occupant and workers

Best Practice
Sign should be highly-visible, securely-fastened, and durable

2.0701.2b – Sign content

Desired Outcome:

Posted signs inside of the crawl space provide essential safety and maintenance information to occupant and users of the crawl space

Specification(s):

Those entering the crawl space will be cautioned not to damage the air barrier, ground moisture barrier, insulation, and mechanical components specific to the crawl space type

Anyone entering the crawl space will be alerted that immediate repairs are needed in case of damage

Installer contact information will be included on the sign in case there are questions or needs for repairs

Objective(s):

Prevent damage to the crawl space after upgrade

Educate anyone entering the crawl space

Provide occupants with a way to contact the installer

Best Practice
Mount sign where clearly visible to anyone entering crawl space

Be sure sign includes relevant information to aid occupant in repairs

Tools:
1. Printer
2. Staple gun

Materials:
1. Paper
2. Laminant
3. Staples

Hacer la señal en español también

2.0701.2c – Hazard warning

Desired Outcome:

Posted signs inside of the crawl space provide essential **Safe**ty and maintenance information to occupant and users of the crawl space

Specification(s):

Language prohibiting storage of hazardous and flammable materials will be provided on site

Objective(s):

Prevent storage of hazardous or flammable materials in the crawl space

Maintain indoor air quality

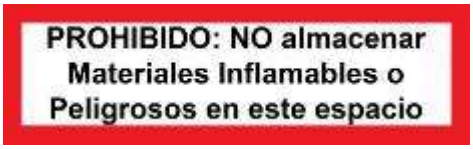
Prevent a fire hazard

Mount sign where anyone entering the crawl space can see it

Best Practice
Alert those entering the crawl space never to store hazardous materials

Tools:
1. Staple gun
2. Printer

Materials:
1. Paper
2. Laminant
3. Staples



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2.0701.3 Crawl Space — Occupant Education

2.0701.3a – Written communication

Desired Outcome:

Occupants educated on the crawl space system and how to maintain it

Specification(s):

Occupants will be given written documentation that describes components of the system, maintenance requirements, and health and **Safe**ty considerations at a minimum

Information will be provided in simple terms

Text and pictures will be used

Documentation may be provided electronically

Literacy levels and language of occupants will be considered in selecting appropriate materials

Objective(s):

Provide occupant with a basic understanding and documentation of the system, its maintenance, and related health and **Safe**ty issues

2.0701.3b – Oral communication

Desired Outcome:

Occupants educated on the crawl space system and how to maintain it

Specification(s):

When possible, the written documents will be reviewed with the occupants

Objective(s):

Confirm that occupants have received the information

Provide an opportunity for questions and answers

2.0701.3c – Contact information

Desired Outcome:

Occupants educated on the crawl space system and how to maintain it

Specification(s):

Information about the installation company and warranty will be provided

Objective(s):

Provide occupants with a way to contact the installer

2.0702 Installed Equipment

2.0702.1 Warranty and Service Agreement

2.0702.1a – Warranty

Desired Outcome:

Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

Specification(s):

A minimum 1-year warranty for materials, workmanship, and serviceability will be provided to occupants upon completion of work

Objective(s):

Provide recourse to occupants for failures in materials, workmanship, and serviceability

2.0702.1b – Warranty renewal and service agreement

2.0702.1b Approved Variance

Desired Outcome:

Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

Specification(s):

An option for annual inspection and renewal of warranty and service agreement for up to 10 years will be offered at a cost (requirement for installers)

Objective(s):

Provide occupants with an option for extending the warranty and service agreement

2.0702.1c – General conditions

Desired Outcome:

Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

Specification(s):

At a minimum, the following concerns and warnings will be addressed within the warranty:

- Possible drying and shrinking effects
- Storage of hazardous and flammable materials
- Mold

Objective(s):

Educate occupants on potential hazards

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3 Air Sealing

3.10 Attics

3.1001 Penetrations and Chases

3.1001.1 Penetrations and Chases

3.1001.1a – Pre-inspection

Desired Outcome:

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

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

3.1001.1b – Backing and infill

Desired Outcome:

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

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

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

- Openings wider than 1/4 inch shall be packed with backing and/or infill material specifically designed as a packing material prior to caulking.

3.1001.1c – Sealant selection

Desired Outcome:

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

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will 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

- Caulking shall be paintable and shall be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources shall be specifically manufactured for installation around heat sources.
- Expanding and non-expanding foam sealant may be used as an air sealing material.
- If mortar or mortar patch is used to air seal, it shall be a color complementary to the surface to which it is applied and be textured to match the surrounding surface as close as possible.
- Spray applied insulation may be used as an air sealing material.
- A maximum of $40 in material and labor per 100 cfm50 reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The cfm50 reductions shall be checked at the end of each measure to determine its cost effectiveness.
- Sealing and repair materials shall match the existing surfaces as closely as possible.

3.1001.1d – High temperature application

Desired Outcome:

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

Specification(s):

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

Local codes will be referenced

Objective(s):

Prevent a fire hazard

Before

Gaps around combustion exhaust flues need to be sealed

After

Sealed penetrations and chases should utilize high-temperature materials

Tools:

1. Drill/screwdriver
2. Caulk gun

Materials:

1. High-temperature caulking
2. 26-gauge steel sheeting

3. Metal snips

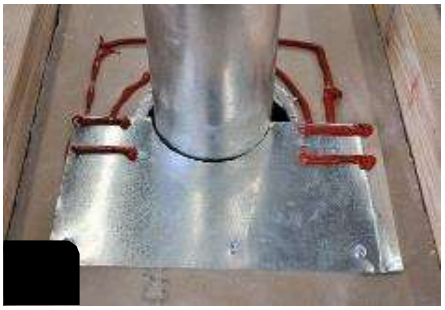
- See 3.1402.1c for Clearance Requirements
- Caulking installed around heat-producing sources shall be specifically manufactured for installation around heat sources.
- A maximum of $40 in material and labor per 100 cfm50 reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The cfm50 reductions shall be checked at the end of each measure to determine its cost effectiveness.
- Sealing and repair materials shall match the existing surfaces as closely as possible.

1
Prepare work area by removing any insulation and debris

2
Use high-temperature caulking (600F min)

3
Apply first ring of caulking to match shape of opening

4
Apply second ring of caulking to size and shape of rigid material



5
Fasten rigid material (26-gauge steel) and apply additional caulking

6
Fasten rigid material to cover penetration and seal against flue with caulk

3.1001.2 Chase Capping

3.1001.2a – Pre-inspection of Chases

Desired Outcome:

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

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

3.1001.2b – Standard chase (interior walls covered with drywall or plaster)

Desired Outcome:

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

Specification(s):

Entire opening will be spanned with rigid material

Material will be cut to fit and fastened as required

Objective(s):

Reduce opening to what can be sealed with sealant

Before
Unsealed standard chases covered with drywall can be leakage points

After
The air barrier is be maintained by capping chases with rigid material

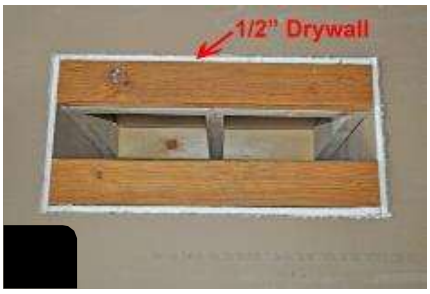
Tools:

1. Drill/screwdriver
2. Caulk gun

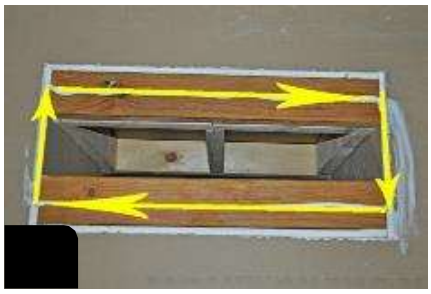
Materials:

1. XPS
2. Drywall
3. Caulk
4. Sheet metal
5. OSB or plywood

- A maximum of $40 in material and labor per 100 cfm50 reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The cfm50 reductions shall be checked at the end of each measure to determine its cost effectiveness.

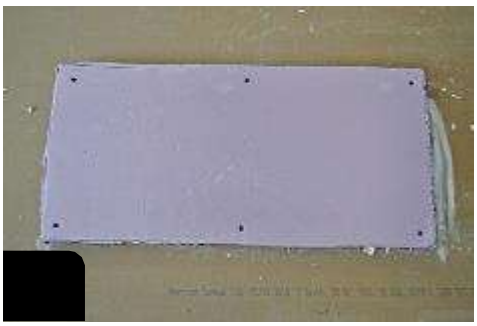


1
Clear area of debris and insulation in preparation for work



2
Apply sealant all the way around opening

3
Trim rigid material, such as drywall or XPS, to size and place over sealant



4
Fasten rigid material appropriately, such as with screws

3.1001.2c – Non-standard chase (interior walls covered with wood or paneling)

Desired Outcome:

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

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 2012 IRC R302.9

Objective(s):

Prevent a fire hazard

Before
Paneled drop soffits typically are more combustible than plain drywall

After
When sealing on attic side, drywall and XPS are viable materials

Tools:

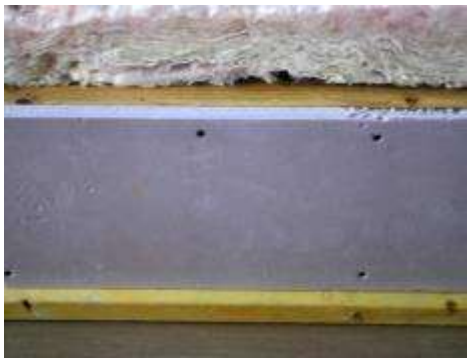
1. Drywall saw
2. Tape measure
3. Caulk gun
4. Drill

Materials:

1. Drywall
2. XPS
3. Fire-block sealant
4. Fasteners

- A maximum of $40 in material and labor per 100 cfm50 reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Prog*ram. The cfm50 reductions shall be checked at the end of each measure to determine its cost effectiveness.
- EPS or bead-board are not acceptable materials.

Sealing with drywall reduces overall combustibility of paneled chases



Sealing with XPS also reduces overall combustibility of paneled chases

3.1001.2d – Support

Desired Outcome:

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

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

Before

Spans greater than 24 inches require additional bracing before capping

After

Support should prevent cap from sagging or moving

Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

Create bracing to support spans larger than 24", either from above or below

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

Ensure new bracing is secure by using screws to fasten to joist

Once chase is capped, it is now ready to be sealed along framing

3.1001.2e – Joint seal

Desired Outcome:

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

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

Before
Chases need to be capped and sealed to prevent leakage

After
Chase is sealed along all cracks, gaps, and penetrations

Tools**:**
1. Spray foam gun
2. Caulk gun

Materials**:**
1. Spray foam
2. Caulk

- Always wear protective gloves when working with sealants.

1
Chase has been capped but needs to be sealed

2
Sealant is used to fill in all cracks and gaps along edges of chase cap

3
Cap is sealed

3.1001.2f – Adjacent framing

Desired Outcome:

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

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

Before
Chases need to be capped and sealed to prevent leakage

After
Chase is sealed along all cracks, gaps, and penetrations

Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk

- A maximum of $40 in material and labor per 100 cfm50 reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The cfm50 reductions shall be checked at the end of each measure to determine its cost effectiveness.
- Always wear gloves when working with sealant.

1
Sealant is used to fill in all cracks and gaps along edges of chase cap

2
Extend seal along adjacent framing

3.1001.3 Walls Open to Attic—Balloon Framing and Double Walls

3.1001.3a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the Nebraska Weatherization Assistance Program.

3.1001.3b – Sealing methods

Desired Outcome:

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

Specification(s):

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

Material will be cut to fit and fastened as required

OR

Wall below openings will be dense packed

OR

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

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

Objective(s):

Prevent air leakage from wall cavity to attic

Before
Wall cavities are open to attic

After
Whatever option chosen, test for visible air movement with smoke pencil

Tools:

1. Utility knife

Materials:

1. Drywall

2. Saw
3. Insulation machine
4. Caulk gun
5. Spray foam gun

2. XPS
3. Spray foam
4. Caulk
5. Fasteners
6. Dense packable insulation
7. Lumber

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

Option 2: Bridge cavities with spray foam

Option 3, Step 1: Apply sealant around opening and on surrounding framing

Option 3, Step 2, Option A: Cap with XPS and seal exposed joints

Option 3, Step 2, Option B: Cap with drywall and seal exposed joints

3.1001.3c – Support

Desired Outcome:

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

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

Before
Spans greater than 24 inches require additional bracing before capping

After
Support should prevent cap from sagging or moving

Tools:

1. Saw
2. Drill
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

Create bracing to support spans larger than 24", either from above or below

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

Ensure new bracing is secure by using screws to fasten to joist

Once chase is capped, it is now ready to be sealed along framing

3.1001.3d – Joint seal

Desired Outcome:

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

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

Before

Balloon framing needs to be capped and sealed to prevent leakage

After

All edges of the cap should be sealed to surrounding surfaces

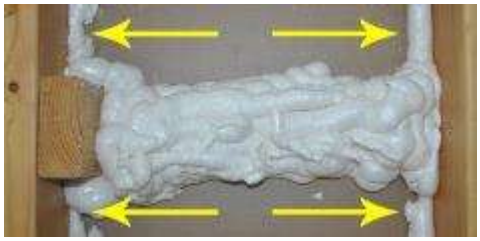
Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam
2. Caulk

For rigid material applications, extend sealant along all seams



Extend sealant or SPF along joist to seal all gaps

3.1001.3e – Adjacent framing

Desired Outcome:

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

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

Before
Balloon framing needs to be capped and sealed to prevent leakage

After
All edges of the cap should be sealed to surrounding surfaces, including adjacent framing

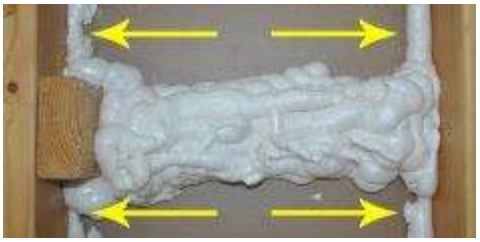
Tools:

1. Spray foam gun
2. Caulk gun

Materials:

1. Spray foam (SPF)
2. Caulk

For rigid material applications, sealant should be applied to framing



When using SPF to bridge cavity, extend SPF along joist and adjacent framing

3.1002 Open Stairwells

3.1002.1 Interior with Sloped Ceiling

3.1002.1a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the Nebraska Weatherization Assistance Program.

3.1002.1b - Standard void over stairwell (15-minute fire-rated material; e.g., gypsum lined)

Desired Outcome:

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

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)

3.1002.1c - Non-standard void over stairwell (surfaces around void are not 15-minute fire-rated (e.g., bookcases, chest of drawers), or lined with paneling

Desired Outcome:

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

Specification(s):

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

Objective(s):

Prevent a fire hazard

3.1002.1d – Support

Desired Outcome:

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

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

3.1002.1e – Joint seal

Desired Outcome:

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

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

3.1002.1f – Perimeter sealing

Desired Outcome:

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

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

3.1002.2 Stairwell to Attic—Door at Bottom with No Ceiling Above

3.1002.2a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1002.2b – Option 1: bring stairwell inside

Desired Outcome:

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

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

- Walk up attic access lids that exceed 12 pounds in weight shall be provided with a counter-balanced weight system to provide ease of access.

3.1002.2c – Option 2: keep stairwell outside

Desired Outcome:

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

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

3.1002.2d – Support

Desired Outcome:

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

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

3.1002.2e – Joint seal

Desired Outcome:

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

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

3.1002.2f – Perimeter sealing

Desired Outcome:

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

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

3.1002.3 Stairwell to Attic—Door at Top with Finished Ceiling Above

3.1002.3a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1002.3b – Option 1: bring stairwell inside

Desired Outcome:

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

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

3.1002.3c – Support

Desired Outcome:

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

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

3.1002.3d – Joint seal

Desired Outcome:

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

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

3.1002.3e – Perimeter sealing

Desired Outcome:

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

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

3.1003 Dropped Ceilings and Soffits

3.1003.1 New Ceiling Below Original—Old Ceiling Intact or Repairable

3.1003.1a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation repair are not eligible expenditures under the *Nebraska Weatherization Assistance Program.*

3.1003.1b – Sealing methods

Desired Outcome:

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

Specification(s):

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

Material will be cut to fit and fastened as required

OR

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

Before
Damage to an older ceiling reveals the new ceiling below

After
Rigid material sealed in place creates an air barrier

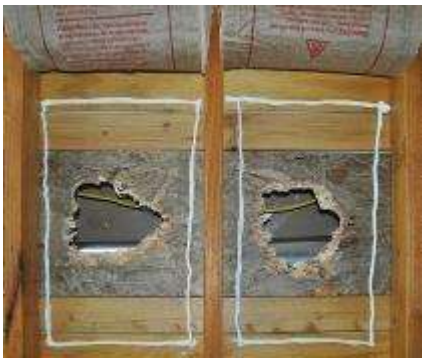
Tools:

1. Utility knife
2. Saw
3. Drill
4. Insulation machine
5. Caulk gun
6. Spray foam gun
7. Tape measure

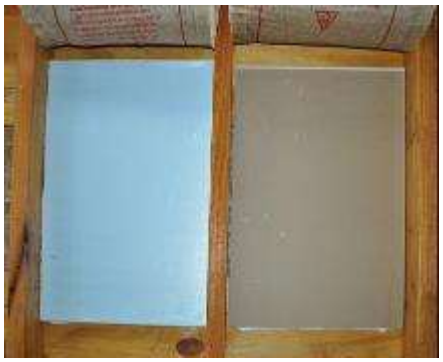
Materials:

1. Caulk sealant
2. Rigid material -- XPS or Drywall
3. Spray foam
4. Fasteners
5. Dense packable insulation
6. Wrapped fiberglass batts

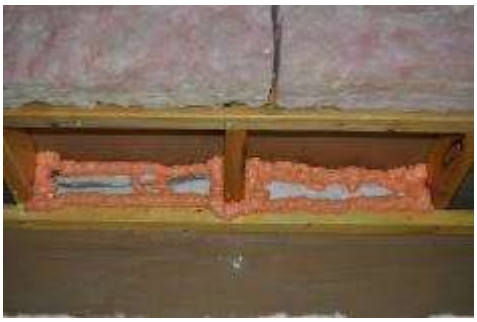
Prepare work area by removing existing insulation and debris



Option 1, Step 1: Run a bead of sealant around damage in old ceiling



Option 1, Step 2: Cover openings with rigid material, either XPS or drywall



Option 2: Seal with rigid material along face of stud cavities

Option 3: Dense pack cavities through fastened wood plate

Option 4: Bridge cavities at new ceiling level with wrapped batts and SPF

Whatever option chosen, test with chemical smoke to verify no leakage

3.1003.1c – Support

Desired Outcome:

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

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

Before

Spans greater than 24 inches require additional bracing before capping

After

Support should prevent cap from sagging or moving

Tools:

1. Saw
2. Drill
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

Create bracing to support spans larger than 24", either from above or below

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

Ensure new bracing is secure by using screws to fasten to joist

Once chase is capped, it is now ready to be sealed along framing

3.1003.1d – Joint seal

Desired Outcome:

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

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

Before
Damage to an old ceiling reveals a newer ceiling below

After
No gaps should remain after sealant is applied

Tools:
1. Spray foam gun
2. Caulk gun

Materials:
1. Caulk
2. Spray foam

1
Apply sealant to surrounding surfaces before setting cap in place

2
Sealant should extend along joists and into seams at top plates

3
Once cap is set, apply sealant to remaining gaps and along all seams

3.1003.1e – Adjacent framing

Desired Outcome:

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

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

Before
Damage to an older ceiling reveals the new ceiling below

After
No gaps should remain after spray foam is applied

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Spray foam
2. Caulk sealant

1
Caulk along all joists before setting cap

2
Use sealant to fill all remaining gaps

3.1003.2 Ceiling Leaks Not Repairable—No Air Barrier Above

3.1003.2a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks, repairing water damage and roof repair are not eligible expenditures under the *Nebraska Weatherization Assistance Progr*am.

3.1003.2b – Sealing methods

Desired Outcome:

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

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

3.1003.2c – Support

Desired Outcome:

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

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

Before
Spans greater than 24 inches require additional bracing before capping

After
Support should prevent cap from sagging or moving

Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

Create bracing to support spans larger than 24", either from above or below

When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

Ensure new bracing is secure by using screws to fasten to joist

Once chase is capped, it is now ready to be sealed along framing

3.1003.2d – Joint seal

Desired Outcome:

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

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

Before

Dropped soffits need to be capped and sealed to prevent leakage

After

No gaps should remain after sealant is applied

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Spray foam
2. Caulk

1

Apply sealant to surrounding surfaces before setting cap in place

2

Sealant should extend along surround joist and into seams at top plates

3

Once cap is set, apply sealant to remaining gaps and along all seams

3.1003.2e – Adjacent framing

Desired Outcome:

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

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

Before
Dropped soffits need to be capped and sealed to prevent leakage

After
No gaps should remain after sealant is applied along adjacent framing

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Spray foam
2. Caulk sealant

1
Sealant should have been along al joists and adjacent framing before cap was set

2
Additional sealant should fill in all remaining gaps after cap has been set

3.1003.3 Above Closets and Tubs

3.1003.3a – Pre-inspection

Desired Outcome:

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

conditioned space

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1003.3b – Above closets and tubs

Desired Outcome:

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

Specification(s):

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

Material will be cut to fit and fastened as required

OR

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

Before

After

Unsealed drop soffits over tubs and closets can be a point of leakage

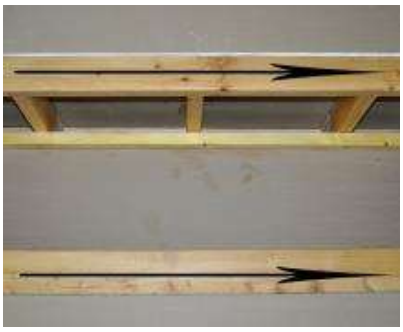
Capped soffits minimize leakage to and from unconditioned spaces

Tools:

1. Utility knife
2. Saw
3. Tape measure
4. Insulation machine
5. Drill
6. Caulk gun
7. Spray foam gun
8. Smoke pencil

Materials:

1. XPS
2. Drywall
3. Plywood
4. Caulk
5. Spray foam
6. Dense packable insulation
7. Fasteners
8. Wrapped fiberglass batts



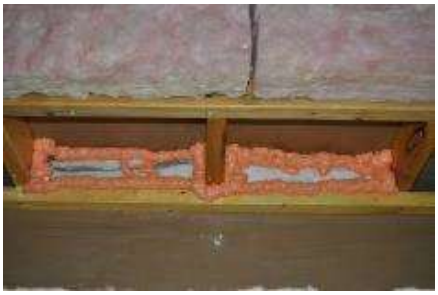
Option 1, Step 1: Apply sealant to top- plates or other relevant surfaces

Option 1, Step 2: Cover soffit with rigid material, such as drywall

Option 1, Step 3: Secure the rigid material with screws

Option 2: Cover face of stud bay with rigid material, like XPS or plywood

Option 3: Dense pack cavity through fastened wood cap



Option 4: Bridge stud bay with wrapped fiberglass and spray foam

All Options: Test with smoke pencil to verify no air movement

3.1003.3c - Support

Desired Outcome:

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

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

Before
Spans greater than 24 inches require additional bracing before capping

After
Support should prevent cap from sagging or moving

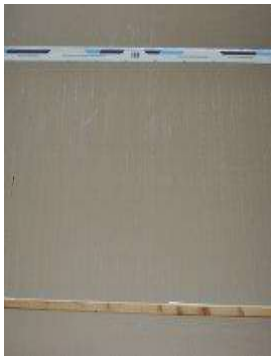
Tools:

1. Drill
2. Saw
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

Create bracing to support spans larger than 24", either from above or below



When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

Ensure new bracing is secure by using screws to fasten to joist

Once chase is capped, it is now ready to be sealed along framing

3.1003.3d - Joint seal

Desired Outcome:

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

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

Before

After

Uninsulated soffits can cause leakage to and from unconditioned spaces

No gaps should remain after spray foam is applied

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Caulk
2. Spray foam

1
Caulk surrounding surfaces before setting cap in place

2
Sealant should extend along surround joist and into seams at top plates

3
Once cap is set, apply sealant to remaining gaps and along all seams

3.1003.3e – Adjacent framing

Desired Outcome:

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

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

Before
Dropped soffits need to be capped and sealed to prevent leakage

After
No gaps should remain after sealant is applied along adjacent framing

Tools:

1. Caulk gun
2. Spray foam gun

Materials:

1. Caulk sealant
2. Spray foam

1
Apply sealant to surrounding surfaces before setting cap in place

2
Sealant should extend along adjacent framing and into seams at top plates

3
Additional sealant should fill in all remaining gaps after cap has been set

3.1003.4 Dropped Ceilings

3.1003.4a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1003.4b – Sealing methods

Desired Outcome:

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

Specification(s):

Entire opening will be spanned with rigid material 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

3.1003.4c - Support

Desired Outcome:

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

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

Before

Spans greater than 24 inches require additional bracing before capping

After

Support should prevent cap from sagging or moving

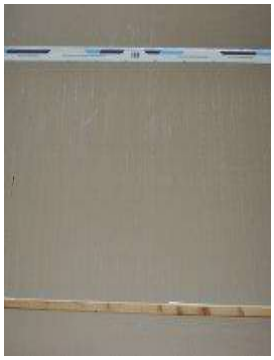
Tools:

1. Saw
2. Drill
3. Tape measure

Materials:

1. Lumber
2. Drywall
3. Fasteners

Create bracing to support spans larger than 24", either from above or below



When supporting from above, apply adhesive between drywall and bracing

Bracing can be screwed to drywall before capping chase

Ensure new bracing is secure by using screws to fasten to joist

Once chase is capped, it is now ready to be sealed along framing

3.1003.4d – Joint seal

Desired Outcome:

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

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

Before
Dropped soffits need to be capped and sealed to prevent leakage

After
No gaps should remain after spray foam is applied

Tools:
1. Spray foam gun
2. Caulk gun

Materials:
1. Spray foam
2. Caulk sealant

1
Caulk surrounding surfaces before setting cap in place

2
Sealant should extend along surround joist and into seams at top plates

3
Once cap is set, apply sealant to remaining gaps and along all seams

3.1003.4e – Adjacent framing

Desired Outcome:

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

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

Before
Dropped soffits need to be capped and sealed to prevent leakage

After
No gaps should remain after sealant is applied along adjacent framing

Tools:
1. Spray foam gun
2. Caulk gun

Materials:
1. Spray foam
2. Caulk

1
Sealant should have been along all joists and framing before cap was set

2
Additional sealant should fill in all remaining gaps after cap has been set

3.1003.5 Dropped Ceiling with Light Boxes and Fixtures

3.1003.5a – Pre-inspection

Desired Outcome:

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1003.5b – Light boxes (e.g., fluorescent lights)

Desired Outcome:

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

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

3.1003.5c – Non-insulation contact (IC) rated recessed lights

Desired Outcome:

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

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

3.1003.6 Dropped Soffits

3.1003.6a – Pre-inspection

Desired Outcome:

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

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

3.1003.6b – Soffit general

Desired Outcome:

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

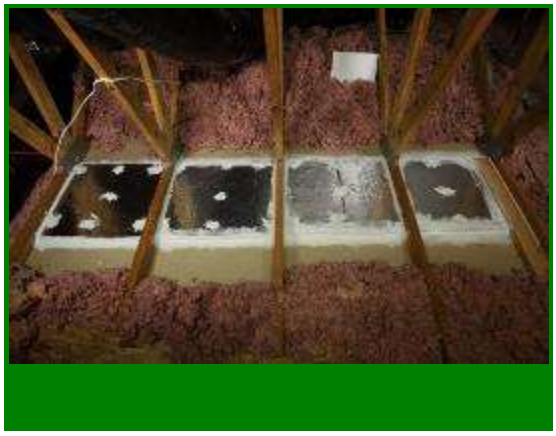
Specification(s):

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

Objective(s):

Provide continuous air barrier across soffit openings

Before
Accessible drop soffits should be sealed to prevent heat gain/loss



After
Completely sealed drop soffits and chases minimize heat transfer

Tools:

1. Measuring tape
2. Utility knife
3. Caulk gun
4. Spray foam gun
5. Saw
6. Drill

Materials:

1. Caulk
2. Spray foam
3. Lumber
4. XPS
5. Fasteners

There is a variety of ways to seal soffits. Please examine 3.1003.6c and 3.1003.6d for more information.

3.1003.6c – Option 1: bring soffit inside (seal at top)

Desired Outcome:

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

Specification(s):

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

Material will be cut to fit and fastened as required

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

Before
Standard soffits are often open to the attic and uninsulated

After
Rigid material encloses the soffit into the conditioned living space

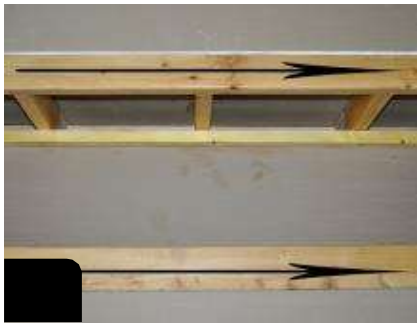
Tools:

1. Drill/screwdriver
2. Caulk gun

Materials:

1. Drywall
2. Sealant

1
Soffits open to the attic need to be sealed to maintain air barrier



2
Apply sealant along top plates

3
Cap soffit with rigid material, such as drywall, cut to size

4

5

Fasten cap with screws to set sealant and create air barrier

Insulate over now-capped soffit

3.1003.6d – Option 2: leave soffit outside (seal at bottom or side)

Desired Outcome:

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

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

Before
Wall cavities are open to attic and heat transfer due to dropped soffit

After
Wall cavities capped and air-sealed in one of a variety of options

Tools:

1. Tape measure
2. Utility knife
3. Saw
4. Insulation machine
5. Drill
6. Caulk gun
7. Spray foam gun

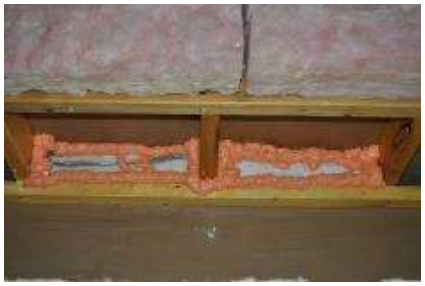
Materials:

1. XPS
2. Drywall
3. Plywood
4. Lumber
5. Fasteners
6. Caulk
7. Spray foam

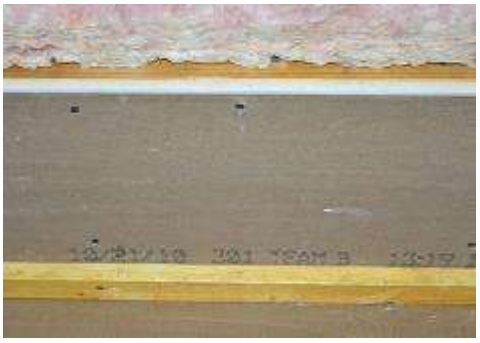
8. Dense packable insulation
9. Poly-wrapped insulation

Clear work area of insulation and debris

Option 1: Span each stud bay with rigid material at level of soffit



Option 2: Backing used to fill bays and sealed with spray foam



Option 3: Stud bay will faced with rigid material, fastened and sealed

3.1003.6e – Soffits containing non-IC rated recessed lights

Desired Outcome:

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

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

3.1004 Cathedralized Attic Ceilings

3.1004.1 Cathedralized Attic Air Sealing (Insulation Installed at Roof Deck)

3.1004.1a – Pre-inspection

Desired Outcome:
Cathedralized attics sealed to prevent air leakage

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1004.1b – Backing and infill

Desired Outcome:
Cathedralized attics sealed to prevent air leakage

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

3.1004.1c – Sealant selection

Desired Outcome:
Cathedralized attics sealed to prevent air leakage

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

3.1005 Other Ceiling Materials

3.1005.1 Tongue and Groove Ceilings

3.1005.1a – Pre-inspection

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

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

- The costs associated with mold remediation, fixing water leaks and repairing water damage are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

3.1005.1b – Backing

Desired Outcome:

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

Specification(s):

Backing will be installed behind tongue and groove ceilings

Objective(s):

Prevent air leakage and allow for sealants

3.1005.1c – Sealant selection

Desired Outcome:

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

Specification(s):

Sealants will be compatible with their intended surfaces

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

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

3.12 Windows and Doors

3.1201 Maintenance, Repair, and Sealing

3.1201.1 Double-Hung Wood Windows

3.1201.1a – Lead paint assessment

Desired Outcome:

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

1

Clean tools and sample site to prevent contamination

2

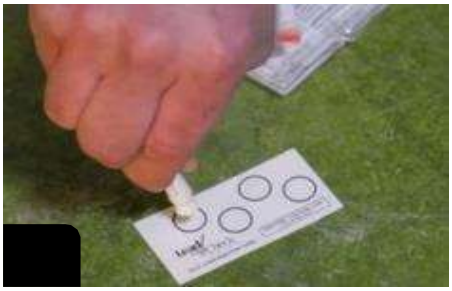
Cut sample site at an angle to expose all older paint layers

3

Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4
Check swab for reaction

5
Red indicates lead positive. White is lead negative.



6
If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1201.1b – Weather-stripping

Desired Outcome:

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

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

3.1201.1c – Sash locks

Desired Outcome:

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

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

3.1201.1d – Replacement sills

Desired Outcome:

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

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

Before
Rot in and under a window sill is often a sign of a bigger problem

After
Once repaired, this window is less leaky and better supported

Tools:

1. Saw
2. Drill
3. Pry bar
4. Sander
5. Caulk gun

Materials:

1. Lumber or metal sill
2. Caulk
3. Fasteners
4. Flashing

Remove sill to determine full extent of rot and necessary repairs

Once rotted materials are cut away, determine sizing of new materials

Cut new materials flush to surrounding surfaces and pitch toward exterior

For exterior repairs, replace flashing

Set new sill, then replace and prime trim

3.1201.1e – Sash replacement

Desired Outcome:

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

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

3.1201.1f – Adjust stops

Desired Outcome:

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

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

3.1201.1g – Replace stops

Desired Outcome:

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

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

3.1201.2 Single-Unit Window and Fixed Frame with Wood Sash

3.1201.2a – Lead paint assessment

Desired Outcome:

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

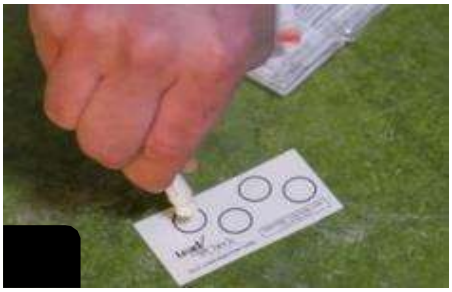
1
Clean tools and sample site to prevent contamination

2
Cut sample site at an angle to expose all older paint layers

3
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4
Check swab for reaction

5
Red indicates lead positive. White is lead negative.



6
If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1201.2b – Operable windows

3.1201.2b Denied Variance

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

Specification(s):
All egress windows will be operable as required by local codes

Objective(s):
Maintain operability of egress windows

3.1201.2c – Air infiltration

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

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

3.1201.2d – Water infiltration

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

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

Objective(s):
Reduce water infiltration

3.1201.2e – Occupant education and maintenance

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

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

3.1201.3 Exterior Doors

3.1201.3a – Lead paint assessment

Desired Outcome:
Doors operable and weather tight

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

Best Practice
In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

3.1201.3 Exterior Doors

3.1201.3a - Lead paint assessment

1
Clean tools and sample site to prevent contamination

2
Cut sample site at an angle to expose all older paint layers

3
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4

5

6

Check swab for reaction	Red indicates lead positive. White is lead negative.	If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1201.3b – Door operation and fit

Desired Outcome:
Doors operable and weather tight

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

Before
Daylight visible around door can indicate it does not hang true and leaks

After
With proper adjustment, doors should hang true and minimize leakage

Tools:
1. Screwdriver
2. Planer

Materials:
1. Shims

- Replacement doors shall be solid core, wood insulated or pre-hung metal insulated doors.
- Pre-hung metal insulated doors shall be R-7 or greater.

- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys shall be provided to the client.
- Any safety lock installed on the existing door shall be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing shall match the existing in design and dimension, as closely as possible.
- The cavities around the door frame shall be insulated or sealed with non-expanding foam sealant.
- Door lights with uninsulated glass shall not exceed 1 square foot.
- Door lights with insulated glass shall not exceed 2 square feet.
- All door casings shall be caulked.
- Doors shall conform to the thickness of the existing jamb.
- Solid core doors shall have 3 hinges.
- If trimming the bottom of the door is required; the door shall be trimmed at a 5 degree angle.
- Weather-strips, thresholds, door bottoms and sweeps shall have a vinyl or silicone insert.
- Weather-strips and sweeps shall have the last fastener or screw no more than 2-1/2 inches from the end.

1
After examining how door hangs, remove door from hinges

2
Adjust hinge plates to bring door back into true

3
Adjust strike plate to allow for secure and smooth operation

4
Rehang door to verify adjustments worked and door operates smoothly

3.1201.3c – Air infiltration

Desired Outcome:

Doors operable and weather tight

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

Before
Daylight visible around an exterior door indicates air infiltration

After
Weather-stripping and a door bottom minimize air infiltration around doors

Tools:

1. Screwdriver
2. Saw
3. Utility knife
4. Caulk gun
5. Drill
6. Tape measure

Materials:

1. Weather-stripping (Q-lan)
2. Door bottom
3. Fasteners
4. Caulk

- Replacement doors shall be solid core, wood insulated or pre-hung metal insulated doors.
- Pre-hung metal insulated doors shall be R-7 or greater.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys shall be provided to the client.
- Any safety lock installed on the existing door shall be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing shall match the existing in design and dimension, as closely as possible.
- The cavities around the door frame shall be insulated or sealed with non-expanding foam sealant.
- Door lights with uninsulated glass shall not exceed 1 square foot.
- Door lights with insulated glass shall not exceed 2 square feet.
- All door casings shall be caulked.
- Doors shall conform to the thickness of the existing jamb.
- Solid core doors shall have 3 hinges.

- If trimming the bottom of the door is required; the door shall be trimmed at a 5 degree angle.
- Weather-strips, thresholds, door bottoms and sweeps shall have a vinyl or silicone insert.
- Weather-strips and sweeps shall have the last fastener or screw no more than 2-1/2 inches from the end.

1
Remove leaky door in order to affix door bottom

2
Measure and trim door, if necessary, to allow for door bottom

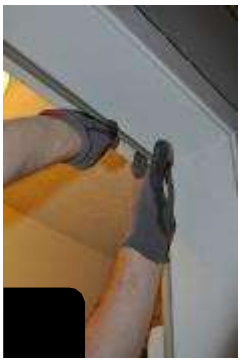
3
Trimming to allow for door bottom

4
Cut door bottom to width of door

5
Ensure door bottom fits snugly around door and fasten into place

6
Measure doorway for weather-stripping

7
Notch upper ends of side weather-stripping to allow for top piece



8
Weather-stripping should fit snugly into rabbit and against other pieces

9
Rehang door and verify fit, operation, and lack of air infiltration

3.1201.3d – Water infiltration

Desired Outcome:

Doors operable and weather tight

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

Before
Daylight visible under exterior doors indicate water can leak in

After
By adjusting the threshold and sealing along it, water should be kept out

Tools:

1. Caulk gun
2. Screwdriver
3. Pry bar

Materials:

1. Caulk sealant

- Replacement doors shall be solid core, wood insulated or pre-hung metal insulated doors.
- Pre-hung metal insulated doors shall be R-7 or greater.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys shall be provided to the client.
- Any safety lock installed on the existing door shall be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing shall match the existing in design and dimension, as closely as possible.
- The cavities around the door frame shall be insulated or sealed with non-expanding foam sealant.
- Door lights with uninsulated glass shall not exceed 1 square foot.
- Door lights with insulated glass shall not exceed 2 square feet.
- All door casings shall be caulked.
- Doors shall conform to the thickness of the existing jamb.
- Solid core doors shall have 3 hinges.
- If trimming the bottom of the door is required; the door shall be trimmed at a 5 degree angle.
- Weather-strips, thresholds, door bottoms and sweeps shall have a vinyl or silicone insert.
- Weather-strips and sweeps shall have the last fastener or screw no more than 2-1/2 inches from the end.

1
Adjust threshold to minimize gap and keep water out

2
Caulk along threshold from inside and outside to prevent water infiltration

3.1201.3e – Occupant education and maintenance

Desired Outcome:
Doors operable and weather tight

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

3.1201.4 Pocket Door

3.1201.4a – Backing and infill

Desired Outcome:
Pocket door sealed top and back to prevent leakage

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

3.1201.4b – Sealant selection

Desired Outcome:
Pocket door sealed top and back to prevent leakage

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 MSDS sheet will be followed for worker safety

Objective(s):

Select permanent sealant

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

3.1202 Repairing/Replacing Cracked and Broken Glass

3.1202.1 Fixed Frame with Wood Sash—Older House

3.1202.1a – Lead paint assessment

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

1
Clean tools and sample site to prevent contamination

2
Cut sample site at an angle to expose all older paint layers

3
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4
Check swab for reaction

5
Red indicates lead positive. White is lead negative.

6
If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1202.1b – Broken glass removal

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):

Putty and push points will be removed

Broken or cracked glass will be removed

Objective(s):

Safely remove old glass

Before
Broken glass with failed repairs needs to be replaced

In Progress
Large pieces of glass have been removed but sash still needs preparation

Tools:

1. Putty knife
2. Chisel
3. Utility knife
4. Shop vacuum
5. Tape measure

Materials:

1. Tape

- Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.
- Replacement window glass shall not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Window glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative window glass shall be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked glass shall be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass shall be replaced with a thermal pane glass whenever possible.
- Replacement door glass shall not be less than "B" grade single strength.
- Door glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Door glass over 1 sq. ft. shall be safety glass.
- Door glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative door glass shall be replaced with a standard glass pane.
- If the client refuses a standard door glass pane, the door glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.

- If the existing door glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked door glass shall be repaired.
- If the interior and/or exterior panes of door glass are broken, the door glass shall be replaced.
- Glass over 1 sq. ft. shall be replaced with safety glass and 1 sq. ft. or less shall be replaced with a standard glass pane.

1
Always wear heavy work gloves when working with glass

2
Cut through caulk bead and glazing to ease removal

3
Remove old putty and glazing to expose metal points holding glass in place

4
With points and glass removed, measure opening for replacement pane

5
Cut replacement glass 1/8" smaller than measured opening

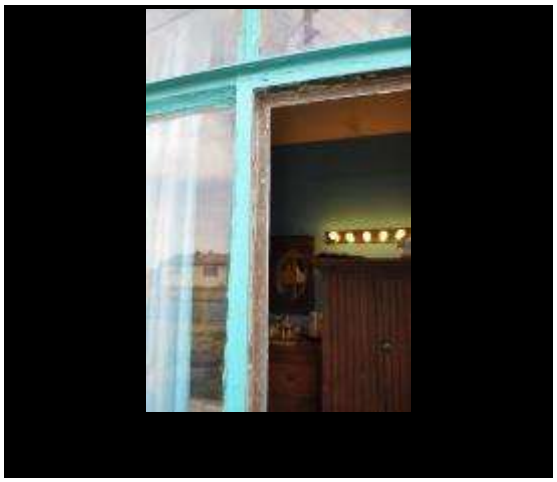
3.1202.1c – Sash preparation

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):
Opening will be cleaned

Objective(s):
Prepare opening for new glass

Before
Remove all debris from sash either by sand paper, knife, or chisel



In Progress
Mount new glass onto a clean surface

Tools:

1. Chisel
2. Utility knife

Materials:

1. Sand paper
2. Cleaning solution
3. Rags

- Replacement window glass shall not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Window glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative window glass shall be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked glass shall be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass shall be replaced with a thermal pane glass whenever possible.
- Replacement door glass shall not be less than "B" grade single strength.
- Door glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Door glass over 1 sq. ft. shall be safety glass.
- Door glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative door glass shall be replaced with a standard glass pane.
- If the client refuses a standard door glass pane, the door glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing door glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked door glass shall be repaired.
- If the interior and/or exterior panes of door glass are broken, the door glass shall be replaced.
- Glass over 1 sq. ft. shall be replaced with safety glass and 1 sq. ft. or less shall be replaced with a standard glass pane.

1
Debris in the sash can cause new glass to seal improperly

2
Check closely to remove all pieces of broken glass and debris

3
With sash cleaned, glass will fit properly and glazing will seal

3.1202.1d – New glass installation

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

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

Before
With sash prepared, installation of new pane can begin

After
Replacement glass should be securely fixed with points and glazing

Tools:

1. Caulk gun
2. Tape measure

Materials:

1. Primer
2. Window glazing

3. Paint brush

3. Push points
4. Shims
5. Replacement glass
6. Tape

- Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.
- Replacement window glass shall not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Window glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative window glass shall be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked glass shall be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass shall be replaced with a thermal pane glass whenever possible.
- Replacement door glass shall not be less than "B" grade single strength.
- Door glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Door glass over 1 sq. ft. shall be safety glass.
- Door glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative door glass shall be replaced with a standard glass pane.
- If the client refuses a standard door glass pane, the door glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing door glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked door glass shall be repaired.
- If the interior and/or exterior panes of door glass are broken, the door glass shall be replaced.
- Glass over 1 sq. ft. shall be replaced with safety glass and 1 sq. ft. or less shall be replaced with a standard glass pane.

1
Always wear heavy work gloves when working with glass

2
With broken glass removed, measure

3
Cut replacement glass 1/8" smaller than measured opening

opening for
replacement glass

4
Use shims to center glass while installing push points

5
With push points in place, glaze to air seal new glass pane in sash

6
Secure pane in place with tape to hold until glazing sets

3.1202.2 Single-Unit Window, Mounted on Rough Opening—Newer House

3.1202.2a – Lead paint assessment

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

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

Best Practice
In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

1
Clean tools and sample site to prevent contamination

2
Cut sample site at an angle to expose all older paint layers

3
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4
Check swab for reaction

5
Red indicates lead positive. White is lead negative.

6
If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1202.2b - Broken glass removal

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):

Window stops and damaged glass will be removed

Objective(s):

Safely remove old glass

Before

Broken glass with failed repairs needs to be replaced

In Progress

After larger pieces are removed, the sash still needs preparation

Tools:

1. Putty knife
2. Chisel
3. Utility knife
4. Shop vacuum
5. Tape measure

Materials:

1. Tape

- Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.
- Replacement window glass shall not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Window glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative window glass shall be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked glass shall be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass shall be replaced with a thermal pane glass whenever possible.

1
Always wear heavy work gloves when working with glass

2
Cut through caulk or glazing to simplify removal

3
Remove old putty and glazing from glass to expose pin nails holding glass

4
With pins and glass removed, measure opening for replacement pane

5
Cut replacement glass 1/8" smaller than measured opening

3.1202.2c – Opening preparation

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):

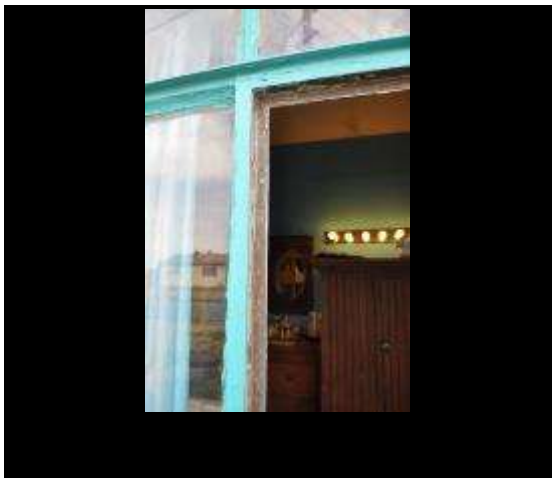
Opening will be cleaned

Glazing tape will be removed or replaced

Objective(s):

Prepare opening for new glass

Before
Remove all debris, glazing tape, and glass from sash



In Progress
Sash surface must be clean before mounting new glass

Tools:

1. Chisel
2. Utility knife

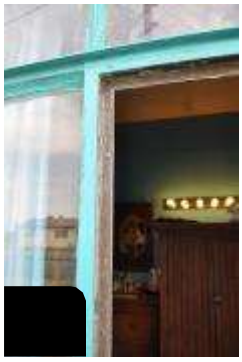
Materials:

1. Cleaning solution
2. Rags

- Replacement window glass shall not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Window glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative window glass shall be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked glass shall be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass shall be replaced with a thermal pane glass whenever possible.

1
Debris in the sash can cause new glass to seal improperly

2
Check closely to remove and collect all broken glass and debris



3
With sash cleaned, glass will fit properly and glazing will seal

3.1202.2d – New glass installation

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

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

Before
With sash prepared, new pane installation can begin

After
Replaced glass should be held in place while glazing sets

Tools:

1. Caulk gun
2. Tape measure
3. Light-duty hammer

Materials:

1. Trim

- Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.
- Replacement window glass shall not be less than "B" grade single strength.
- Window glass over 40 inches in either dimension shall not be less than "B" grade double strength.
- Window glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.
- Damaged decorative window glass shall be replaced with a standard glass pane.

- If the client refuses a standard window glass pane, the window glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.
- If the existing window glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked glass shall be repaired.
- If the interior and/or exterior panes of thermal pane window glass are broken, the window glass shall be replaced with a thermal pane glass whenever possible.

1
Always wear heavy work gloves when working with glass

2
With broken glass removed, measure rough opening for replacement glass size

3
Cut replacement glass 1/8" smaller than measured opening

4
With sash prepared, shim glass to center in opening and reinstall stops

5
Apply window glazing to air seal new pane

3.1203 Replacement

3.1203.1 Replacement Window in Existing Window Frame

3.1203.1a – Lead paint assessment

Desired Outcome:

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

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

Best Practice

In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

1

Clean tools and sample site to prevent contamination

2

Cut sample site at an angle to expose all older paint layers

3

Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4
Check swab for reaction

5
Red indicates lead positive. White is lead negative.

6
If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1203.1b – Opening preparation for Replacement Window in Existing Window Frame

Desired Outcome:

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

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

3.1203.1c – Replacement Window Installation

Desired Outcome:

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

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

- New primary replacement windows shall have an NFRC (National Fenestration Rating Council) U-factor of 0.33 or lower.

3.1203.1d – Safety

Desired Outcome:

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

Specification(s):

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

Objective(s):

Meet all codes when replacing windows

3.1203.1e – Occupant education and maintenance

Desired Outcome:

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

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

3.1203.2 Single-Unit Window, Mounted on Rough Opening—Newer House

3.1203.2a – Lead paint assessment

Desired Outcome:

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

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

Best Practice
In homes built before 1978, test paint before beginning renovation

Tools:

1. Note: Mask must be worn during testing
2. LeadCheck test kit
3. Utility knife
4. Camera

EPA RRP certification required to conduct Lead Paint assessment.

1
Clean tools and sample site to prevent contamination

2
Cut sample site at an angle to expose all older paint layers

3
Break capsules and shake to mix reagents. Swab sample site for 30 seconds

4
Check swab for reaction

5
Red indicates lead positive. White is lead negative.

6
If negative, verify validity of test with provided calibration card

7
Lead in calibration card should test positive and turn red

8
Record test results to maintain documentation

3.1203.2b – Opening preparation

Desired Outcome:

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

Specification(s):

Replacement window will be laid out with trim

Exterior trim will be removed or exterior siding will be cut back to fit new window with trim

Existing window will be removed

Window opening will be flashed in accordance with accepted industry standards

Objective(s):

Provide a clean and properly flashed opening for replacement window unit

Before
Single pane window in newer home

In Progress
Window is removed to allow for replacement with double pane unit

Tools:

1. Pry bar
2. Utility knife
3. Drill

Materials:

1. Window and door flashing

1
Single pane window needs to be replaced with double pane

2
Cut through caulk at stops to break seal

3
Remove stops while attempting to keep damage to rough opening to minimum

4
Remove interior trim

5
Remove exterior trim

6
Remove exterior fasteners to free window

7
Remove window from rough opening

8
Clean rough opening to remove old caulk and debris

9
Install flashing along sides and bottom of rough opening

3.1203.2c – Replacement unit preparation

Desired Outcome:

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

fenestration

Specification(s):

Mounting detail will be determined based on depth of window and location of window liner

Objective(s):

Allow for good fit and finish of replacement window

Before
Single pane window is being removed

In Progress
Double-pane unit replaces previous single- pane one

Tools:

1. Tape measure
2. Utility knife

1
Measure rough opening depth to determine best method of installation

2
Clean old sealant off exterior surface to allow for flange installation

3
Install unit following appropriate detail for rough opening and unit depth

3.1203.2d – Replacement window installation

Desired Outcome:

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

Specification(s):

Replacement windows will be installed in accordance with manufacturer specifications and will be

integrated with flashing

Gaps between the new window and existing frame will be sealed with low-expanding foam

Objective(s):

Ensure replacement window operates properly

Ensure replacement window is weather tight

Before
Single pane window is being removed to install double pane unit

After
Double pane unit installed with trim in place

Tools:

1. Utility knife
2. Spray foam gun
3. Drill
4. Hammer
5. Saw

Materials:

1. Fasteners
2. Flashing
3. Low-expansion spray foam
4. Backer rod
5. Primed trim

- New primary replacement windows shall have an NFRC (National Fenestration Rating Council) U-factor of 0.33 or lower.

1
Install flashing to manufacturer specs and industry standards

2
Flanges have been folded out to allow for easy installation

3
Fasten window flange securely around exterior of entire window

4
With window secured in place, check for proper function

5
Check that sash locks align properly, indicating window is plumb

6
Fill interior gap with compressible foam or appropriate sealant

7
Prime and replace interior trim and, if needed, sill

8
Replace exterior trim and patch exterior siding or finish as needed

3.1203.2e – Safety

Desired Outcome:

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

Specification(s):

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

Objective(s):

Meet all codes when replacing windows

3.1203.2f – Occupant education and maintenance

Desired Outcome:

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

Specification(s):

Occupant 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

3.14 Basements and Crawl Spaces

3.1401 Basements Connected to Crawl Spaces

3.1401.1 Basements Connected to Crawl Spaces—Sealing and Insulating

3.1401.1a – Conditioned basements with vented crawl spaces

Desired Outcome:

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

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

3.1401.1b – Conditioned basements with closed crawl spaces

Desired Outcome:

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

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

3.1401.1c – Unconditioned basements with vented crawl spaces

Desired Outcome:

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

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

3.1401.1d – Unconditioned basements with closed crawl spaces

Desired Outcome:

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

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

3.1402 Crawl Spaces

3.1402.1 Crawl Spaces—Sealing Floor Penetrations

3.1402.1a – Backing and infill

Desired Outcome:

Air leakage prevented and indoor air quality protected

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

Before
Gaps around floor penetrations, such as plumbing, HVAC, and electrical

After
Gaps should be sealed to maintain air barrier

Tools:

1. Headlamp

Materials:

1. Backer rod
2. Sealant

1
Prepare work space by removing any insulation

2
Infill with backer rod

3
Apply appropriate caulking to ensure backing/infill does not move

4
Visually inspect to verify no gaps remain

3.1402.1b – Sealant selection

Desired Outcome:

Air leakage prevented and indoor air quality protected

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

Bad Practice
Avoid sealants that do not allow for expansion between dissimilar materials

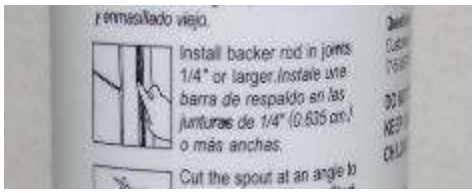
Best Practice
Flexible sealants compensate for differential expansion and maintain a seal

Tools:
1. Caulk gun
2. Spray foam gun

Materials:
1. Caulk
2. Spray foam

Caulking can be used to span gaps up to 1/4 inch

Spray foam can be used to span gaps up to 3 inches



Check manufacturer specifications to verify spanning capabilities

Also check manufacturer specs for incompatibility with intended surfaces

3.1402.1c – High temperature application

Desired Outcome:

Air leakage prevented and indoor air quality protected

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

Before

Gaps around floor penetrations allow air and moisture movement

After

Use non-combustible materials, like 26-gauge steel and high-temp caulk

Tools:

1. Caulk gun
2. Metal snips
3. Drill/screwdriver

Materials:

1. High-temperature caulk
2. 26-gauge steel sheeting

1

Prepare work area by removing any insulation and debris

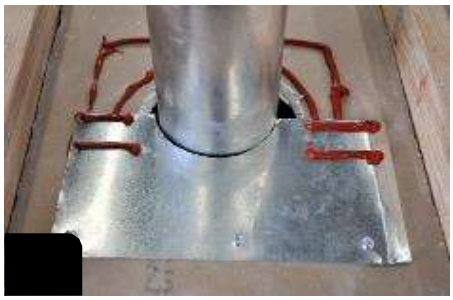
2

Use high-temperature caulking (600F min)

3

Apply first ring of caulking to match shape of opening

4



5

6

Apply second ring of caulking to size and shape of rigid material	Fasten rigid material (26-gauge steel) and apply additional caulking	Fasten rigid material to cover penetration and seal against flue with caulk

3.1402.2 Closed Crawl Spaces—Air Sealing Foundation Vents

3.1402.2a – Vent closure

3.1402.2a Approved Variance

Desired Outcome:

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

Specification(s):

Vent opening will be permanently closed and sealed

Objective(s):

Prevent air and moisture penetration

3.1402.3 Closed Crawl Spaces—Air Sealing Exterior Wall

3.1402.3a – Seal penetrations

Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

Specification(s):

Penetrations will be sealed with a durable material

A minimum expected service life of 10 years will be ensured

Objective(s):

Prevent air and moisture penetration into crawl space

Before

Light showing through penetration in exterior block wall

After

Sealed with durable material to prevent air and water leakage, and pests

Tools:

1. Caulk gun
2. Sprayfoam gun
3. Metal snips
4. Drill

Materials:

1. Caulk
2. Sprayfoam
3. Metal mesh
4. Fasteners

Measure holes to determine the best backing and fill strategy

In holes larger than 1/4 inch, wire mesh should be used for backing

Sprayfoam or caulk seal the hole

3.1402.3b – Pest exclusion

Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

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

Before

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

After

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

Tools:

1. Caulk gun
2. Sprayfoam gun
3. Metal snips
4. Drill

Materials:

1. Caulk
2. Sprayfoam
3. Metal mesh
4. Rigid backing

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

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

Sprayfoam can be used to seal the hole and hold mesh in place

3.1402.4 Closed Crawl Spaces—Air Sealing Brick Curtain Wall with Piers

3.1402.4a – Seal penetrations

3.1402.4a Approved Variance

Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

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 A minimum expected service life of 10 years will be ensured

Objective(s):

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

Decrease probability of rot

3.1402.4b – Pest exclusion

Desired Outcome:

Well-sealed exterior wall prevents leakage and pests

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

3.1402.5 Closed Crawl Spaces—Attached Crawl Spaces Under Unconditioned Spaces

3.1402.5a – Separate crawl spaces

Desired Outcome:

Closed, attached crawl spaces sealed but accessible

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

3.1402.5b – Entry point

3.1402.5b Approved Variance

Desired Outcome:

Closed, attached crawl spaces sealed but accessible

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 2012 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

3.1488 Special Considerations

3.1488.1 Skirting Post and Pier Foundations

3.1488.1a – Skirting

Desired Outcome:

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

Specification(s):

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

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

- New insulated skirting, indicated as cost-effective in the Energy Audit, shall be metal, vinyl or pressure treated plywood supported by a wood frame and insulated with a minimum R-11 faced batt or a minimum R-10 foam board.
- New insulated skirting framing shall have a pressure treated, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.
- Insulation on new insulated skirting shall cover the top plate and extend a minimum of 24 inches on top of a ground laid moisture barrier.
- *Manufactured* insulating skirting, indicated as cost-effective in the Energy Audit, may be used.
- It shall have a minimum of R-8 insulation.
- Accesses shall be constructed of ¾ inch pressure treated plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism, if the skirting is insulated, and weather-stripped.
- *Manufactured* insulating skirting shall have one access.

3.1488.1b – Flashing

Desired Outcome:

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

Specification(s):

Skirting will be flashed to prevent the entrance of water

Objective(s):

Prevent water from entering space under house

- New insulated skirting, indicated as cost-effective in the Energy Audit, shall be metal, vinyl or pressure treated plywood supported by a wood frame and insulated with a minimum R-11 faced batt or a minimum R-10 foam board.
- New insulated skirting framing shall have a pressure treated, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.
- Insulation on new insulated skirting shall cover the top plate and extend a minimum of 24 inches on top of a ground laid moisture barrier.
- *Manufactured* insulating skirting, indicated as cost-effective in the Energy Audit, may be used.
- It shall have a minimum of R-8 insulation.
- Accesses shall be constructed of ¾ inch pressure treated plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism, if the skirting is insulated, and weather-stripped.
- *Manufactured* insulating skirting shall have one access.

3.1488.1c – Fastening

Desired Outcome:

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

Specification(s):

Entire skirting will be mechanically fastened

Objective(s):

Ensure lasting upgrade

- New insulated skirting, indicated as cost-effective in the Energy Audit, shall be metal, vinyl or pressure treated plywood supported by a wood frame and insulated with a minimum
- R-11faced batt or a minimum R-10 foam board.
- New insulated skirting framing shall have a pressure treated, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.
- Insulation on new insulated skirting shall cover the top plate and extend a minimum of 24 inches on top of a ground laid moisture barrier.
- *Manufactured* insulating skirting, indicated as cost-effective in the Energy Audit, may be used.
- It shall have a minimum of R-8 insulation.
- Accesses shall be constructed of ¾ inch pressure treated plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism, if the skirting is insulated, and weather-stripped.
- *Manufactured* insulating skirting shall have one access.

3.15 Attached Garages

3.1501 Garage Openings

3.1501.1 Penetrations, Cracks, and Doors Between Garage and House

3.1501.1a – Penetrations

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

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

Objective(s):

Prevent air leakage and pollutant entry

Before
Penetrations between the garage and house can leak hazardous fumes

After
Seal penetrations to minimize risks and air leakage

Materials:

1. Backer Rod
2. Caulk
3. Spray foam

3.1501.1b – Ductwork

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

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

Objective(s):

Prevent air leakage and pollutant entry

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

After
Sealed ductwork connections help prevent leakage.

Materials:

1. Mesh tape
2. Mastic

- Tears and joints shall be sealed using nontoxic and water-resistant mastic.
- Mesh tape shall be used when openings and tears are over 1/16 of an inch.
- Appropriate Energy Code UL181duct sealing tape may be used only when the installation of mastic is not feasible.

1

2

3

Prepare work area by assessing any safety concerns.

Wrap joint with fiberglass mesh tape.

Apply UL 181 mastic to seal joint.

3.1501.1c – Cracks

Desired Outcome:

Openings from garage sealed to prevent leakage

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

Before
Cracks in shared walls of attached garages are a potential leakage site

After
Air sealing reduces pollutant entry, but does not diminish fire resistance

Materials:

1. Sprayfoam
2. Fire-block caulk

Determine which walls are shared between garage and living space

Inspect wall and ceiling for cracks and penetrations

Clear work area of obstacles and debris

Apply appropriate sealant dependent upon size of crack and location

Ensure sealant does not decrease wall's fire resistance

3.1501.1d – Garage to house door

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

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

Objective(s):

Prevent air leakage and pollutant entry

Before

Daylight visible under door to garage indicates leakage

After

Door sweep, with weather-stripping, will minimize air exchange with garage

Tools:

1. Caulk gun
2. Screwdriver
3. Utility knife
4. Hacksaw
5. Saw
6. Tape measure
7. Drill
8. Planer

Materials:

1. Weather-stripping (Q-lan)
2. Door sweep
3. Caulk
4. Fasteners

- Replacement doors shall be solid core, wood insulated or pre-hung metal insulated doors.
- Pre-hung metal insulated doors shall be R-7 or greater.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys shall be provided to the client.
- Any safety lock installed on the existing door shall be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing shall match the existing in design and dimension, as closely as possible.
- The cavities around the door frame shall be insulated or sealed with non-expanding foam sealant.
- Door lights with uninsulated glass shall not exceed 1 square foot.
- Door lights with insulated glass shall not exceed 2 square feet.
- All door casings shall be caulked.
- Doors shall conform to the thickness of the existing jamb.
- Solid core doors shall have 3 hinges.
- If trimming the bottom of the door is required; the door shall be trimmed at a 5 degree angle.
- Weather-strips, thresholds, door bottoms and sweeps shall have a vinyl or silicone insert.
- Weather-strips and sweeps shall have the last fastener or screw no more than 2-1/2 inches from the end.

Remove door for access to work space and to install sweep

Measure for weather-stripping around door

Install weather-stripping into rabbit around door

Corners of weather-stripping should be snug and secure

Adjust threshold to minimize contaminant and water infiltration

Caulk along threshold to minimize water and contaminant infiltration

Cut door sweep to width of the door

Ensure door sweep fits tightly against bottom of door and fasten in place

Rehang door to verify snug fit and smooth operation

3.1501.1e – Glass

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

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

Objective(s):

Prevent air leakage and pollutant entry

Before

Broken glass in exterior and garage doors allows for leakage. Replace it

After

With new glass in place, take care to tightly seal and replace stops

Tools:

1. Hammer
2. Pry bar
3. Caulk gun
4. Tape measure

Materials:

1. Brads
2. Caulk
3. Glazing
4. New glass cut to size of rough opening

Remove stops, taking care not to damage them

Remove broken glass and clean old sealant and glazing from rough opening

Measure rough opening and cut new glass to size

Apply sealant to rough opening and place new glass

Seal glass into place from inside as well to ensure no air infiltration

Replace stops and rehang door

3.1501.1f – Carbon monoxide (CO) alarm

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

CO alarms will be installed in accordance with ASHRAE 62.2, applicable codes and manufacturer specifications

Objective(s):

Warn occupants of CO exposure from attached garage

Best Practice

Best Practice

Carbon monoxide alarms should be installed throughout the house

Occupants should be alerted to CO alarm locations and maintenance

- All homes where combustible appliances are present and/or the home has an attached garage will have a functioning Carbon Monoxide Detector.
- CO alarms should be installed one per floor and near sleeping areas.

3.1501.1g – Occupant education

Desired Outcome:

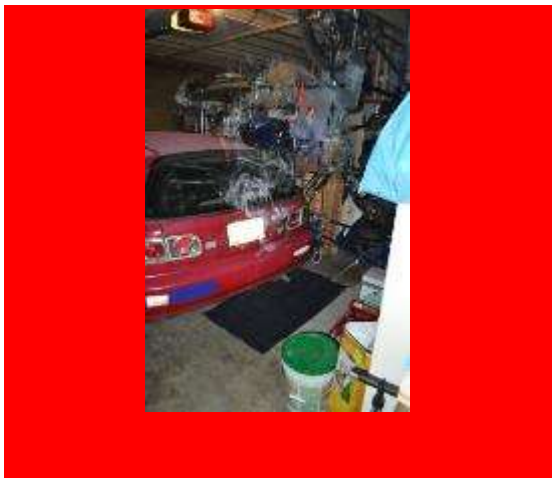
Openings from garage sealed to prevent leakage

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



Unsafe

Communicate importance of never running vehicles in a closed garage

Best Practice

Speak with occupant about hazards of using gas appliances in the garage

Occupants should never run vehicles in a closed garage

Occupants should not light combustibles inside garages

Speak with occupant about hazards of using gas appliances in the garage

3.16 Ducts

3.1601 Duct Preparation

3.1601.1 Preparation and Mechanical Fastening

3.1601.1a – Preparation

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

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

3.1601.1b – Metal to metal

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

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

3.1601.1c – 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

Objective(s):

Ensure durable joints

3.1601.1d – Duct board to duct board

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):
Joints will be fastened with clinch stapler

Objective(s):
Ensure durable joints

3.1601.1e – Flexible duct to duct board

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Metal take-off collar will be used and attached in accordance with 2012 IRC M1601.4.1

Objective(s):
Ensure durable joints

3.1601.1f – Metal plenum to air handler cabinet

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Plenum will be mechanically fastened

Objective(s):
Ensure durable joints

3.1601.1g – Duct board plenum to air handler cabinet

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

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

3.1601.1h – Boot to wood

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Screws or nails will be used to fasten boot to wood

Objective(s):
Ensure durable joints

3.1601.1i – Boot to wood

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

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

3.1601.1j – Flex to duct board

Desired Outcome:
Ducts and plenums properly fastened to prevent leakage

Specification(s):
Take-offs will be in accordance with 2012 IRC Chapter 16, 2012 IRC N1103.2, and applicable local code

Objective(s):
Ensure durable joints

3.1601.2 Duct Preparation for SPF Application

3.1601.2a – Inspection

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

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

3.1601.2b – Repair

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

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

3.1601.3 Support

3.1601.3a – Support (applies to all duct types)

Desired Outcome:

Ducts and plenums properly supported

Specification(s):

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

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

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

Objective(s):

Eliminate falling and sagging

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

After
Properly supported ducts minimize heat loss and maximize duct run

Tools:

1. Metal snips
2. Utility knife
3. Drill
4. Stapler

Materials:

1. 18 gauge metal strap (at least 1/2" wide)
2. 12 gauge galvanized wire
3. Fabric support straps (at least 1 1/2" wide)
4. Staples
5. Fasteners

- The Nebraska Weatherization Assistance Program limits new metal flexible ducts to 4 feet or less.

BAD:
Make sure supports DO NOT compress insulation or duct

Flex ducts should have supports no less than every 4 feet

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

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

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

Metal wire should be at least 12 gauge and galvanized

3.1602 Duct Sealing

3.1602.1 Air Sealing Duct System

3.1602.1a – New component to new component sealant selection

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Any closure system used will be in accordance with 2012 IRC Chapter 16

Objective(s):
Ensure effectiveness of air sealing system

3.1602.1b – New component to existing component

Desired Outcome:
Ducts and plenums sealed to prevent leakage

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

The *Nebraska Weatherization Assistance Program* requires:

- Mastic alone is acceptable for holes less than 1/8" that are more than 10' from air handler.
- Seams, cracks, joints, holes, and penetrations greater 1/8" will be sealed using fiberglass mesh and mastic.
- Seams, cracks, joints, holes, and penetrations between ¼"" and ½" will be sealed in two stages; 1)They will be backed using temporary tape (e.g., foil tape) as a support prior to sealing and 2)They will be sealed using fiberglass mesh and mastic.
- Seams, cracks, joints, holes, and penetrations greater than ½" will be backed using rigid duct material as a support prior to sealing.

3.1602.1c – Existing component to existing component

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

Fiberglass mesh and mastic will overlap temporary tape by at least 1" on all sides

Fiberglass mesh and mastic will become the primary seal

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

Fiberglass mesh and mastic will overlap repair joint by at least 1" on all sides

Fiberglass mesh and mastic will be the primary seal

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

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

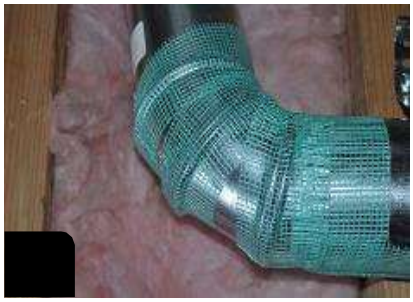
After
Sealed ductwork connections help prevent leakage

Materials:

1. Mastic
2. Fiberglass mesh tape

- Tears and joints shall be sealed using nontoxic and water-resistant mastic.
- Mesh tape shall be used when openings and tears are over 1/16 of an inch.
- Appropriate Energy Code UL181duct sealing tape may be used only when the installation of mastic is not feasible.

1
Prepare work area by assessing any safety concerns



2
Wrap joint with fiberglass mesh tape

3
Apply UL 181 mastic to seal joint

3.1602.2 Duct Spray Polyurethane Foam (SPF) Installation

3.1602.2a – Installation

Desired Outcome:

Exposed ductwork in unconditioned spaces insulated and sealed

Specification(s):

Insulation will be installed according to manufacturer specifications and all provisions of the 2012 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 2012 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

3.1602.4 Air Sealing System Components

3.1602.4a – Duct boot to interior surface

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

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

Gypsum edge will be wetted before applying water-based sealant

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

Objective(s):

Prevent air leakage

Prevent a fire hazard

Before
Gaps around duct boots allow for leakage to and from the attic

After
Use a mesh in mastic system to seal duct boot to interior surface

Tools:

Materials:

1. Utility knife
2. Spray bottle
3. Putty knife

1. Mastic
2. Mesh tape

1
Remove grill to expose duct boot and gaps

2
Wet the edges of the drywall to ensure a good bond

3
Cut mesh tape to fit around duct boot and cover gaps

4
Apply mastic over mesh tape to create heat resistant, durable bond

5
Once mastic is set, grill can be replaced and mastic should not show

3.1602.4b – Wood plenums and building cavities – Air Sealing

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
Accessible connections and joints will be made airtight using approved material

Objective(s):
Ensure ducts and plenums will not leak

3.1602.4c – Air handler cabinet

Desired Outcome:
Ducts and plenums sealed to prevent leakage

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

Objective(s):
Reduce air leakage while maintaining accessibility

Before
Unnecessary holes in the air handler cabinet need to be sealed

After
Use removable foil tape to seal holes

Materials:

1. Foil tape

Unnecessary holes in the air handler cabinet should be sealed

Removable foil tape should be used to seal

Fully cover holes with tape to seal completely

3.1602.4d – Filter slot

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

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

Objective(s):

Reduce air leakage while maintaining accessibility

Before
Uncovered filter slots are a point of leakage

After
Filter slots should be covered

3.1602.5 Return—Framed Platform

3.1602.5a – Preparation

Desired Outcome:
The return duct installed to prevent air leakage

Specification(s):
Debris and dirt will be cleaned out of the return platform

Objective(s):
Allow for the application of rigid materials and sealants

Before
Dirty, unsealed return platform needs to be cleaned out before sealing

In Progress
Vacuum out debris and dirt from the return to prepare work area

Tools:
1. Shop vacuum

3.1602.5b – Infill and backing

Desired Outcome:

The return duct installed to prevent air leakage

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

Before

Leakage from air return into wall cavities should be eliminated

In Progress

Only materials rated for use in higher temperature areas should be used

Tools:

1. Tape measure
2. Utility knife
3. Drill
4. Caulk gun

Materials:

1. XPS
2. Drywall
3. Fire-resistant caulk
4. Fasteners

Do NOT use EPS in air returns due to proximity to combustion appliances

XPS (extruded polystyrene) and drywall are safe for use in air returns

3.1602.5c – Sealant selection

Desired Outcome:

The return duct installed to prevent air leakage

Specification(s):

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

Objective(s):

Select permanent sealant

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

Best Practice
Sealants, like mesh and UL 181 mastic, meet IRC, ASTM, and UL specs

Best Practice
Caulk sealants will be continuous

Tools:

1. Caulk gun
2. Utility knife
3. Taping knife

Materials:

1. Fiberglass mesh
2. Siliconized caulk
3. UL 181 mastic

Paraphrased from 2012 IRC R302.9: Wall and ceiling finishes will have a flame spread index of 200 or less and a smoke-developed index of 450 or less

3.1602.7 Return and Supply Plenums in Basements and Crawl Spaces

3.1602.7a – Supply plenums (includes conditioned 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

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

3.1602.7b – Return Plenums

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

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

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4 Insulation

4.10 Attics

4.1001 General Preparation

4.1001.1 Non-Insulation Contact (IC) Recessed Light

4.1001.1a – Air barrier system

Desired Outcome:

Ensure Safety from fire and prevent air leakage

Specification(s):

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

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

OR

The non-IC rated 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

OR

Air sealing measures as approved by the authority having jurisdiction

Objective(s):

Prevent a fire hazard

Prevent air leakage through fixture

Before
Non-IC rated recessed light fixtures should be dammed from insulation

After
Sealed box around non-IC light should be taller than surrounding insulation

Tools:

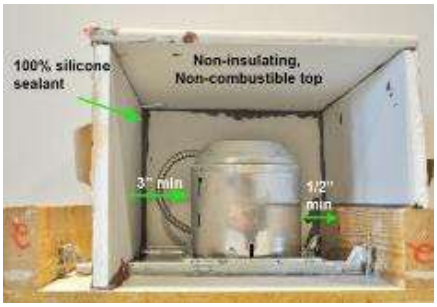
1. Utility knife

Materials:

1. 5/8" fire-rated drywall

2. Tape measure

2. Fire-rated caulk sealant



Box should be constructed with clearances in mind

Sealed box should be constructed of fire-rated drywall

OR non-IC can light can be replaced with IC-rated recessed light

4.1001.1b – Enclosure top

Desired Outcome:

Ensure Safety from fire and prevent air leakage

Specification(s):

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

The top of the enclosure will be left free of insulation

Objective(s):

Prevent heat build up

Before

Non-IC rated recessed lights create excess heat and are a fire risk

After

Once dammed from insulation, it should still not have insulation on top

Tools:

1. Utility knife
2. Caulk gun

Materials:

1. Drywall

- Shielding shall be kept a minimum of 6” from the high heat source.

4.1001.1c – Clearance

Desired Outcome:

Ensure Safety from fire and prevent air leakage

Specification(s):

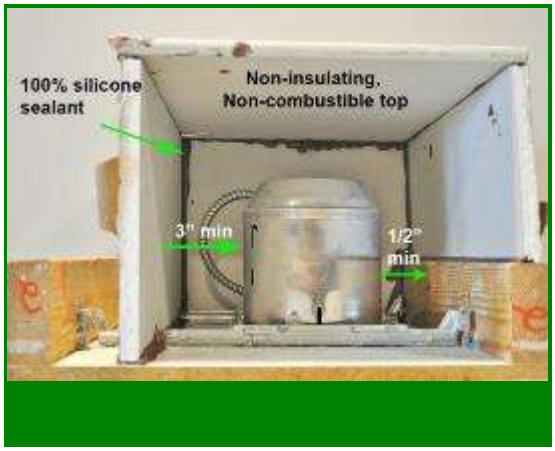
The entire closure will maintain a 3" clearance between the closure and the fixture including wiring, box, and ballast

Objective(s):

Keep an air space around the fixture

Before

Non-IC rated recessed lights produce excess heat and can be a fire risk



After

A 3 inch clearance should be kept from boxing materials

Tools:

1. Utility knife
2. Tape measure
3. Caulk gun

Materials:

1. Fire-rated sealant
2. Drywall

4.1001.1d – Sealants and weather-stripping

Desired Outcome:

Ensure Safety from fire and prevent air leakage

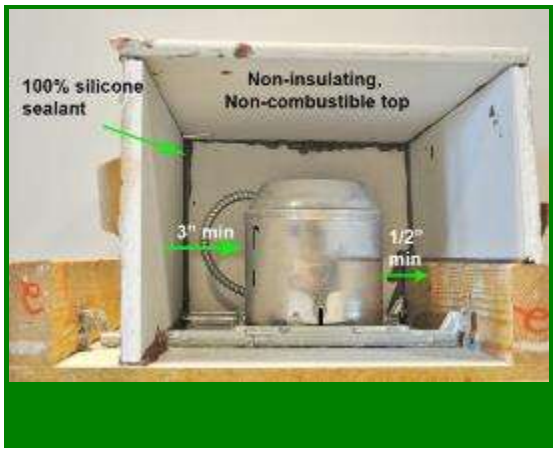
Specification(s):

Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only

Objective(s):

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

Before
Non-IC recessed light fixtures produce excess heat and can be a fire risk



After
Entire box should be sealed, but none should come in contact with light

Tools:
1. Caulk gun
2. Spray foam gun
3. Putty knife

Materials:
1. Fire-rated silicone caulk
2. UL-181 mastic
3. Spray foam

4.1001.2 Knob and Tube Wiring

4.1001.2 Approved Variance

4.1001.2a – Identifying knob and tube wiring

Desired Outcome:
Insulation kept away from contact with live wiring

Specification(s):
Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring

Objective(s):
Determine if knob and tube wiring exists

Unsafe

Identify knob and tube wiring in homes to insulate properly and safely

More knob & tube wiring

Knob & tube wiring again

4.1001.2b – Testing to determine if live

Desired Outcome:

Insulation kept away from contact with live wiring

Specification(s):

Non-contact testing method will be used to identify live wiring

Objective(s):

Ensure Safety of occupants, workers, and house

Plan where remediation is needed

Unsafe

Knob & tube wiring needs to be tested to determine if still live. Red=live

Safe

Live wiring should be dammed or professionally disabled before insulating

Tools:

1. Non-contact wire tester

4.1001.2c - Isolate or replace

Desired Outcome:

Insulation kept away from contact with live wiring

Specification(s):

Live knob and tube will not be covered or surrounded; required by the National Electrical Code

(NEC) or authority having jurisdiction

A licensed electrical contractor will inspect and certify wiring to be Safe and place a warning at all entries to the attic about the presence of knob and tube wiring

A dam that does not cover the top will be created to separate insulation from the wire path

OR

Knob and tube wiring will be replaced with new appropriate wiring by a licensed electrician in accordance with local codes

Remaining knob and tube wiring will be rendered inoperable by licensed electrician in accordance with local codes

Objective(s):

Ensure work can be completed safely

Protect occupant and house

Ensure future work can be done safely

Prevent the overheating of the wiring

Before
Knob & tube wiring radiates heat and cannot be insulated over

After
Before insulation, wiring should be dammed or disabled and replaced

Tools:

1. Non-contact wire tester
2. Drywall
3. Plywood
4. Saw
5. Drill
6. Tape measure

Materials:

1. Fasteners
2. Romex as needed

NEC guidelines and local jurisdictions often closely prescribe the treatment of knob & tube wiring. Check your local codes.

If electrician determines wiring is Safe and keeps it active, isolate wires

To isolate, dams higher than intended insulation depth should be installed

Warning of knob & tube should be posted at all entrances to related spaces

Warning signs should encourage the use of certified electrician for repairs

Some jurisdictions require warning signs in Spanish as well

If knob & tube can be replaced, all existent k&t should be disabled

Many electricians will removed exposed wires to prevent reactivation

Modern wiring should replace all knob & tube

4.1001.3 Fireplace Chimney and Combustion Flue Vents

4.1001.3a – Verify attic prep

Desired Outcome:

Combustible materials kept away from combustion sources

Specification(s):

Holes, penetrations, and bypasses will be sealed

Dams will be fixed in places that maintain required clearance

Objective(s):

Prevent air leakage

Ensure insulation dams maintain clearance

Before

Gaps and penetrations in attic need to be sealed to maintain air barrier

After

Chimneys, flues, and light fixtures should be dammed to prevent fire

Tools:

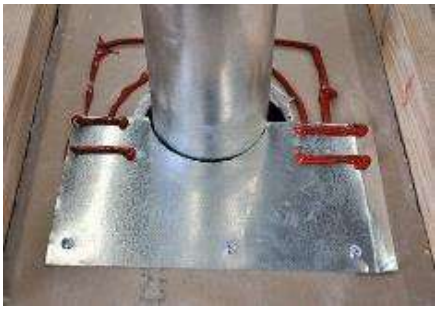
1. Metal snips
2. Caulk gun
3. Fasteners

Materials:

1. 26-gauge steel sheeting
2. High temperature caulk
3. Caulk
4. Backer rod
5. Spray foam

Gaps around flues and penetrations need to be sealed before insulating

High temperature caulk should be used for flues and chimneys



26-gauge steel should be used to construct seals and dams on flues

Only construct dam after sealing has been completed properly

Dammed chimneys, flues and light fixtures prevent fires

4.1001.3b – Required clearance

Desired Outcome:

Combustible materials kept away from combustion sources

Specification(s):

A rigid dam having a height greater than the insulation to be installed will be constructed to ensure a

3" clearance between combustion flue vent and dam

Chimney vents will have an airspace clearance to combustibles in accordance with 2012 IRC M1801.3.4

Objective(s):

Ensure dam material does not bend, move, or sag

Prevent a fire hazard

Before
To prevent fire hazards, flues, chimneys, and light fixtures require dams

After
Observe a 6 inch minimum clearance for dams around flues and chimneys

Tools:

1. Metal snips

Materials:

1. 26-gauge steel sheeting
2. Fasteners

- Shielding shall be kept a minimum of 6” from a high heat source.
- If sheet metal is used as a barrier around heat producing devices or chimneys, it must be

fastened securely to the ceiling joist so the barrier won't collapse.

4.1001.3c –Safety

Desired Outcome:

Combustible materials kept away from combustion sources

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

Before
Dams around flues, chimneys, and light fixtures should hold back insulation

After
Clear dams of any loose insulation in order to minimize risk of fire

4.1001.3d – Occupant education

Desired Outcome:

Combustible materials kept away from combustion sources

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

Best Practice
Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1001.4 Vented Eave or Soffit Baffles

4.1001.4a – Installation

Desired Outcome:

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

Specification(s):

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

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

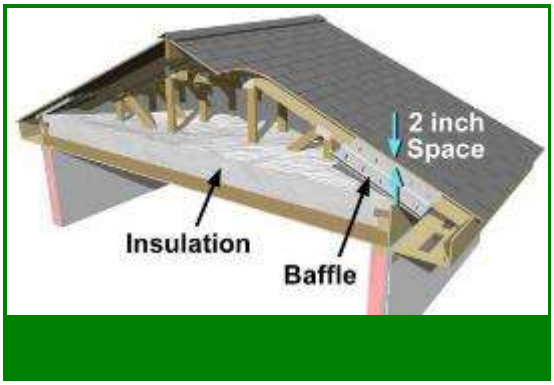
Installation will allow for the highest possible R-value above the top plate of the exterior wall

Objective(s):

Ensure insulation R-value is not reduced

Maintain attic ventilation

Before



After

Insulation should not block vented eaves

Baffles installed in vented attics to allow air flow past insulation

Tools:

1. Stapler

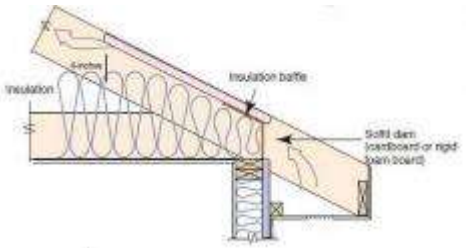
Materials:

1. Baffles
2. Staples

Allow a standard two inch gap for air flow through eave

Baffles should be securely fastened to prevent movement over time

Once baffles are properly installed, insulation can be placed against them



Baffles also hold insulation from falling into eave

4.1001.5 Dense Pack Preparation

4.1001.5a – Preparation

Desired Outcome:

Proper material density achieved safely and cleanly

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

- All junction boxes must have approved covers, and their location marked with a flag or other visible marker.

4.1001.6 Unvented Roof Deck—Preparation for Spray Polyurethane Foam

4.1001.6a – Surface preparation

Desired Outcome:

Backstop provided to prevent SPF from entering soffit areas

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

4.1001.6b – Installation of insulation dams

Desired Outcome:

Backstop provided to prevent SPF from entering soffit areas

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

4.1001.6c – Elimination of insulation dams

Desired Outcome:

Backstop provided to prevent SPF from entering soffit areas

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

4.1001.6d – Removal of existing insulation and vapor retarder

Desired Outcome:

Backstop provided to prevent SPF from entering soffit areas

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

4.1001.7 Vented Roof Deck—Preparation for SPF

4.1001.7a – Surface preparation

Desired Outcome:

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

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

4.1001.7b – Installation of vent chutes

Desired Outcome:

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

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

4.1001.7c – Installation of insulation dams

Desired Outcome:

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

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

4.1001.7d – Removal of existing insulation and vapor retarder

Desired Outcome:

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

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

4.1003 Attic Ceilings

4.1003.1 Pitched/Vaulted/Cathedralized Ceilings—Loose Fill Over

4.1003.1a - Ventilation

Desired Outcome:

Reduce the rate of heat transfer through cathedral or vaulted ceiling

Specification(s):

Venting will be continuous, if applicable

Objective(s):

Ensure capacity to increase R-value while not altering ventilation

4.1003.1b - Lighting

Desired Outcome:

Reduce the rate of heat transfer through cathedral or vaulted ceiling

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

4.1003.1c – Installation

Desired Outcome:

Reduce the rate of heat transfer through cathedral or vaulted ceiling

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 Insulweb 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 Insulweb 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

4.1003.1d – Occupant education

Desired Outcome:

Reduce the rate of heat transfer through cathedral or vaulted ceiling

Specification(s):

A dated receipt 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

4.1003.2 Pitched/Vaulted/Cathedralized Ceilings—Dense Pack Over

4.1003.2a – Fill slant ceilings

Desired Outcome:

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

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 cubic foot
- Loose fiberglass material will be installed and will be specifically approved for air flow resistance per 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 using chemical smoke at 50 pascals of pressure difference

Objective(s):

Ensure complete and consistent coverage throughout ceiling plane

Eliminate voids and settling

Minimize framing cavity air flows

- Insulation specifications including the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1003.2b – Onsite documentation

Desired Outcome:

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

Specification(s):

A dated receipt signed by the installer will be provided that includes:• Coverage area• Thickness• R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

4.1003.3 Unvented Flat Roof with Existing Insulation

4.1003.3a – Ventilation

Desired Outcome:

Insulation reduces heat flow through unvented roof

Specification(s):

Code compliant ventilation will be installed before insulation

Objective(s):

Reduce possibility of moisture issues

Before
Unvented flat roofs should have venting installed

After
Vents in the space below the roof help maintain proper air flow

Tools:

1. Saw
2. Grinder
3. Metal snips
4. Drill

Materials:

1. Metal lath
2. Stucco

Unvented flat roofs should have venting installed

Vents in the space below the roof help maintain proper air flow

Mushroom capped vents in the roof are equally important to air flow

4.1003.3b – Installation

Desired Outcome:

Insulation reduces heat flow through unvented roof

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

Before
Vent reveals attic is insulated with old rug -- not adequate.

In Progress
Attic will be dense packed to R-value specified on Work Order.

Tools:

1. Insulation machine

Materials:

1. Loose fillable or dense packable insulation

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1003.3c – Occupant education

Desired Outcome:

Insulation reduces heat flow through unvented roof

Specification(s):

A dated receipt 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

Best Practice
Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1003.4 Cape Cod Side Attic Roof—Dense Pack Installation

4.1003.4b – Netting, fabric rigid sheathing

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space

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

4.1003.4c – Installation

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space

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

4.1003.4d – Onsite documentation

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space

Specification(s):

A dated receipt 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

4.1003.4e – Occupant education

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1003.5 Unvented Roof Deck—Spray Polyurethane Foam Installation

4.1003.5a - Installation

Desired Outcome:

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

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

4.1003.5b – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

4.1003.5c – Occupant education

Desired Outcome:

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

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

- The insulation specifications shall include the insulation brand name, thermal resistance chart,

certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1003.6 Vented Roof Deck—Spray Polyurethane Foam Installation

4.1003.6a - Installation

Desired Outcome:

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

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

4.1003.6b – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1003.6c – Occupant education

Desired Outcome:

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

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1005 Attic Floors

4.1005.1 Accessible Floors—Batt Installation

4.1005.1a – Preparation

Desired Outcome:

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

Specification(s):

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

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

Before
Remove flooring in attic spaces to access floor cavities and insulate

After
Flag electrical junctions to make future maintenance and repairs easier

Tools:

1. Hammer
2. Pry bar

Materials:

1. Flags

- The ceilings must be inspected to ensure that the weight of the added insulation will be supported.
- Leaks in the roof and penetrations in the ceilings shall be repaired prior to insulating the attic.
- Sealing and repair materials shall match the existing surfaces as closely as possible.

1
Pry up flooring to access floor cavities

2
Check cavity for electrical junctions and penetrations

3
If electrical junctions are found, they should be enclosed and flagged

4
Air seal any penetrations

4.1005.1b – Installation

Desired Outcome:

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

Specification(s):

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

Insulation will be installed to the prescribed R-value

Objective(s):

Insulate to prescribed R-valueBefore

Before
Accessible attic floors should be air sealed and insulated

After
Insulate floor cavities to prescribe R-value from the work order

Tools:

1. Hammer
2. Utility knife
3. Tape measure

Materials:

1. Fiberglass batts

- Installed insulation should extend over the top of all exterior plates and be full R-value.

1
Insert fiberglass batts into floor cavities, kraft-face down

2
Fill entire volume of floor cavity

3
Once insulated, flooring should be reinstalled

4.1005.1c - Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1005.2 Accessible Floors—Loose Fill Installation

4.1005.2a – Preparation

Desired Outcome:

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

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

Before
Accessible attic floors should be air sealed and insulated

After
Depth markers and insulation dams aid in proper insulation of attic spaces

Tools:

1. Pry bar
2. Hammer
3. Caulk gun
4. Utility knife
5. Staple gun
6. Spray foam gun
7. Tape measure

Materials:

1. Flags
2. Depth markers
3. Staples
4. XPS
5. Caulk
6. Spray foam

- The ceilings must be inspected to ensure that the weight of the added insulation will be supported.
- Leaks in the roof and penetrations in the ceilings shall be repaired prior to insulating the attic.
- Sealing and repair materials shall match the existing surfaces as closely as possible.

Check cavity for electrical junctions and penetrations

Flag and install covers on electrical junctions

Seal any penetrations

Non-IC (insulation contact) can lights should be covered with a dam and have no insulation on top

Install depth markers and insulation dams above height of insulation

4.1005.2b – Air barrier

Desired Outcome:

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

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

Before

After

When missing, bottom plates must be installed under knee walls

New bottom plates complete air barrier and hold insulation in place

Tools:

1. Tape measure
2. Utility knife
3. Saw
4. Drill
5. Spray foam gun
6. Caulk gun

Materials:

1. Spray foam
2. XPS
3. Drywall
4. Plywood
5. Fasteners
6. Caulk sealant

Measure floor cavity for new bottom plate

Cut rigid material, such as XPS, to size to snugly fit into cavity

Align block with air barrier of conditioned space

Air seal around new bottom plate with spray foam

4.1005.2c – Installation

Desired Outcome:

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

Specification(s):

All insulation will be installed to the depth indicated on the manufacturer coverage chart for desired R-value

Objective(s):

Reduce heating and air conditioning costs

Improve comfort

Minimize noise

Before
Accessible attic floor should be air sealed and insulated

After
Check chart on package to ensure proper insulation depth to achieve R-value

Tools:

1. Insulation machine

Materials:

1. Loose fill insulation

- Blown insulation specifications shall be stapled near the attic access of each accessible attic.
- Cellulose insulation should be installed over existing batt insulation.
- Enclosed ceilings shall be insulated the full cavity depth, Installed using the tube-fill method to a minimum of 3.5 pounds per cubic foot.
- All insulation installed should extend over the top of all exterior plates and be the full R-value.

1
Use depth markers to ensure insulation has reached prescribed R-value

2
Where flooring cannot be removed, verify insulation is meeting R-value goal

4.1005.2d – Onsite documentation

Desired Outcome:

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

Specification(s):

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

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

Objective(s):

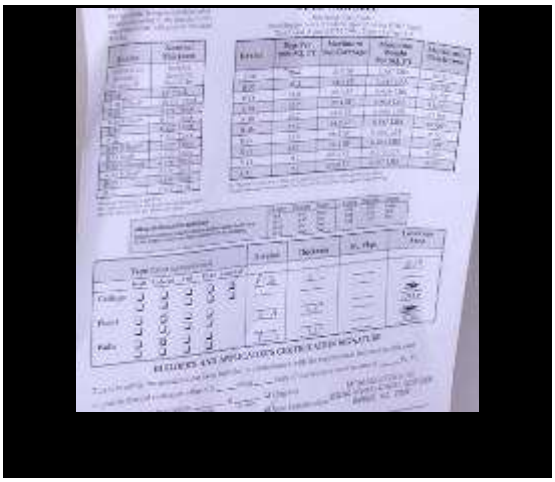
Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with 16 CFR 460.17

Best Practice
Information on insulation installed should be posted nearby



Best Practice
Posted info includes insulation type, R-value, depth, coverage area, etc.

- The insulation specifications shall also include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.
- Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For loose-fill, the receipt must show the coverage area, initial installed thickness, minimum settled thickness, R-value, and the number of bags used. To figure out the R-value of the insulation, use the data that the manufacturer gives you. The receipt must be dated and signed by the installer.

4.1005.3 Accessible Floors—Batt Insulation Over Existing Insulation

4.1005.3a – Preparation

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

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

Objective(s):

Ensure proper performance of insulation

- The ceilings must be inspected to ensure that the weight of the added insulation will be supported.
- Leaks in the roof and penetrations in the ceilings shall be repaired prior to insulating the attic.
- Sealing and repair materials shall match the existing surfaces as closely as possible.

4.1005.3b – Installation

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

If the top of the existing insulation is below the top of the framing, new batts will be installed parallel with framing members

If the top of the existing insulation is above the top of the framing, new batts will be installed perpendicular to framing members

Objective(s):

Ensure uniform depth of insulation in continuous contact with existing insulation

Eliminate voids and gaps

- If additional batt insulation must be installed, the new batt should be unfaced.

4.1005.3c – Insulation

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

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

- Coverage area
- Thickness
- R-value

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

- The insulation specifications shall also include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1005.3d – Safety

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

Insulation will not be allowed on top of 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

4.1005.3e – Occupant education

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1005.4 Accessible Floors—Loose Fill Over Existing Insulation

4.1005.4a – Preparation

Desired Outcome:

Insulation controls heat transfer through ceiling

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

- The ceilings must be inspected to ensure that the weight of the added insulation will be supported.
- Leaks in the roof and penetrations in the ceilings shall be repaired prior to insulating the attic.
- Sealing and repair materials shall match the existing surfaces as closely as possible

4.1005.4b – Installation

Desired Outcome:

Insulation controls heat transfer through ceiling

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

- Cellulose insulation should be installed over existing batt insulation.

4.1005.4c – Safety

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

Insulation will not be allowed on top of 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

4.1005.4d – Onsite documentation

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

A dated receipt 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):

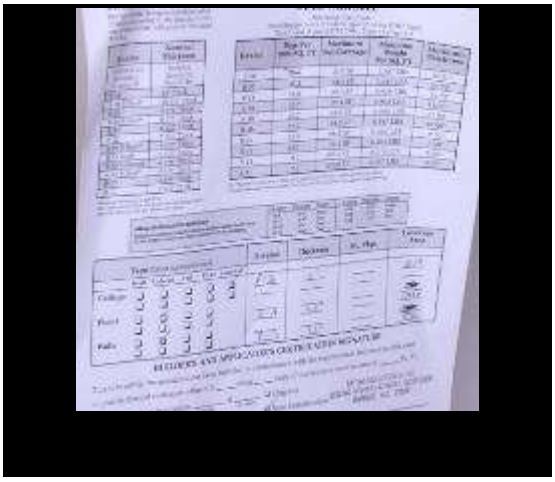
Document job completion to contract specifications

Confirm amount of insulation installed

Ensure ability to match bags required for total area completed

Comply with 16 CFR 460.17

Best Practice
Written documentation of insulation type and efficiency will be provided



Best Practice
Information should include depth of loose fill installed and once settled

- The insulation specifications shall also include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.
- Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For loose-fill, the receipt must show the coverage area, initial installed thickness, minimum settled thickness, R-value, and the number of bags used. To figure out the R-value of the insulation, use the data that the manufacturer gives you. The receipt must be dated and signed by the installer.

4.1005.5 Enclosed Bonus Room Floor Over Unconditioned Space—Dense Pack

Installation

4.1005.5a – Air barrier

Desired Outcome:

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

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

Before
This finished garage below a bonus room is an unconditioned space

After
Rigid material forms an air barrier located under the bonus room stem wall

Tools:

1. Drywall saw
2. Utility knife
3. Tape measure
4. Straight edge

Materials:

1. XPS or other rigid material

Snap chalk lines to keep access cuts clean and easy to repair

Cut through garage ceiling to access joist cavities below bonus room

The rigid block should be placed in line with the stem wall above

Measure joist cavity depth

Measure joist cavity width

Cut XPS, or other rigid material, to measured size of joist cavity

Rigid block should fit snugly into joist cavity to prevent insulation leaks

Rigid block will hold the insulation in place under the bonus room above

4.1005.5b – Fill floors

Desired Outcome:

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

Specification(s):

Each cavity will be 100% filled to consistent density:

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

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

Before
With rigid block in place under bonus room stem wall, insulation can begin

After
Chemical smoke at 50pa indicates insulation is at appropriate density

Tools:

1. Insulation machine
2. Drill
3. Smoke pencil
4. Blower door
5. Small hole saw bit

Materials:

1. Cellulose insulation
2. Dense packable insulation
3. Spackle
4. Seam tape

Blow insulation into cavities to density appropriate for chosen material

Close cavities with access panel cut out at the beginning

Cut small test holes in cavities to verify specified density has been met

Set up blower door and depressurize bonus

With blower door running, chemical smoke should not draw into test holes

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

room to -50pa wrt
outside

4.1005.5c – Safety

Desired Outcome:

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

Specification(s):

Insulation will not be allowed on top of 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

Before
Dams around flues, chimneys, and light fixtures should hold back insulation

After
Clear dams of any insulation or debris in order to minimize risk of fire

No insulation on top of non-insulation contact (non-IC) rated fixtures

4.1005.5d – Onsite documentation

Desired Outcome:

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

Specification(s):

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

6. Coverage area
7. Thickness
8. R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

After
Documentation of insulation installed should be provided in writing

- The insulation specifications shall also include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.
- Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For all insulation except loose-fill and aluminum foil, the receipt must show the coverage area, thickness, and R-value of the insulation you installed. The receipt must be dated and signed by the installer. To figure out the R-value of the insulation, use the data that the manufacturer gives you.

A copy of the posted documentation may be provided to the client

Information should include insulation type, R-value, coverage area, etc.

4.1005.6 Enclosed Attic Storage Platform Floor—Dense Pack Installation

4.1005.6a – Fill floors

Desired Outcome:

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

Specification(s):

Each cavity will be 100% filled to consistent density:

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

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

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

4.1005.6b – Safety

Desired Outcome:

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

Specification(s):

Insulation will not be allowed on top of 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

4.1005.6c – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart and

certification that the insulation conforms to federal specifications.

- The specifications shall also include the name of the company or agency that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation.

4.1005.7 Attic Floor—Preparation and Installation of Spray Polyurethane Foam (SPF)

4.1005.7a – Preparation

Desired Outcome:

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

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

4.1005.7b – Installation

Desired Outcome:

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

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

4.1005.7c – Safety

Desired Outcome:

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

Specification(s):

Insulation will not be allowed on top of 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

4.1005.7d – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart and certification that the insulation conforms to federal specifications.
- The specifications shall also include the name of the company or agency that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation.

4.1005.7e – Occupant education

Desired Outcome:

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

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

4.1004 Knee Walls

4.1004.1 Preparation for Dense Packing

4.1004.1a – Backing

Desired Outcome:

Airtight cavity and insulated knee wall

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

Before
Knee walls often need sealing and insulation

After
Knee wall is prepped for dense pack insulation

Tools:

1. Tape measure
2. Utility knife
3. Caulk gun
4. Spray foam gun
5. Drill
6. Stapler

Materials:

1. Drywall
2. XPS
3. Caulk
4. Spray foam
5. Fasteners
6. Staples

- Knee wall insulation shall be held in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an air infiltration barrier.
- If batt insulation is used to seal the base of the kneewalls, the batt shall be sealed in an enclosed vapor barrier.
- Materials used shall form an airtight seal.

1

2

3

Knee walls missing top plates need one created from rigid material

Top plate holds dense pack insulation in cavity

New top plate should be sealed to surrounding joists and studs

4
Bottom plates also need to be installed. Measure for size

5
Cut to size and attempt to install in line with air barrier above

6
Seal to surrounding joist

7
If using house-wrap or fabric, tack in place with furring strips or staples

8
Drywall is also a good barrier for dense packing knee walls

4.1004.1b – Installation

Desired Outcome:

Airtight cavity and insulated knee wall

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

4.1004.2 Preparation for Batt Insulation

Objective(s):

Eliminate misalignment of existing insulation

Prevent insulation from settling or moving

Before
Existing batt insulation should be adjusted to fit properly

After
If properly dense-packed, insulation should hold in place when finished

- Knee wall insulation shall be held in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an air infiltration barrier.
- If batt insulation is used to seal the base of the kneewalls, the batt shall be sealed in an enclosed vapor barrier.
- Materials used shall form an airtight seal.

Attach furring strips to create pockets for dense-pack insulation

Insulation should meet manufacturer specifications for density.

4.1004.2a – Knee wall prep for batts

Desired Outcome:

Airtight cavity and properly insulated knee wall

Specification(s):

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

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

Objective(s):

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

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

Create an air barrier

Before
Top plate is missing from knee wall

After
New top plate is sealed to adjacent framing

Tools:

1. Spray foam gun
2. Caulk gun
3. Tape measure
4. Utility knife
5. Drill
6. Saw

Materials:

1. XPS
2. Lumber
3. Caulk
4. Spray foam
5. Fasteners

- Knee wall insulation shall be held in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an *air infiltration barrier*.
- If *batt* insulation is used to seal the base of the kneewalls, the *batt* shall be sealed in an enclosed vapor barrier.
- Materials used shall form an airtight seal.

1
Top plate has been cut and fit to size

2
Top plate has been sealed to adjacent framing

3
Bottom plate is also missing. Space is measured so XPS can be cut

4
Bottom plate is cut to size

5
Bottom plate is placed in line with interior air barrier

6
Bottom plate is also sealed to surrounding joist and framing

4.1004.2b – Installation

Desired Outcome:

Airtight cavity and properly insulated knee wall

Specification(s):

Insulation will be installed using one of the following methods:

- New batts will be installed in accordance with manufacture specifications
- All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates

Objective(s):

Eliminate misalignment of existing insulation

Before
Knee wall with batts improperly installed and missing from stud bays

After
Properly fit insulation filling full volume of stud bay

Tools:

1. Utility knife
2. Tape measure

Materials:

1. Fiberglass batts

- Knee wall insulation shall be held in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an *air infiltration barrier*.
- If *batt* insulation is used to seal the base of the kneewalls, the *batt* shall be sealed in an enclosed

vapor barrier.

- Materials used shall form an airtight seal.

1
Where existing insulation is improperly installed, fix it

2
Kraft-face should go to "warm in winter" side and batt should fill bay

3
Batts should fill entire volume of knee wall stud bays

4.1004.2c – Backing knee wall

Desired Outcome:

Airtight cavity and properly insulated knee wall

Specification(s):

If rigid material is used, material will be installed to cover 100% of the surface of the knee wall

If foam sheathing is used, sheathing will be listed for uncovered use in attic, or covered with a fire barrier

Objective(s):

Prevent insulation from settling or moving

Before
Knee walls with batt insulation require covering

After
Foam sheathing? Needs to be covered with a fire barrier

Tools:

1. Utility knife
2. Tape measure
3. Drill

Materials:

1. Drywall
2. House wrap

- Knee wall insulation shall be held in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an *air infiltration barrier*.
- If *batt* insulation is used to seal the base of the kneewalls, the *batt* shall be sealed in an enclosed vapor barrier.
- Materials used shall form an airtight seal.

Fiberglass batts in attic knee walls can be held in place by house wrap

If foam sheathing is used, it needs to be covered with a fire barrier

4.1004.3 Strapping for Existing Insulation

4.1004.3a – Sealing

Desired Outcome:

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

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.1004.3b – Installation

Desired Outcome:

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

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

- Knee wall insulation shall be secured in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an air infiltration barrier.

4.1004.3c – Attachment

Desired Outcome:

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

Specification(s):

Strapping material will have a minimum expected service life of 20 years

Objective(s):

Maintain alignment

4.1004.3d – Occupant education

Desired Outcome:

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

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1004.4 Knee Wall Without Framing

4.1004.4a – Sealing

Desired Outcome:

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

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.1004.4b – Flat cavity present

Desired Outcome:

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

Specification(s):

Gap between framing and existing air barrier will be insulated

Objective(s):

Create a flat insulated surface

4.1004.4c – Installation

Desired Outcome:

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

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

4.1004.4d – Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1004.5 Knee Walls and Gable End Walls—Preparation for and Installation of Spray Polyurethane Foam (SPF)

4.1004.5a – Installation of backing

Desired Outcome:

Airtight and insulated knee and gable end walls

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

4.1004.5b – Installation

Desired Outcome:

Airtight and insulated knee and gable end walls

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

4.1004.5c – Onsite documentation

Desired Outcome:

Airtight and insulated knee and gable end walls

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value of the added insulation and be included in the Sub-grantee client file.

4.1006 Attic Openings

4.1006.1 Pull-Down Stairs

4.1006.1a – Installation

Desired Outcome:

Pull-down attic stair properly sealed and insulated

Specification(s):

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

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

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

Objective(s):

Achieve uniform R-value

Prevent loose insulation from entering the living area

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

After
Insulated pull-down stairs cover installed to prevent air leakage

Tools:

1. Tape measure
2. Drill
3. Saw
4. Caulk gun

Materials:

1. Caulk sealant
2. Lumber
3. XPS
4. Pre-fabricated stairwell cover

- Pull-down ladder hatch shall be shielded/dammed with 1-inch common lumber or ¾ inch plywood with a hinged ¾ inch plywood lid and insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly.

1
Stairs and hatch should both be insulated to match R-value of attic

4.1006.1b – Sealing

Desired Outcome:

Pull-down attic stair properly sealed and insulated

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, or solid material that allows attic door operation

Objective(s):

Prevent air leakage

Before
Unsealed pull-down stairs leads to air leakage to and from the attic

After
To preserve thermal envelope, an airtight seal needs to be created

Tools:

1. Caulk gun

Materials:

1. Weather-stripping
2. Spray foam
3. Caulk

Seal around frame of pull-down stairs with appropriate sealant

Weather-strip around stair panel to encourage a tight seal

Remember to seal finish details and trim

Insulation and sealing should be airtight but openable

4.1006.1c – Durability

Desired Outcome:

Pull-down attic stair properly sealed and insulated

Specification(s):

Completed measure will meet a minimum expected service life of 20 years

Objective(s):

Ensure a minimum expected service life

4.1006.1d – Occupant education

Desired Outcome:

Pull-down attic stair properly sealed and insulated

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

4.1006.2 Access Doors and Hatches

4.1006.2a – Installation

Desired Outcome:

Attic access door properly sealed and insulated

Specification(s):

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

Attic hatches rough opening will be surrounded with a durable 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

Before
Uninsulated attic hatches and access panels weaken the thermal envelope

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

Materials:

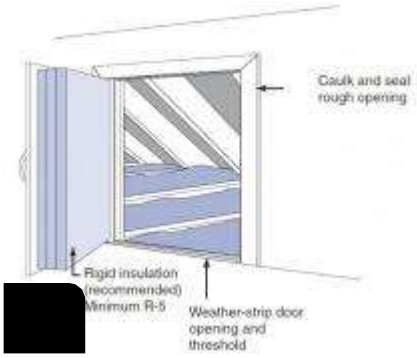
1. XPS
2. Lumber
3. Weather-stripping
4. Fasteners

- All accessible attics over 100 square feet shall have an access.
- New attic accesses shall be located in an area agreeable to the client, be conducive to adding insulation and installed as per state and local codes.
- A new attic hatch cover shall be installed on new accesses and on existing accesses, if necessary.
- Attic accesses should have a minimum opening of 13 inches x 20 inches and shall be framed and boxed with 1 inch common lumber or ¾ inch plywood, at a height to accommodate the added insulation, fastened securely to the ceiling joists so the *damming* won't collapse or move.
- Existing attic hatches that do not provide adequate access shall be reframed to provide an acceptable opening and be boxed with 1 inch thick common lumber or ¾ inch plywood at a height to accommodate the insulation and access.
- Attic access hatch cover shall be constructed of ¾ inch plywood or particle board.
- The attic access shall be finished to match the ceiling where installed as closely as possible.
- New kneewall attic access covers or doors shall be minimum ¾ inch plywood and attached with a minimum of 2 hinges and 2 latching mechanisms.
- New kneewall attic accesses shall be finished to match the wall as closely as possible.

1
Create hatch cover that matches r- value of surrounding insulation

2
Build dam to hold back attic insulation and hold cover in place tightly

3
Weather-strip underside of hatch cover to create tight seal



4
Alternate installation for vertical access panel to attic

4.1006.2b – Sealing

Desired Outcome:

Attic access door properly sealed and insulated

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 of a pre-fabricated unit above the opening that do not require a latch

The measure must include a protective baffle or insulation barrier

Objective(s):

Prevent air leakage

Before
Unsealed attic hatches and panel doors allow air leakage to and from attic

After
Once sealed, air leakage at attic hatch or door should be minimized

Materials:

1. Weather-stripping
2. 3/4" Lumber
3. Caulk

- Attic access hatch casing shall be caulked with a paintable clear caulk or with a color complementary to the surface to which it is applied.
- Knee wall attic access trim shall be caulked with clear caulking or caulking that is a color complementary to the surface to which it is applied.
- New kneewall attic access covers or doors shall be minimum ¾ inch plywood and attached with a minimum of 2 hinges and 2 latching mechanisms.

1
Remember to seal around finish details and framing on interior

2
Build insulation dam from 3/4 inch lumber and seal around base

3
Weather-strip around bottom edge of hatch cover to create air tight seal

4.1006.2c – Attachment

Desired Outcome:

Attic access door properly sealed and insulated

Specification(s):

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

Objective(s):

Insulate to prescribed R-value

Before
Unsealed and uninsulated attic hatches and access doors allow leakage

After
Rigid insulation on back of new hatch cover attached firmly and squarely to allow for air- tight fit

Tools:

1. Caulk gun
2. Utility knife

Materials:

1. XPS
2. Adhesive

- Attic access hatch cover shall be constructed of ¾ inch plywood or particle board.
- New kneewall attic access covers or doors shall be minimum ¾ inch plywood and attached with a minimum of 2 hinges and 2 latching mechanisms.

1
Apply foam tape to "warm side" face of attic hatch

2
Ensure an air tight seal by making sure foam tape has no gaps

3
Apply strong adhesive to "cold-side" of hatch

4
Adhesive should ring perimeter as well as crisscrossing hatch to ensure

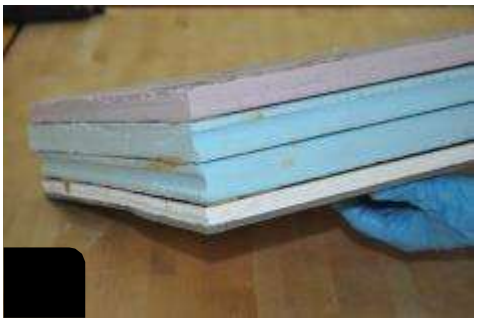
5
Affix XPS insulation to "cold-side" of hatch with adhesive,

6
Repeat adhesive and XPS layers to reach maximum R-

complete attachment of insulation

ensuring XPS is tight and square to hatch

value without making hatch excessively heavy or awkward



7
All XPS layers should be attached firmly to one another and square to hatch

4.1006.2d – Durability

Desired Outcome:

Attic access door properly sealed and insulated

Specification(s):

Completed measure will meet a minimum expected service life of 20 years

Objective(s):

Ensure a minimum expected service life

4.1006.2e – Occupant education

Desired Outcome:

Attic access door properly sealed and insulated

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

4.1006.3 Whole-House Fan

4.1006.3a – Installation

Desired Outcome:

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

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

4.1006.3b – Air sealing

Desired Outcome:

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

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

4.1006.3c – Attachment

Desired Outcome:

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

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

4.1006.3d – Durability

Desired Outcome:

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

Specification(s):

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

Objective(s):

Ensure a minimum expected service life

4.1006.3e – Occupant education

Desired Outcome:

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

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

4.1088 Special Considerations

4.1088.1 Attic Ventilation

4.1088.1a – Air barrier and thermal boundary

Desired Outcome:

Properly restored vents minimize moisture and ice dams

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

Objective(s):

Ensure presence of continuous air barrier and thermal boundary

- Attic venting shall be installed prior to insulating.
- Venting shall not be installed on metal roofs.
- Attics with metal roofs that cannot be vented shall not be insulated
- Attics with no vapor retarder shall have a minimum of 1 square foot of net free vent area for every 150 square feet of attic area.
- Attics with a vapor retarder shall have a minimum of 1 square foot of net free vent area for every 300 square feet of attic area.
- In attics with over 300 square feet of attic area, vents shall be located to provide the most adequate venting opportunity.

4.1088.1b – Vent type

Desired Outcome:

Properly restored vents minimize moisture and ice dams

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

- Attic venting shall be installed prior to insulating.
- Venting shall not be installed on metal roofs.
- Attics with metal roofs that cannot be vented shall not be insulated.
- Soffit vents should be installed with the fins facing towards the house with rust proof, pan-headed screws.

- Gable vents should be set in caulking and nailed or screwed in place using rust proof fasteners. The vent shall be trimmed.
- Gable vents installed in siding without wood sheathing behind it shall have the vent framed.
- Roof, turbine and ridge vents shall be sealed with roofing tar and attached with roofing nails.
- Roof vents shall be centered within 2 feet of the ridge or peak of the roof.
- Shingles shall overlap the top half of the roof vent flange. The bottom half of the vent's flange shall be exposed on top of the shingles.
- Roof, turbine and ridge vents are considered to be high or exhaust vents, while soffit and gable vents are considered to be low or intake vents.

4.1088.1c – Vent location

Desired Outcome:

Properly restored vents minimize moisture and ice dams

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

- In attics with over 300 square feet of attic area, vents shall be located to provide the most adequate venting opportunity.
- Roof vents should not be installed over framing members. If vents must be installed over framing members, care must be taken to insure that the rafters are not cut. The roof vent opening is to be framed.
- Soffit vents should be installed with the fins facing towards the house with rust proof, pan-headed screws.
- Gable vents should be set in caulking and nailed or screwed in place using rust proof fasteners. The vent shall be trimmed.
- Gable vents installed in siding without wood sheathing behind it shall have the vent framed.
- Roof, turbine and ridge vents shall be sealed with roofing tar and attached with roofing nails.
- Roof vents shall be centered within 2 feet of the ridge or peak of the roof.
- Shingles shall overlap the top half of the roof vent flange. The bottom half of the vent's flange shall be exposed on top of the shingles.
- Roof, turbine and ridge vents are considered to be high or exhaust vents, while soffit and gable vents are considered to be low or intake vents.

4.1088.1d – Ventilation baffling

Desired Outcome:

Properly restored vents minimize moisture and ice dams

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

4.1088.1e – Ventilation screens

Desired Outcome:

Properly restored vents minimize moisture and ice dams

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

4.1088.3 Skylights

4.1088.3a – Sealing

Desired Outcome:

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

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

4.1088.3b – Installation of Skylight Insulation in Attics

Desired Outcome:

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

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

4.1088.3c – Occupant education

Desired Outcome:

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

Specification(s):

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

- Insulation type
- Coverage area
- R-value
- Installed thickness and settled thickness (settled thickness required for loose-fill only)
- 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

Best Practice

Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.11 Walls

4.1101 Preparation

4.1101.1 Exterior Wall Dense Packing

4.1101.1a – Preparation

Desired Outcome:

Walls properly prepared to receive dense pack insulation

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

4.1101.1b – Exterior dense pack

Desired Outcome:

Walls properly prepared to receive dense pack insulation

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 cubic foot

- 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

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

4.1102 Accessible Walls

4.1102.1 Open-Cavity Wall Insulation—General

4.1102.1a – Sealing

Desired Outcome:

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

Specification(s):

Holes and penetrations will be sealed

Bypasses will be blocked and sealed

Objective(s):

Prevent air leakage

Before
Penetrations and bypasses create places where blown in insulation can leak

After
Sealed penetrations offer leakage protection and keep insulation in place

Tools:

1. Caulk gun

Materials:

1. Backer rod
2. Spray foam
3. Caulk

- Wall repairs shall be durable and permanent and match the existing area as closely as possible.
- Materials used in areas of high moisture or areas exposed to the weather must be of suitable grade.
- If faced *batt* insulation is installed in an open wall cavity, the vapor barrier shall be installed to the warm side and fit snugly between the studs and wall.

1
Open walls to be insulated and dry walled need air sealing

2
Penetrations and bypasses should be sealed to keep insulation in cavities

3
Use backer rod or other infill for larger penetrations

4
Seal penetration with caulk or fire- block, as appropriate

4.1102.1b – Installation

Desired Outcome:

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

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-valueBefore

Before
Open walls should be insulated

After
Well-insulated rooms are significantly more comfortable in all seasons

Tools:

1. Insulation machine
2. Staple gun

Materials:

1. Loose fillable insulation
2. Netting
3. Staples
4. Fiberglass batts

- Open wall cavities shall be covered and insulated with batt, blown or spray-applied insulation.
- Wall repairs shall be durable and permanent and match the existing area as closely as possible.
- Materials used in areas of high moisture or areas exposed to the weather must be of suitable grade.
- Fiberglass *batt* insulation installed in a *living area* shall be covered with paneling, plywood, chipboard, hardboard or drywall, with the exception of sill box insulation. If the covering is drywall, the drywall shall be taped and receive one coat of joint compound.
- If the covering of an open wall cavity is drywall, the drywall shall be taped and receive one coat of joint compound.
- If the covering of an open wall cavity is plywood, chipboard or hardboard the joints shall be caulked.
- If faced *batt* insulation is installed in an open wall cavity, the vapor barrier shall be installed to the warm side and fit snugly between the studs and wall.
- If plywood, chipboard or hardboard is installed, the joints shall be caulked.
- If paneling is installed, the paneling shall be a minimum 3/16 inch and the joints shall be caulked.

Wall should be netted and insulation blow in to prescribed R-value

OR: Wall can be insulated using batts installed without gaps

4.1102.1c – Pre-drywall verification

Desired Outcome:

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

Specification(s):

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

Objective(s):

Install insulation correctlyBefore

Before
Verify insulation is properly installed before dry walling

After
Once proper installation is verified, begin dry walling to finish wall

Tools:

1. Hands
2. Eyes

Take a visual and physical inspection of insulation installation

4.1102.1d – Occupant education

Desired Outcome:

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

Specification(s):

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

- Insulation type
- Coverage area
- R-value
- Installed thickness and settled thickness (settled thickness required for loose-fill only)
- 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

Best Practice
Provide occupant with documentation of and about insulation installed

- Insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support	Documentation should include insulation material and R-value	Provide occupant with copies of all documentation

4.1102.2 Open-Cavity Wall—Spray Polyurethane Foam (SPF) Installation

4.1102.2a – Installation

Desired Outcome:

Exterior walls are insulated and sealed

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

4.1102.2b – Vapor retarders

Desired Outcome:

Exterior walls are insulated and sealed

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

4.1102.2c – Fire protection

Desired Outcome:

Exterior walls are insulated and sealed

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

4.1102.2d – Onsite documentation

Desired Outcome:

Exterior walls are insulated and sealed

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

4.1103 Enclosed Walls

4.1103.1 Dense Pack Exterior Walls

4.1103.1a – Exterior Dense Pack

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed

R-value of an adjoining insulated assembly

Specification(s):

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

- Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density
- Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit air flow that corresponds to an air permeance value of 3.5 cfm/sq. ft. at 50 pascals, as measured using BPI-102 "Standard for Air Resistance of Thermal Insulation Used in Retrofit Cavity Applications – Material Specification" or ASTM 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 using chemical smoke at 50 pascals of pressure difference

Objective(s):

Eliminate voids and settling

Minimize framing cavity air flows

- Siding shall be removed or drilled and all enclosed wall cavities shall be filled. Wall cavities that are less than 3 feet in height or where it is not possible to tube fill may be insulated through a minimum 1 inch entry holes.
- Interior and exterior walls shall be repaired prior to insulating.
- Wall repairs shall be durable and permanent and match the existing area as closely as possible.
- Materials used in areas of high moisture or areas exposed to the weather must be of suitable grade.
- Removed siding shall be reinstalled using the original fastening system whenever possible.

- The seam tabs on slate siding shall be reinstalled.
- Entry holes shall be sealed with plastic or wood plugs, or covered with felt paper prior to reinstalling the siding if the siding was removed.
- Entry holes in stucco or masonry siding shall be sealed with mortar or a material specifically manufactured to repair stucco or masonry.
- Sealing materials shall completely seal the opening and be textured and painted to match the surrounding surface.
- Whenever plastic or wood plugs are used on the exterior of the siding, the plugs shall be painted to match the existing siding color.
- Interior entry holes in drywall or plaster shall be plugged and taped or sealed with one coat of a material specifically manufactured to repair drywall or plaster.

4.1103.1b – Onsite Documentation

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed

R-value of an adjoining insulated assembly

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed Comply with 16 CFR 460.17

- Wall repairs shall be durable and permanent and match the existing area as closely as possible.
- Materials used in areas of high moisture or areas exposed to the weather must be of suitable grade.
- Removed siding shall be reinstalled using the original fastening system whenever possible.
- The seam tabs on slate siding shall be reinstalled.
- Entry holes shall be sealed with plastic or wood plugs, or covered with felt paper prior to reinstalling the siding if the siding was removed.
- Entry holes in stucco or masonry siding shall be sealed with mortar or a material specifically manufactured to repair stucco or masonry.
- Sealing materials shall completely seal the opening and be textured and painted to match the surrounding surface.
- Whenever plastic or wood plugs are used on the exterior of the siding, the plugs shall be painted to match the existing siding color.
- Interior entry holes in drywall or plaster shall be plugged and taped or sealed with a material specifically manufactured to repair drywall or plaster.
- Interior entry holes shall be made ready for paint.

4.1103.2 Additional Exterior Wall Cavities

4.1103.2a – Location of cavities

Desired Outcome:

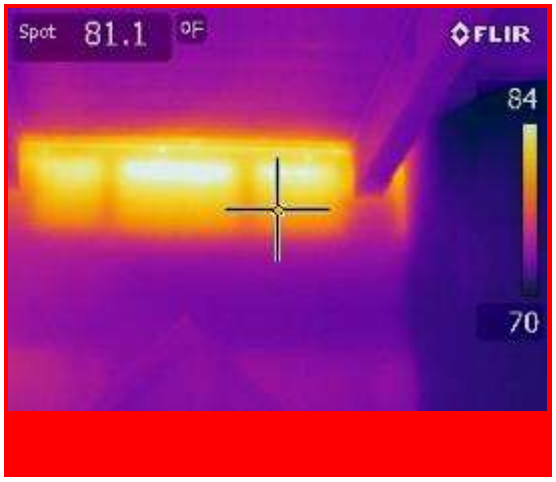
Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

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



Before
Cavities missing insulation allow greater heat transfer than insulated ones

In Progress
Either from inside or outside, using IR camera to locate cavities for fill

Tools:

1. Infrared camera
2. Drill
3. Hole saw
4. Tape measure
5. Probe

4.1103.2b – Sealing

Desired Outcome:

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

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

Before
Unsealed penetrations should be sealed to ensure insulation stays in place

After
Once air barrier has been preserved by sealing, insulation can begin

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Fire-block, when necessary

4.1103.2c – Dense Packing

Desired Outcome:

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

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 BPI-102 "Standard for Air Resistance of Thermal Insulation Used in Retrofit Cavity Applications—Material Specification" or ASTM 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 using chemical smoke at 50 pascals of pressure difference

Objective(s):

Eliminate voids and settling

Minimize framing cavity air flows

4.1103.2d – Quality assurance

Desired Outcome:

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

Specification(s):

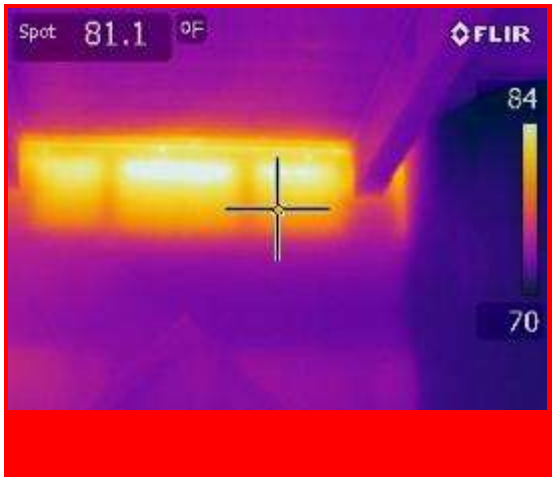
Completed wall sections will be viewed using infrared camera with blower door operating

Any voids or low density areas will be drilled and re-packed

Objective(s):

Establish air barrier and thermal boundary

Confirm no voids or hidden air flows remain



Before
Uninsulated exterior wall cavities to be insulated

After
Reduced temperature difference indicating insulated wall cavities

Tools:

1. Infrared camera

Depressurize house (if safe) to -50pa wrt outside

Inspect for voids and low density areas

Reduced temperature difference indicating insulated wall cavities

4.1103.2e – Close holes

Desired Outcome:

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

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

In Progress
With insulation complete, wall needs to be patched to better-than-found

After
When repair is finished, it shouldn't be obvious any work was done

Tools:

1. Taping knife
2. Caulk gun
3. Drill
4. Paint brush

Materials:

1. Spackle
2. House wrap
3. Lath
4. Stucco
5. Fasteners
6. Adhesive
7. Primer
8. Drywall
9. XPS

- Interior entry holes in drywall or plaster shall be plugged and taped or sealed with one coat of a material specifically manufactured to repair drywall or plaster.

For interior access, locate access holes at studs for easier patching

Once drywall patches are spackled, prime and paint.

For exterior access, use a drop cloth or gutter to help with clean up

Plug holes with rigid material that will not move or sag over time

For stucco and plaster patches, lath will need to be used to hold weight

If possible, maintain house wrap, or replace it after holes are plugged

Put siding back in place, or return exterior finish to match remaining wall

4.1103.2f – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- Insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

4.13 Floors

4.1301 Accessible Floors

4.1301.1 Standard Floor System—Batt Installation

4.1301.1a – Sealing

Desired Outcome:

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

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

Before
Gaps around penetrations can cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

- Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

1
Locate gaps around penetrations for plumbing, electrical, etc.

2
Fill gaps greater than 1/4 inch with backer rod or spray foam

3
Caulk smaller gaps and to hold backer rod in place

4.1301.1b – Installation

Desired Outcome:

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

Specification(s):

Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions

If Kraft-faced batts are used, they will be installed with Kraft facing to subfloor

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

Before
Uninsulated floors above unconditioned spaces are an energy drain

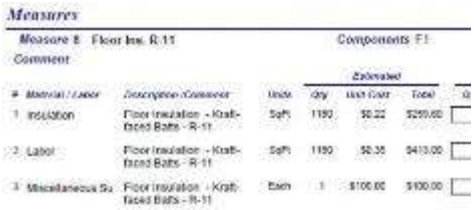
After
Batts should fill most of joist bay and be in full contact with subfloor

Tools:

1. Utility knife
2. Tape measure

Materials:

1. Kraft-faced fiberglass batts to work order specifications



Measures

Measure 8 Floor Ins. R-11 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Unit Cost	Total
1	Insulation	Floor Insulation - Kraft-faced Batts - R-11	SqFt	1150	$0.22	$253.00
2	Labor	Floor Insulation - Kraft-faced Batts - R-11	SqFt	1150	$0.35	$403.00
3	Miscellaneous Su	Floor Insulation - Kraft-faced Batts - R-11	Each	1	$100.00	$100.00

Order and install insulation as called for in Work Order

If precise R-value cannot be purchased, choose option with greater R-value

Install Kraft-faced batts with paper against subfloor

Ensure batts are in full contact with subfloor and remain uncompressed

4.1301.1c – Securing batts

Desired Outcome:

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

Specification(s):

Batts will be secured with physical fasteners

Objective(s):

Ensure insulation remains in contact with subfloorBefore

Before

After

Fiberglass batts should not be hanging away from subfloor

"Lightning rods" or twine can be used to hold batts in contact

Tools:

1. Utility knife
2. Drill
3. Staple gun

Materials:

1. Lightning rods
2. Twine
3. Fasteners

Batt should be in contact with subfloor without being compressed

Twine fastened across bays in a zig-zag pattern can also be used

4.1301.1d – Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.2 Standard Floor System—Loose Fill with Netting

4.1301.2a – Sealing

Desired Outcome:

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

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

Before

After

Gaps around penetrations can cause air leakage and negate insulation

Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.2b – Netting, fabric

Desired Outcome:

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

Specification(s):

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

Netting or fabric will meet local fire codes

Objective(s):

Secure insulation

Before

In Progress

Uninsulated floors above unconditioned spaces are an energy drain

Netting is secured to joists and sills to create cavities for insulation

Tools:

1. Utility knife
2. Scissors
3. Stapler

Materials:

1. Fabric netting
2. Staples

1
Secure netting across each joist to create separate cavities

2
Secure netting across sills to prevent leakage of insulation

3
Keep netting taut while stapling to prevent wrinkles and leakage

4
Staples should be kept tightly together, placed no more than 1 1/2" apart

4.1301.2c – Installation

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed

R-value of an adjoining insulated assembly

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

In Progress
With netting in place, insulation can begin

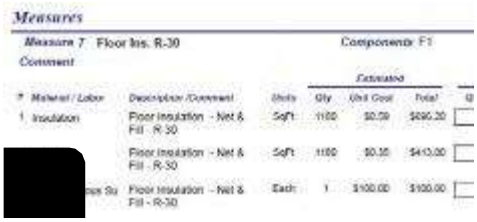
After
Cavities filled to manufacturer specs to achieve prescribed R-value

Tools:

1. Utility knife
2. Insulation machine

Materials:

1. Loose fill fiberglass



Measures

Measure 7 Floor Ins. R-30 Components: F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Unit Cost	Total
1	Insulation	Floor Insulation - Net & Fill - R-30	SqFt	1100	$0.30	$330.00
		Floor Insulation - Net & Fill - R-30	SqFt	1100	$0.30	$410.00
		Floor Insulation - Net & Fill - R-30	Each	1	$100.00	$100.00

1
Order and install insulation based on specifications in work order

2
Always wear proper PPE when blowing in insulation

3
Cut holes in each individual cavity to insert insulation machine nozzle

4

5

6

Ensure that hole is large enough for nozzle without allowing for outflow	Consult manufacturer specs on insulation packaging for proper installation	Blow in insulation to prescribed R-value

4.1301.2d – Occupant education

Desired Outcome:

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

Specification(s):

A dated receipt 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

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.3 Standard Floor System—Loose Fill with Rigid Barrier

4.1301.3a – Sealing

Desired Outcome:

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

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

Before
Gaps around penetrations cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Backer rod
2. Caulk
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

1
Locate gaps around penetrations for plumbing, electrical, etc.

2
Fill gaps greater than 1/4 inch with backer rod or spray foam

3
Caulk smaller gaps and to hold backer rod in place

4.1301.3b – Rigid air barrier

Desired Outcome:

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

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

Before
Uninsulated floors over unconditioned spaces are an energy drain

After
Rigid barriers provide air sealing and create cavities for insulation

Tools:

1. Utility knife
2. Saw
3. Drill
4. Caulk gun

Materials:

1. Rigid material - drywall, XPS, plywood
2. Fasteners
3. Caulk

1
Attach barrier to joists using appropriate fasteners for chosen material

2
When possible, align seams with joist. Seal all seams with caulk

3
Pay particular attention to sealing at complex joints to prevent leakage

4
Remember to seal along sills as well

4.1301.3c – Installation

Desired Outcome:

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

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

Before

Once rigid barrier is sealed, insulation can be blown in

After

Tools:

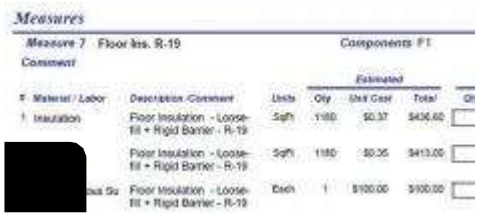
1. Insulation machine
2. Caulk gun

Materials:

1. Loose fill insulation
2. Caulk

1

Make sure to wear proper PPE when working with insulation



Measures

Measure 7 Floor Ins. R-19 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Unit Cost	Total
1	Insulation	Floor Insulation - Loose-fill + Rigid Barrier - R-19	Sqft	1160	$0.37	$436.60
		Floor Insulation - Loose-fill + Rigid Barrier - R-19	Sqft	1160	$0.35	$413.00
		Floor Insulation - Loose-fill + Rigid Barrier - R-19	Each	1	$100.00	$100.00

2

Purchase and install loose fill to R-value specified on Work Order

3

Check manufacturer specifications for proper density to reach R-value

4

Drill hole slightly larger than hose in rigid barrier

5

Loose fill cavities created by rigid barrier

6

Once filled to prescribed density, prepare plug to preserve rigid barrier

7
Plug should be sealed in place to prevent leakage

4.1301.3d – Occupant education

Desired Outcome:

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

Specification(s):

A dated receipt 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

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.4 Dense Pack Floor System with Rigid Barrier

4.1301.4a – Sealing

Desired Outcome:

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

Specification(s):

Sealing the floor system will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

Before
Gaps around penetrations can cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk

2. Backer rod
3. Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

1
Locate gaps around penetrations for plumbing, electrical, etc.

2
Fill gaps greater than 1/4 inch with backer rod or spray foam

3
Caulk small gaps and to hold backer rod in place

4.1301.4b – Rigid air barrier

Desired Outcome:

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

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

Before
Uninsulated floors over unconditioned spaces are an energy drain

After
Rigid barriers allow for air sealing and create cavities for insulation

Tools:

1. Utility knife
2. Saw

Materials:

1. Rigid material -- drywall, XPS, plywood
2. Fasteners

3. Drill
4. Tape measure
5. Caulk gun

3. Caulk

1
Securely fasten rigid barrier, aligning seams with joist when possible

2
Seal all seams with caulk to prevent leakage

3
Pay particular attention at complex joints

4
Remember to caulk along sills

4.1301.4c – Installation

Desired Outcome:

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

Specification(s):

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

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

Before
Once rigid barrier is sealed, insulation can be blown in

After
Rigid barrier should be resealed to maintain air barrier after filling

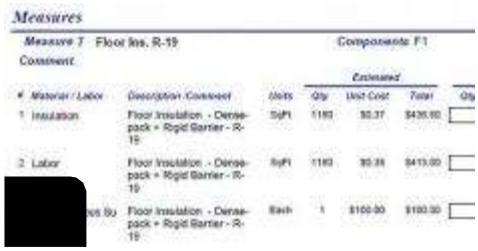
Tools:

1. Insulation machine
2. Caulk gun

Materials:

1. Dense packable insulation
2. Caulk

1
Ensure that proper PPE is worn while working with insulation



Measures

Measure 7 Floor Ins. R-19 Components F1

Comment

#	Material / Labor	Description/Comment	Units	Qty	Unit Cost	Total
1	Insulation	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1183	$0.37	$436.60
2	Labor	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1183	$0.35	$413.00
		Floor Insulation - Dense-pack + Rigid Barrier - R-19	Each	1	$100.00	$100.00

2
Fill cavities to specified R-value from Work Order

3
Check manufacturer specifications for R-value before filling

4
Drill hole slightly larger than nozzle into rigid barrier with hole saw

5
Dense pack insulation into floor cavities

6
When filled to specified density and r- value, fill access hole

7
Plug access hole and seal to maintain air barrier

4.1301.4d – Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.5 Cantilevered Floor—Batt Installation

4.1301.5a – Air barrier for Accessible Cantilevered Floor – Batt Installation

Desired Outcome:

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

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

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

4.1301.5b – Installation

Desired Outcome:

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

Specification(s):

Air barrier will be insulated between joist 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

If Kraft-faced batts are used, they will be installed with Kraft facing to the air barrier

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

4.1301.5c – Attachment

Desired Outcome:

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

Specification(s):

Batts will be secured with physical fasteners

Objective(s):

Ensure insulation remains in contact with subfloor and air barrier

Before
Insulation should be secured to prevent drooping or movement

After
"Lightning rods" or twine should keep full contact with the subfloor

Tools:

1. Utility knife
2. Drill
3. Staple gun

Materials:

1. Lightning rods
2. Twine
3. Fasteners

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

Batts should have full contact with subfloor without being compressed

Twine fastened across bays in a zig-zag pattern can also be used

4.1301.5d – Exterior Soffit

Desired Outcome:

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

Specification(s):

Exterior soffit material will be installed and sealed

Objective(s):

Cover and protect insulation

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

4.1301.5e – Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

Best Practice

Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.6 Pier Construction Subfloor Insulation—Batt Installation with Rigid Barrier

4.1301.6a – Subfloor preparation

Desired Outcome:

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

Specification(s):

Sealing between house and crawl space will be completed before insulating

Objective(s):

Ensure airtight envelope

Prevent leakage

Before
Gaps around penetrations can cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

- Be alert to high-temperature flues and chimneys and use appropriate sealants and materials.
- See 3.1402.1c.
- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

1
Locate gaps around penetrations for plumbing, electrical, etc.

2
Fill gaps greater than 1/4 inch with backer rod or spray foam

3
Caulk smaller gaps and to hold backer rod in place

4.1301.6b – Installation

Desired Outcome:

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

Specification(s):

Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions

If Kraft-faced batts are used, they will be installed with Kraft facing to subfloor

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

Before

After

Uninsulated floors above unconditioned spaces are an energy drain

Batts should fill most of joist bay and be in full contact with subfloor

Tools:

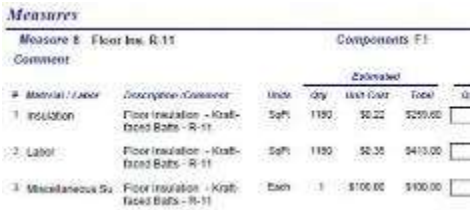
1. Utility knife
2. Drill

Materials:

1. Kraft-faced fiberglass batts to work order specifications
2. Rigid barrier -- drywall, plywood, XPS
3. Fasteners

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

Order and install insulation as called for in Work Order



Measures

Measure 8 Floor Ins. R-11 Components F1

Comment

#	Material / Labor	Description/Comment	Units	Estimated Qty	Estimated Unit Cost	Estimated Total
1	Insulation	Floor Insulation - Kraft-faced Batts - R-11	Sqft	1150	$0.22	$253.00
2	Labor	Floor Insulation - Kraft-faced Batts - R-11	Sqft	1150	$0.35	$403.00
3	Miscellaneous Su	Floor Insulation - Kraft-faced Batts - R-11	Each	1	$100.00	$100.00

If precise R-value cannot be purchased, choose option with greater R-value

Install Kraft-faced batts with paper against subfloor

Ensure batts are in full contact with subfloor and remain uncompressed

4.1301.6c – Secure batts

Desired Outcome:

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

Specification(s):

Batts will be secured with physical fasteners

Objective(s):

Ensure insulation remains in contact with subfloorBefore

Before
Batts should not hang away from subfloor

After
"Lightning rods" or twine should be used to maintain contact

Tools:

1. Utility knife
2. Drill
3. Staple gun

Materials:

1. Lightning rods
2. Twine
3. Fasteners

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

Batts should be in full contact with subfloor without being compressed

Twine fastened across bays in a zig-zag pattern can also be used

4.1301.6d – Rigid air barrier

Desired Outcome:

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

Specification(s):

A rigid air barrier will be mechanically fastened to underside of floor assembly

Seams and penetrations will be sealed

Objective(s):

Protect insulation

Before
Unfaced fiberglass batts can be attractive housing for pests

After
Rigid barrier allows for air sealing and protects batt insulation

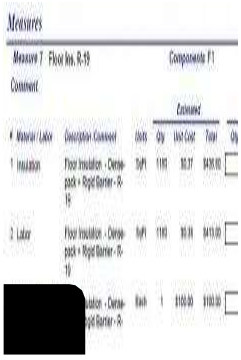
Tools:

1. Utility knife
2. Saw
3. Drill
4. Tape measure
5. Caulk gun

Materials:

1. Rigid material - drywall, XPS, plywood
2. Caulk
3. Fasteners

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.



1
Fasten rigid barrier, aligning seams with joists when possible

2
Seal all seams with caulk to prevent leakage

3
Pay particular attention to complex joints

4
Remember to seal along sills

4.1301.6e – Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.7 Pier Construction Subfloor Insulation—Loose Fill with Rigid Barrier

4.1301.7a – Subfloor preparation

Desired Outcome:

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

Specification(s):

Sealing between house and crawl space will be completed before insulating

Objective(s):

Prevent air leakage

Before
Gaps around penetrations can cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

- Be alert to high-temperature flues and chimneys and use appropriate sealants and materials.
- See 3.1402.1c.
- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered

with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

1
Locate gaps around penetrations for plumbing, electrical, etc.

2
Fill gaps greater than 1/4 inch with backer rod or spray foam

3
Caulk smaller gaps and to hold backer rod in place

4.1301.7b – Rigid air barrier

Desired Outcome:

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

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

Before
Uninsulated floors over unconditioned spaces are an energy drain

After
Rigid barriers allow for air sealing while creating cavities for insulation

Tools:

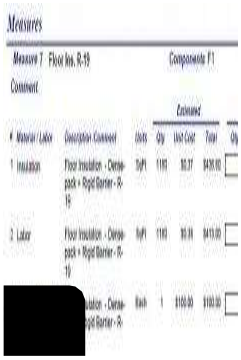
1. Utility knife
2. Saw
3. Drill
4. Tape measure

Materials:

1. Rigid material - drywall, XPS, plywood
2. Fasteners
3. Caulk

5. Caulk gun

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.



1
Fasten rigid barrier, aligning seams with joists when possible

2
Seal all seams to prevent leakage

3
Pay particular attention to complex joints

4
Remember to caulk along sills

4.1301.7c – Installation

Desired Outcome:

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

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

Before
Once rigid barrier has been sealed, insulation can be blown in

After
After insulating, restore rigid barrier to prevent leakage

Tools:

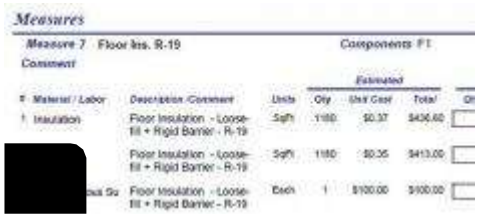
1. Insulation machine
2. Caulk gun

Materials:

1. Loose fill insulation
2. Caulk

- Exposed floors, except over garages, shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

1
Always wear proper PPE when working with insulation



Measures

Measure 7 Floor Ins. R-19 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Unit Cost	Total
1	Insulation	Floor Insulation - Loose-fill + Rigid Barrier - R-19	Sqft	1160	$0.37	$436.60
		Floor Insulation - Loose-fill + Rigid Barrier - R-19	Sqft	1160	$0.35	$413.00
		Floor Insulation - Loose-fill + Rigid Barrier - R-19	Each	1	$100.00	$100.00

2
Purchase and install insulation to r- value specified on Work Order

3
Check manufacturer specs to ensure proper installation and density

4

5

6

Drill hole in rigid barrier slightly larger than insulation hose

Fill cavities formed by rigid barrier with loose fill insulation

Once cavities have been filled to specified R-value, prepare plug

Seal rigid barrier to prevent leakage

4.1301.7d – Occupant education

Desired Outcome:

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

Specification(s):

A dated receipt 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

Best Practice

Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.8 Pier Construction Subfloor Installation—Dense Pack with Rigid Barrier

4.1301.8a – Subfloor preparation

Desired Outcome:

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

Specification(s):

Sealing between house and crawl space will be completed before insulating

Objective(s):

Prevent air leakage

Before
Gaps around penetrations can cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier

Tools:

1. Caulk gun

Materials:

1. Caulk
2. Backer rod
3. Spray foam

- Be alert to high-temperature flues and chimneys and use appropriate sealants and materials.
- See 3.1402.1c.
- Exposed floors except over garages shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place

4.1301.8b – Rigid air barrier

Desired Outcome:

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

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

Before

After

Uninsulated floors over unconditioned spaces are an energy drain

Rigid barriers allow for air sealing while creating cavities for insulation

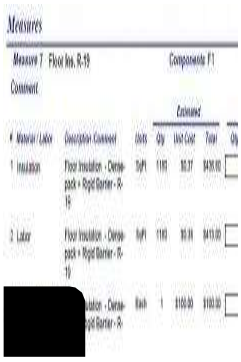
Tools:

1. Utility knife
2. Saw
3. Drill
4. Tape measure
5. Caulk gun

Materials:

1. Rigid material - drywall, XPS, plywood
2. Fasteners
3. Caulk

Nebraska WAP requires: Exposed floors except over garages shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.



1
Fasten rigid barrier, aligning seams with joists when possible

2
Seal all seams with caulk to prevent leakage

3
Pay particular attention to complex seams

4
Remember to seal along sills

4.1301.8c – Installation

Desired Outcome:

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

Specification(s):

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

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

Before

Once rigid barrier has been sealed, insulation can be blown in

After

Rigid barrier should be sealed after insulating to maintain air barrier

Tools:

1. Insulation machine
2. Caulk gun

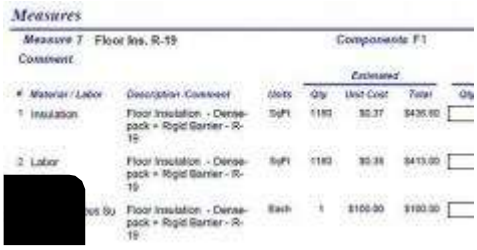
Materials:

1. Dense packable insulation
2. Caulk

- Exposed floors except over garages shall be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.

1

Make sure to wear proper PPE when working with insulation



Measures

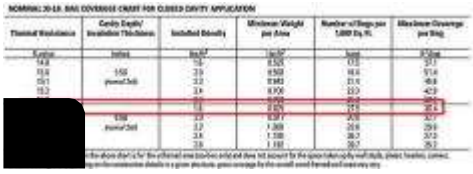
Measure 7 Floor Ins. R-19 Components F1

Comment

#	Material / Labor	Description /Comment	Units	Qty	Unit Cost	Total
				Enclosure		
1	Insulation	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	$0.37	$436.60
2	Labor	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	$0.35	$413.00
	[redacted]	Floor Insulation - Dense-pack + Rigid Barrier - R-19	Each	1	$100.00	$100.00

2

Purchase and install insulation as per Work Order



3

Check manufacturer specifications to install properly

4
Drill hole in rigid barrier slightly larger than insulation hose

5
Blown in insulation to density and r- value specified by work order

6
Once cavity is filled, prepare plug to reseal rigid barrier

7
Securely seal plug into rigid barrier to prevent leakage

4.1301.8d – Occupant education

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R-value

Provide occupant with copies of all documentation

4.1301.9 Open Floors Over Unconditioned Space and Cantilevered Floors, Floors Over Garages, Floors Over Unconditioned Crawl Spaces—Spray Polyurethane

4.1301.9a – Preparation

Desired Outcome:

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

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

- Exposed floors, except over garages, shall be insulated with *batt* or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.
- Exposed floors over garages shall be insulated with *batt* or blown insulation. Fire code drywall shall be installed on open floor cavities over garages. The drywall shall be taped and receive one coat of joint compound or the joints and seams shall be caulked to form an airtight seal.

4.1301.9b – Installation

Desired Outcome:

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

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

- Exposed floors, except over garages, shall be insulated with *batt* or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.
- Exposed floors over garages shall be insulated with *batt* or blown insulation. Fire code drywall shall be installed on open floor cavities over garages. The drywall shall be taped and receive one coat of joint compound or the joints and seams shall be caulked to form an airtight seal.

4.1301.9c – Fire protection

Desired Outcome:

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

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

- Exposed floors, except over garages, shall be insulated with *batt* or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams shall be caulked.
- Exposed floors over garages shall be insulated with *batt* or blown insulation. Fire code drywall

shall be installed on open floor cavities over garages. The drywall shall be taped and receive one coat of joint compound or the joints and seams shall be caulked to form an airtight seal.

4.1301.9d – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

4.14 Basements and Crawl Spaces

4.1401 Band/Rim Joists

4.1401.1 Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation

4.1401.1a – Preparation

Desired Outcome:

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

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

4.1401.1b – Installation

Desired Outcome:

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

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

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

- Sill box insulation shall be a minimum R-10.

4.1401.1c – Fire protection

Desired Outcome:

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

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 Local codes will be confirmed and followed for fire protection requirements

Objective(s):

Provide necessary fire protection for combustible SPF insulation

4.1401.1d – Onsite documentation

Desired Outcome:

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

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

4.1401.2 Band/Rim Joists – Insulation other than Spray Polyurethane Foam

4.1401.2a – Preparation

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

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

4.1401.2b – Insulation installation

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

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

- Sill box insulation shall be a minimum R-10.

4.1401.2c – Onsite documentation

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications Confirm amount of insulation installed Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

4.1402 Basements and Crawl Space Walls

4.1402.1 Closed Crawl Spaces—Wall Insulation

4.1402.1a – Insulation selection

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):

A non-fibrous, fire-rated Class I insulation will be used with a minimum life expectancy of 10 years

Objective(s):

Provide fire-Safe durable insulation

- Insulation shall be a minimum R-10.
- Crawlspace wall shall be insulated with foam board or spray applied insulation.
- If faced *batt* insulation is installed, the vapor barrier shall be to the warm side and the insulation shall be supported with twine, wire, hex netting or wire expanders.

4.1402.1b – R-value

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):

Regional International Energy Conservation Code (IECC) will be followed for required R-values

Objective(s):

Improve thermal performance

- Insulation shall be a minimum R-10.
- Crawlspace wall shall be insulated with foam board or spray applied insulation.
- The insulation shall fill the sill box, extend down the foundation wall and, batt insulation is used, lay a minimum of 24 inches on top of a ground laid moisture barrier.
- To ensure there are no gaps in the wall insulation, 24 inch wide *batt*s shall be used in areas of 16 inch floor joist spacing and 16 inch *batt*s shall be used in areas of 24 inch joist spacing.
- If faced *batt* insulation is installed, the vapor barrier shall be to the warm side and the insulation shall be supported with twine, wire, hex netting or wire expanders.

4.1402.1d – Attachment

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):

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

Objective(s):

Prevent insulation from detaching from the foundation wall

4.1402.1g – Onsite documentation

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):

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

- Coverage area
- Thickness
- R-value

Objective(s):

Document job completion to contract specifications

Confirm amount of insulation installed

Comply with 16 CFR 460.17

- The insulation specifications shall include the insulation brand name, thermal resistance chart, certification that the insulation conforms to federal specifications, the name of the company or agency that installed the insulation, the date the insulation was installed and the R-value and be included in the Sub-grantee client file.

4.1402.2 Basement Wall Insulation—No Groundwater Leakage

4.1402.2a – R-value

Desired Outcome:

Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):

Regional IECC will be followed for required R-values

Objective(s):

Improve thermal performance of the basement and living space

	Continuous Rigid Insulation, Interior or Exterior	Interior Cavity Insulation
Zone 1	0	0
Zone 2	0	0
Zone 3	5	13
Zone 4, except marine	10	13
Zone 5 and marine 4	15	19
Zone 6-8	16	19

Best Practice

Find your regional zone and insulation application to determine R-value

- The insulation shall be a minimum R-10.

4.1402.2b – Air barrier

Desired Outcome:

Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):

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

Objective(s):

Prevent condensation on the basement wall

4.1402.2c – Vapor permeability

Desired Outcome:

Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):

When absorbent insulation materials are installed, assembly will remain vapor permeable to the interior in all climate zones except Zone 7

Objective(s):

Provide drying potential to the basement

Before
Kraft-faced fiberglass insulation is absorbent

After
Drywall typically has a perm rating of 50 – good for zones 1-6

Tools:

1. Utility knife
2. Drill
3. Tape measure
4. Taping knife

Materials:

1. Drywall
2. Kraft-faced fiberglass batts
3. Spackle
4. Seam tape
5. Fasteners

- The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50.
- From 2007 IRC definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).
- Batt, spray applied and foam board insulation shall be covered as required by local or state code jurisdiction requirements.
- *Basement* wall insulating systems shall be installed according to manufacturer's instructions.

Determine in which zone you are working before selecting work materials

Many light-weight drywall brands have higher perm ratings for humid zones

In zones 7 & 8, vapor permeability is undesirable. Use a vapor retarder

4.16 Ducts

4.1601 Insulating Ducts

4.1601.2 Insulating Metal Ducts

4.1601.2a – Selection of duct insulation material

Desired Outcome:

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

Specification(s):

Duct insulation on all ducts located in unconditioned spaces will be a minimum of R-8, in accordance with local code, or buried under attic insulation, whichever is greater, and have an attached vapor retarder

Hot humid and warm coastal regions will not bury ducts

Objective(s):

Decrease heat loss and condensation problems

Before
Uninsulated ducts in unconditioned spaces are an energy drain

After
Properly insulated ducts operate at much higher rates of efficiency

- Tears and joints shall be sealed using nontoxic and water-resistant mastic.
- Mesh tape shall be used when openings and tears are over 1/16 of an inch.

- Appropriate Energy Code UL181duct sealing tape may be used only when the installation of mastic is not feasible.
- The insulation shall have a vapor barrier.

Ducts in unconditioned areas should have r-8 insulation with vapor barrier

OR ducts can be buried in loose fill in attic spaces in drier climates

Burying ducts is discouraged in warm coastal and hot humid regions

4.1601.2b – Duct sealing

Desired Outcome:

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

Specification(s):

All joints, seams, and connections in ductwork shall be securely fastened and sealed with UL 181 B-M mastics (adhesives) or mastic- plus-embedded-fabric systems installed in accordance with the manufacturer's instructions before insulation is applied

Objective(s):

Minimize duct leakage

Before

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

After

Sealed ductwork connections help prevent leakage

Tools:

1. Putty knife

Materials:

1. Mesh tape
2. Mastic

- Tears and joints shall be sealed using nontoxic and water-resistant mastic.
- Mesh tape shall be used when openings and tears are over 1/16 of an inch.

- Appropriate Energy Code UL181duct sealing tape may be used only when the installation of mastic is not feasible.
- The insulation shall have a vapor barrier.

1
Prepare work area by assessing any Safety concerns

2
Wrap joint with fiberglass mesh tape

3
Apply UL 181 mastic to seal joint

4.1601.2c – Attachment of duct insulation

Desired Outcome:

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

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

Before
Materials holding insulation in place should not compress or kink duct

After
Durable materials can be attached without compressing insulation

Tools:

1. Scissors
2. Metal snips

Materials:

1. Nylon twine
2. Wire
3. Tie bands

- Ductwork shall be insulated with a minimum R-8 insulation secured with cord, wire, plastic or nylon bands.
- The insulation shall have a vapor barrier installed to the exterior and the joints shall be sealed with butyl tape, caulking or mastic.
- Fiberglass duct liner shall not be installed.

4.1601.2d – Taping of the duct insulation

Desired Outcome:

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

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

Before
Unsecured and sealed insulation around ducts is useless

After
All seams should be sealed with UL-181 duct tape to preserve vapor barrier

Tools:

1. Utility knife

Materials:

1. UL-181 tape
2. R-8 duct insulation with vapor barrier

- Tears and joints shall be sealed using nontoxic and water-resistant mastic.
- Mesh tape shall be used when openings and tears are over 1/16 of an inch.
- Appropriate Energy Code UL181duct sealing tape may be used only when the installation of mastic is not feasible.
- The insulation shall have a vapor barrier.

4.99 Insulation—Additional Resources

4.9901 Materials

4.9901.1 General Information on Spray Polyurethane Foam (SPF)

4.9901.1a – Low-Pressure SPF

Desired Outcome:

To provide general Information on spray polyurethane foam

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

4.9901.1b – High-Pressure SPF

Desired Outcome:

To provide general Information on spray polyurethane foam

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

4.9901.1c – Manufacturer Installation Instructions

Desired Outcome:

To provide general Information on spray polyurethane foam

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, MSDSs, and evaluation reports.

Objective(s):

To provide general Information on spray polyurethane foam

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5 Heating and Cooling

5.30 Forced Air

5.3001 Design

5.3001.1 Load Calculation and Equipment Selection

5.3001.1a – Load calculation

Desired Outcome:

Equipment sized properly and operates efficiently

Specification(s):

Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications

Objective(s):

Properly size equipment for load

- Replacement heating plants shall be competitively bid and properly sized using the post – weatherization characteristics of the home.
- Replacement central air conditioners and heat pumps shall be competitively bid and properly sized using the post-weatherization characteristics of the home.

5.3001.1b – Equipment selection

Desired Outcome:

Equipment sized properly and operates efficiently

Specification(s):

Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications

Objective(s):

Ensure equipment is able to heat, cool, and dehumidify the house

- Replacement central air conditioners shall be a minimum 14-SEER (Seasonal Energy Efficiency Factor) and use environmentally friendly Freon.
- Replacement heat pumps shall be a minimum14-SEER and 8.2-HSPF (Heating Seasonal Performance Factor) and use environmentally friendly Freon. Heat pumps must be installed with ramp-up type thermostats especially designed to bring backup heat in stages, and only when the heat pump can no longer keep up with demand, and must be able to differentiate between a demand call and a 'return from setback' call for heat.
- Forced air furnaces shall have a minimum AFUE of 90 percent, boilers a minimum of 85 percent and wall and console heaters, a minimum of 80 percent.
- Efficiency ratings for forced air furnaces and boilers must be listed in the most current edition of the Gas Appliance Manufacturers Association (GAMA) Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment.
- Heat exchangers in all replacement heating plants shall have a minimum 10 year manufacturer's warranty.

5.3001.1c – Air filtration

Desired Outcome:

Equipment sized properly and operates efficiently

Specification(s):

New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters

Objective(s):

Particle removal to protect equipment and help maintain indoor air quality

5.3001.2 Ductwork and Termination Design

5.3001.2a – Duct design

Desired Outcome:

Efficient air flow to all rooms ensured by proper ductwork

Specification(s):

Duct design will be performed in accordance with ANSI/ACCA Manual D and manufacturer specifications

Objective(s):

Maximize air flow

- The replacement heating plant and or cooling system shall use the existing ductwork.
- New ductwork may be installed to properly balance the system.
- New flexible ductwork shall be no more than 4 lineal feet per run if possible.

5.3001.2b – Termination design

Desired Outcome:

Efficient air flow to all rooms ensured by proper ductwork

Specification(s):

Termination design will be performed in accordance with ANSI/ACCA Manual T and manufacturer specifications

Objective(s):

Maximize air flow

Ensure occupant comfort

- All misaligned or disconnected ductwork and floor registers shall be realigned or reattached using sheet metal screws.
- Missing or damaged ductwork and floor registers shall be replaced and sealed.

5.3001.2c – Air filtration

Desired Outcome:

Efficient air flow to all rooms ensured by proper ductwork

Specification(s):

New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters

Objective(s):

Particle removal to protect equipment and help maintain indoor air quality

5.3002 Site Preparation

5.3002.1 Preparation for New Equipment

5.3002.1a – Access

Desired Outcome:

Existing equipment removed safely and lawfully

Specification(s):

A code compliant walkway and service platform will be installed in attics, if not present

Walkway and platform will be above the level of insulation (if practical)

Objective(s):

Ensure new equipment can be installed and serviced

Maintain adequate insulation level

- The costs associated with the installation of access walkways and/or platforms are not eligible expenses in the *Nebraska Weatherization Assistance Program*.

5.3002.1b – Utility disconnect

Desired Outcome:

Existing equipment removed safely and lawfully

Specification(s):

Electricity and fuel will be turned off prior to starting removal of old appliance

Objective(s):

Protect workers and occupants from injury

5.3002.1c – Refrigerant recovery

Desired Outcome:

Existing equipment removed safely and lawfully

Specification(s):

Refrigerant will be recovered in accordance with 40 CFR 608 (EPA) by a licensed contractor

Objective(s):

Comply with Safe Handling of Refrigerant Law

Protect workers and occupants from injury

5.3002.1d – Equipment disconnection

Desired Outcome:

Existing equipment removed safely and lawfully

Specification(s):

Refrigerant lines, plumbing, ducts, electric, control wires, vents, and fuel supply will be disconnected

Objective(s):

Ensure equipment can be removed

- All repair and replacement work on heating plants, air conditioners and heat pumps shall be completed by a Qualified Heating Technician.

5.3002.1e – Removal

Desired Outcome:

Existing equipment removed safely and lawfully

Specification(s):

Equipment will be removed (e.g., furnace, air handler, evaporator, condensing unit)

Equipment will be removed from space without damaging property and disturbing or compressing the insulation

Equipment will be disposed of in accordance with local laws and regulations, recycling materials when feasible

Objective(s):

Provide room to install new equipment and work safely

Comply with applicable disposal laws

5.3003 System Assessment and Maintenance

5.3003.1 Data Plate Verification

5.3003.1a – Data plate verification

Desired Outcome:

Data for commissioning and future service work is recorded

Specification(s):

Equipment will be visually inspected

Information will be recorded from the equipment data plates indoors and outdoors

Objective(s):

Ensure technician has equipment data necessary for commissioning and future service work

5.3003.2 Combustion Analysis of Oil-Fired Appliances

5.3003.2a – Oil system: nozzle size

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

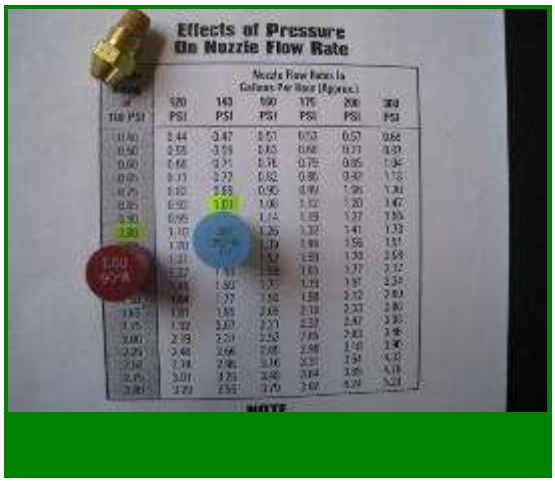
Nozzle size will be correct for design input and within equipment firing rate of the heating system manufacturer

Objective(s):

Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently

Ensure equipment is durable

Locate nozzles on oil-fired water heaters and furnaces



After
Verify that nozzle size is appropriate for model by consulting flow chart

Tools:

1. Calipers

- This work to be completed by a Qualified Heating Technician.

5.3003.2b – Fuel pressure

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

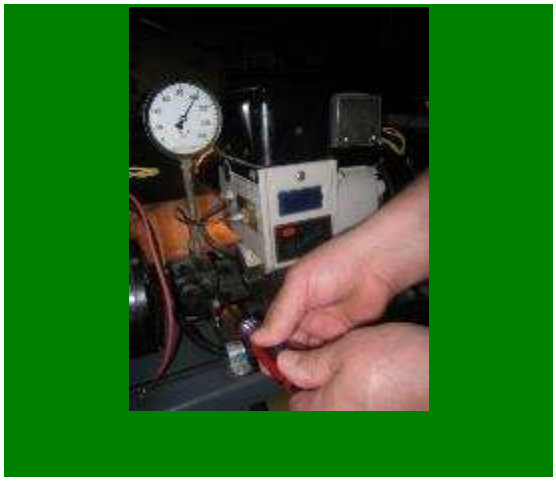
Specification(s):

Measurement will be verified in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently

Ensure equipment is durable



Check oil-fired furnaces and water heaters for proper fuel pressure

After
Verify that fuel pressure matches manufacturer's specifications

- This work to be completed by a Qualified Heating Technician.

5.3003.2c – Oil system: steady state efficiency (SSE)

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

Measurement will be verified in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently

Ensure equipment is durable

In Progress
Test flue gases to determine steady state efficiency

After
At steady state, this furnace tests at 83%- – within manufacturer tolerances

Tools:

1. Combustion analyzer with probe

- This work to be completed by a Qualified Heating Technician.

5.3003.2d – Oil system: smoke test (This test must be conducted before any combustion testing is completed)

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

Smoke spot reading will be in accordance with burner manufacturer specifications

If smoke test is more than actionable levels, specify a clean and tune

Objective(s):

Ensure equipment operates as designed Ensure equipment operates safely Ensure equipment operates efficiently

Ensure equipment is durable

Verify oil-fired furnaces and water heaters are operating safely

Best Practice
Smoke tests determine if oil-fired appliances burn cleanly by testing soot

Tools:

1. Smoke testing pump

Materials:

1. Filter paper

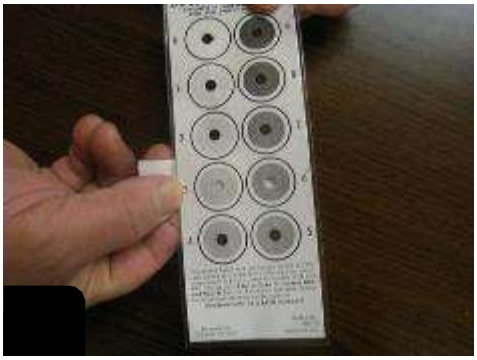
- This work to be completed by a Qualified Heating Technician.

5.3003.2d – Oil system: smoke test (This test must be conducted before any combustion testing is completed)

1
Place filter paper in testing pump and draw air through paper

2
Remove paper and verify draw was successful by checking for soot

3
Compare level of soot deposit against smoke chart. A rating of 0 is ideal



4
Appliances with ratings of 3 or higher should be cleaned and tuned

5.3003.2e – Net stack temperature

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

Net stack temperature will be measured and verified in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates safely

Ensure equipment operates efficiently

Ensure equipment is durable

In Progress
Verify oil-fired appliances are not burning hotter than manufacturer specs

After
T-stack minus T-air equals net stack temperature. Check against specs

Tools:

1. Combustion analyzer with probe

- T=temperature. T-stack minus T-air = Delta T or Net Stack Temperature.
- This work to be completed by a Qualified Heating Technician.

5.3003.2f – Carbon dioxide and oxygen

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

Measurement will be verified in accordance with industry manuals and manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates safely

Ensure equipment operates efficiently

Ensure equipment is durable

In Progress
Verify oil-fired appliances are burning safely by testing CO2 and O2 levels

After
Levels should be within industry standards and match manufacturer specs

Tools:
1. Combustion analyzer with probe
2. Drill

- This work to be completed by a Qualified Heating Technician.
- 15.4% should be the highest allowable level of CO2 produced by an oil-fired appliance.
- O2 levels in the atmosphere are at a constant 20.9%. O2 readings in appliances vary due to O2 density and the efficiency of the combustion process.

5.3003.2g – Excess air

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

Excess air will be calculated and shown to be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates safely

Ensure equipment operates efficiently

Ensure equipment is durable

In Progress
Oil-fired appliances require an appropriate level of air mixed with the oil

After
The percentage of Excess Air (EA) should be within manufacturer specs

Tools:

1. Combustion analyzer with probe
2. Drill

- This work to be completed by a Qualified Heating Technician.

5.3003.2h – CO in flue gas

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications

Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer

For CO levels exceeding 200 ppm as measured, or 400 ppm air-free measurement, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates safely

Ensure equipment operates efficiently

Ensure equipment is durable

In Progress
Test oil-fired appliances for CO in the flue gases to verify safe levels

After
CO should measure less than 200ppm

Tools:
1. Combustion analyzer with probe
2. Drill

- This work to be completed by a Qualified Heating Technician.

CO should measure less than 200ppm

Air-free CO, or CO(0), should be less than 400ppm

5.3003.3 Evaluating Air Flow

5.3003.3a – Total air flow

Desired Outcome:
Air flow is properly tested

Specification(s):
Total system air flow will be measured by:

- Temperature rise
- Flow plate

- Fan depressurization device (e.g., Duct Blaster, DucTester)

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3b – External static pressure

Desired Outcome:

Air flow is properly tested

Specification(s):

External static pressure will be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3c – Pressure

Desired Outcome:

Air flow is properly tested

Specification(s):

Pressure drop across cooling coils will be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3d – Pressure drop: filter

Desired Outcome:

Air flow is properly tested

Specification(s):

Pressure drop across filter will be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3e – Balancing room flow: new ductwork

Desired Outcome:

Air flow is properly tested

Specification(s):

Air flow will be measured at each register to ensure proper air flow delivery

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3f – Supply wet bulb and dry bulb

Desired Outcome:

Air flow is properly tested

Specification(s):

Supply wet bulb and dry bulb air temperatures will be recorded

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3g – Return web bulb and dry bulb

Desired Outcome:

Air flow is properly tested

Specification(s):

Return wet bulb and dry bulb air temperatures will be recorded

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.3h – Temperature rise: gas and oil furnaces only

Desired Outcome:

Air flow is properly tested

Specification(s):

Temperature rise between the supply and return will be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment provides comfort

Ensure equipment operates safely

Ensure equipment is durable

5.3003.4 Evaluating Electrical Service

5.3003.4a – Polarity

Desired Outcome:

Electrical components properly tested

Specification(s):

Polarity of equipment will be correct

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates safely

5.3003.4b – Voltage/amperage: incoming power

Desired Outcome:

Electrical components properly tested

Specification(s):

Voltage/amperage will be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

5.3003.4c – Voltage: contactor

Desired Outcome:

Electrical components properly tested

Specification(s):

In accordance with manufacturer specifications, voltage drop will be within acceptable range

Objective(s):

Ensure contactor does not overheat

Ensure equipment operates as designed

5.3003.4d – Grounding

Desired Outcome:

Electrical components properly tested

Specification(s):

Grounding must conform to meet NFPA 70 National Electric Code

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates safely

- The costs associated with bringing a home into compliance with appropriate codes are not eligible expenses in the *Nebraska Weatherization Assistance Program*.

5.3003.4e – Blower amperage

Desired Outcome:

Electrical components properly tested

Specification(s):

Amperage will not exceed manufacturer full load amperage

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment operates safely

5.3003.4f – Compressor amperage

Desired Outcome:

Electrical components properly tested

Specification(s):

Amperage will not exceed manufacturer full load amperage

Objective(s):

Ensure equipment operates as designed

Ensure equipment operates efficiently

Ensure equipment operates safely

5.3003.4g – Door switch operation

Desired Outcome:

Electrical components properly tested

Specification(s):

Blower compartment safety switch operation will be verified

Objective(s):

Ensure blower does not operate during service

5.3003.4h – Heat pump: emergency heat

Desired Outcome:

Electrical components properly tested

Specification(s):

Emergency heat circuit functions will be verified

Objective(s):

Ensure system delivers heat in case of compressor failure

5.3003.5 Refrigerant Line Inspection

5.3003.5a – Insulation

Desired Outcome:

Refrigerant lines properly installed

Specification(s):

All liquid refrigerant lines will be insulated to a minimum of R-4

Vapor or high side lines will not be insulated unless specified by the equipment's manufacturer

Suction lines will be insulated to a minimum of R-4

Objective(s):

Ensure refrigerant lines do not gain excessive heat

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, 2012 IRC N1103.3.1, or local code

Objective(s):

Install insulation so it does not degrade

5.3003.5c – Sizing

Desired Outcome:

Refrigerant lines properly installed

Specification(s):

Refrigerant lines will be sized to meet manufacturer specifications for the installed equipment

Objective(s):

Ensure system moves appropriate volume of refrigerant

5.3003.5d – Installation quality

Desired Outcome:

Refrigerant lines properly installed

Specification(s):

Refrigerant lines will be installed without kinks, crimps, or excessive bends

Objective(s):

Ensure system moves appropriate volume of refrigerant

5.3003.5e – Support

Desired Outcome:

Refrigerant lines properly installed

Specification(s):

Refrigerant lines will be routed, supported, and secured to house in a manner that protects the line from damage by workers or occupants

Objective(s):

Ensure refrigerant lines do not move, vibrate, or sag

Protect lines from damage

5.3003.7 Occupant Education

5.3003.7a – Basic operation

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Basic operation of the equipment will be explained to the occupant (e.g., design conditions, efficiency measures, differences from previous system or situation)

Objective(s):

Ensure occupant has a reasonable expectation of the equipment's capability

5.3003.7b – System controls (e.g., thermostat, humidistat)

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Proper operation and programming of system controls to achieve temperature and humidity control will be explained to the occupant

Objective(s):

Ensure occupant can operate system controls

5.3003.7c – System disconnects

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Indoor and outdoor electrical disconnects and fuel shut-offs will be demonstrated to occupant

Objective(s):

Ensure occupant can shut off equipment in emergencies

5.3003.7d – Combustion air inlets

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Location of combustion air inlets will be identified for occupant in accordance with NFPA 31, 54, and 58

Importance of not blocking inlets will be explained to occupant

Objective(s):

Ensure occupant does not block combustion air inlets

5.3003.7e – Blocking air flow

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Importance of cleaning dust and debris from return grilles will be explained to occupant

Proper placement of interior furnishings with respect to registers will be explained to occupant

Negative consequences of closing registers will be explained to occupant

Importance of leaving interior doors open as much as possible will be explained to occupant

Objective(s):

Ensure occupant does not prevent equipment from operating as designed

5.3003.7f – Routine maintenance

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Proper filter selection and how to change the filter will be explained to occupant

Importance of keeping outside unit clear of debris, vegetation, decks, and other blockage will be explained to occupant

Importance and timing of routine professional maintenance will be explained to occupant

There will be no air bypass around the filters and new central forced air HVAC systems will have minimum MERV 6 filtration

Objective(s):

Ensure equipment operates as designed

5.3003.7g – Calling heating, ventilation, and air conditioning (HVAC) contractor

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Situations when the occupant should contact the HVAC contractor will be explained, including:

- Fuel odors
- Water draining from secondary drain line
- Emergency heat indicator always on for a heat pump system
- System blowing cold air during heating season and vice versa
- Icing of the evaporator coil during cooling mode
- Outside unit never defrosts
- Unusual noises
- Unusual odors

Objective(s):

Notify occupant to contact installer when system is not operating as designed

5.3003.7h – Carbon monoxide (CO)

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

A carbon monoxide (CO) alarm will be installed

Objective(s):

Occupant will be made aware of operation of CO alarm

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home.

5.3003.7i – Warranty and service

Desired Outcome:

Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment

Specification(s):

Occupant will be provided with relevant manuals and warranties

The labor warranty will be explained and the occupant will be given a phone number to call for warranty service

Objective(s):

Provide manuals and warranties for future servicing

5.3003.9 Heating and Cooling Controls

5.3003.9a – Removal of mercury-based thermostats

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Mercury based thermostat will be removed safely and disposed of in accordance with EPA regulations

Objective(s):

Protect workers and occupants from injury

Protect environment from damage

5.3003.9b – Removal of existing controls

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Existing controls will be removed in accordance with EPA lead-safe work rules

Objective(s):

Protect workers and occupants from injury

Protect environment from damage

5.3003.9c – Penetrations

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Penetrations for control wiring will be sealed with a durable sealant (e.g., caulk, silicone, foam)

Objective(s):

Ensure controls operate as designed

Minimize infiltration and exfiltration from house

5.3003.9d – Thermostat location

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Thermostats will be installed to reflect the temperature of the zone in which they are installed

Thermostats will not be exposed to extreme temperatures, radiant heat sources, and drafts

Objective(s):

Ensure controls operate as designed

5.3003.9e – Blower speed

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Blower speed will be set for equipment in accordance with manufacturer specifications

Objective(s):

Ensure equipment has correct air flow

5.3003.9f – Thermostat selection: heat pump

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

A thermostat with equipment supplementary heat lockout that can interface with an outside temperature sensor will be selected

Objective(s):

Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load

5.3003.9g – Heat pump: supplementary heat

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Supplementary heat will be used on air-to-air heat pumps with conditions that allow for a balance point of less than 30°F

Supplementary heat lockout will be installed and set to manufacturer specifications

Objective(s):

Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load

5.3003.9h – Heat pump: low ambient compressor lockout

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

For air-to-air heat pumps, low ambient compressor lockout will be set to 0°F outdoor temperature or to manufacturer specifications

Objective(s):

Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load

5.3003.9i – Heat pump: outside air sensor

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

An outdoor temperature sensor will be installed in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

5.3003.9j – Heat pump: supplementary heat wiring

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Supplementary heat will be wired onto second-stage heating terminal in accordance with manufacturer specifications

Objective(s):

Do not operate supplementary heat in stage one heating

5.3003.9k – Thermostat: installer programming

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

The installer options will be set to match the thermostat to the equipment and control board settings

Objective(s):

Ensure equipment operates as designed

5.3003.9l – Time delay settings

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Time delay for equipment will be set in accordance with manufacturer specifications and as appropriate for the climate zone (e.g., no time delay for hot humid climates)

Objective(s):

Maximize transfer of heat without adversely affecting indoor humidity levels

5.3003.9n – Occupant education

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Occupants will be educated on proper use of thermostat including:

- Proper use of setbacks for air conditioners and heat pumps
- Allowing occupant comfort to determine setback for combustion heating appliances
- Using emergency heat appropriately

Objective(s):

Ensure equipment and controls operate as designed

Provide comfort throughout house

5.3003.10 Condensate Drainage of Heating and Air Conditioning Equipment

5.3003.10a – Connection

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Connections in condensate drain system will be watertight

Objective(s):

Ensure condensate drain connections do not leak

Before
HVAC equipment needs condensate drainage to prevent water damage

In Progress
Drainage pipes should be sealed to be water – tight

Tools:

1. Hacksaw
2. Crimper

Materials:

1. Pex piping and angles
2. PVC piping and angles
3. Purple primer

5.3003.10b – Insulation

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Condensate drain lines will be insulated with a minimum 1" of insulation with a vapor retarder when there is potential for condensation or freezing on the drain line

Objective(s):

Ensure condensate drain connections do not leak

Before

After

Once drainage pipes cross into unconditioned space, they can freeze

Pipes in unconditioned spaces should be insulated with 1" pipe insulation

Tools:

1. Tape measure
2. Utility knife

Materials:

1. 1" thick pipe insulation
2. Zip ties

5.3003.10c – Overflow protection: up flow

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Secondary drain pan and float switch will be installed when overflow could damage finished surfaces

OR

Float switch in the primary condensate drain for up flow systems will be installed when overflow could damage finished surfaces

Objective(s):

Ensure condensate drain connections do not leak

A float switch should be installed to prevent overflow and damage

5.3003.10d – Pumps

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Condensate drain pumps will be installed when condensate cannot be drained by gravity

Power source for pump will be installed Operation and drainage of pump will be verified

Objective(s):

Ensure condensate drain connections do not leak

Before
HVAC equipment that drains upward through a roof cannot drain naturally

After
For non-gravity draining systems, a pump is necessary

HVAC unit is mounted to "historic" adobe wall which cannot be penetrated

Instead, unit is drained by utilizing a pipe and pump in the next room

The pump is connected directly into the sewage system

5.3003.10e – Vents and traps

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Vents and traps will be installed on condensate drain lines

Trap supplied with the equipment will be used and manufacturer specifications will be followed

Objective(s):

Ensure condensate drain operates as designed

Ensure condensate drain does not leak air

5.3003.10f – Drain pan

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Condensate from all cooling coils or evaporators shall be conveyed from the drain pan outlet to an approved place of disposal

Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than 1/8 unit vertical in 12 units horizontal (1% slope)

Condensate shall not discharge into a street, alley, or other areas where it would cause a nuisance

Objective(s):

Prevent water damage from drain system malfunction

- Drip pans in poor condition may be replaced.

5.3003.10g – Float switch

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

All secondary drain pans will have a float switch and be drained away through a drain line

Objective(s):

Prevent water overflowing the pan and draining onto the ceiling below

Float switches should be installed in drainage pans to prevent overflow

5.3003.10h – Termination

Desired Outcome:

Equipment and condensate drain operate as designed

Specification(s):

Condensate drain will be terminated in accordance with local codes

Objective(s):

Ensure condensate does not leak to the house

Ensure condensate drain does not freeze

5.3003.14 Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas)

5.3003.14a – Place appliance in operation

Desired Outcome:

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

Specification(s):

Heating equipment will be placed in operation in accordance with applicable NFPA standards and manufacturer specifications when available

Objective(s):

Ensure equipment:

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

5.3003.14b – Gas pressure

Desired Outcome:

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

Specification(s):

Measurement will be verified by a certified professional in accordance with fuel type and manufacturer specifications

Objective(s):

Ensure equipment:

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

5.3003.14c – Carbon dioxide (CO2) and oxygen (O2)

Desired Outcome:

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

Specification(s):

Measurement will be verified in accordance with industry manuals (e.g., Testo, Bacharach)

Objective(s):

Ensure equipment:

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

5.3003.14d – Excess combustion air

Desired Outcome:

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

Specification(s):

Excess combustion air will be calculated and verified in accordance with industry manuals (e.g., Testo, Bacharach)

Objective(s):

Ensure equipment:

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

5.3003.14e – 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 100 ppm

Objective(s):

Ensure equipment:

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

5.3003.14f – 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

5.31 Hydronic Heating (Hot Water and Steam)

5.3101 Design

5.3101.1 Heat Load Calculation—Whole House

5.3101.1a – Heating load calculation

Desired Outcome:

A properly sized heating appliance selected

Specification(s):

Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications

Objective(s):

Enable proper sizing of the heating appliance

- Replacement heating plants shall be competitively bid and properly sized using the post – weatherization characteristics of the home

5.3101.1b – Equipment selection

Desired Outcome:

A properly sized heating appliance selected

Specification(s):

Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications

Objective(s):

Ensure equipment is able to heat the house

- Boilers shall have a minimum AFUE of 85 percent.
- Efficiency ratings for boilers must be listed in the most current edition of the Gas Appliance Manufacturers Association (GAMA) Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment.

Heat exchangers in all replacement heating plants shall have a minimum 10 year manufacturer's warranty.

5.3101.2 Space Load Calculation—Heat Emitter Sizing

5.3101.2a – Space load calculation

Desired Outcome:

Heat emitter selected provides adequate heat output

Specification(s):

Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications

Objective(s):

Enable proper sizing of the heating appliance

5.3104 Equipment Maintenance, Testing, and Repair

5.3104.1 Controls—Thermostat Replacement

5.3104.1a – Visual inspection

Desired Outcome:

Thermostat replaced when appropriate

Specification(s):

Thermostats will be visually located

Verify anticipator setting, if appropriate for thermostat model

Replacement will be recommended if a digital, double setback thermostat is not present

Objective(s):

Determine if existing thermostats need to be replaced

5.3104.1b – Mercury assessment

Desired Outcome:

Thermostat replaced when appropriate

Specification(s):

Thermostats containing mercury will be identified and disposed of in accordance with EPA guidance

Objective(s):

Protect workers and occupants from mercury exposure

5.3104.1c – Removal (if removal is recommended)

Desired Outcome:

Thermostat replaced when appropriate

Specification(s):

Heating system will be de-energized before removal

Thermostat will be removed

Compatibility will be verified (e.g., voltage, wiring condition, location) and documented

Location of existing thermostat will be assessed for appropriateness (e.g., central to the house, out of direct sunlight, away from supply air, protected from abnormal radiant surface temperatures)

Objective(s):

Proper removal of thermostat

5.3104.1d – Installation

Desired Outcome:

Thermostat replaced when appropriate

Specification(s):

Location for new thermostat will be determined

Compatibility with new thermostat will be verified (e.g., voltage, wiring, condition, location)

Replacement will be recommended if a digital, double setback thermostat is not present

Heating system will be re-energized and cycled

Thermostat will be programmed to occupant lifestyle choices

Objective(s):

Achieve comfort and energy savings for the occupant

- The thermostat shall be calibrated and adjusted and any operable accessories that were installed on the existing heating system shall be removed and reinstalled on the new heating system, if possible. If a new thermostat is installed, the wire hole in the wall behind the thermostat shall be sealed.

5.3104.1e – Disposal

Desired Outcome:

Thermostat replaced when appropriate

Specification(s):

Thermostats will be disposed of in accordance with EPA guidelines and local regulations

Objective(s):

Prevent mercury from entering the environment

5.3104.1f – Occupant education

Desired Outcome:

Thermostat replaced when appropriate

Specification(s):

Occupant will be involved in the initial programming of thermostat and educated on common settings and programming

On new installs, occupants will be encouraged to save the manual and keep it accessible

Objective(s):

Educate occupant on best use

5.3104.2 Maintenance: Gas Boiler Service Inspection

5.3104.2a – Visual inspection

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

The following conditions will be assessed by a licensed contractor:

- Water, steam, and fuel leaks
- Damaged or missing pipe insulation
- Venting issues—draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)
- Corrosion (e.g., rust, mineral deposits)
- General condition of components

Objective(s):

Observe general conditions to determine needed repairs or maintenance

5.3104.2b – Appliance gas valve

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

When replacement is necessary, gas valve will be removed and replaced according to manufacturer specifications

Objective(s):

Provide gas to burner when there is a call for heat

Control volume of gas for burner

Ensure the safe shut off of gas at the end of a call for heat

5.3104.2c – Ignition system

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

Components of ignition system will be repaired or replaced in accordance with manufacturer specifications

Objective(s):

Do not allow flow of main burner gas without proof of ignition

5.3104.2d – Main gas burners

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

Problems that may interfere with flame (e.g., dust, debris, misalignment) will be cleaned, vacuumed, and adjusted

Objective(s):

Produce combustion in a safe, clean, and efficient manner

5.3104.2e – Venting

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

Flue gases will be removed from the venting system in accordance with 2012 IRC G2427 or per manufacturer specifications

Objective(s):

Ensure the safety and durability of the venting system

5.3104.2f – Flue gas testing

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012

If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to meet manufacturer specifications or local codes

Objective(s):

Confirm that combustion occurs safely with maximum efficiency

5.3104.2g – Combustion efficiency checks

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with accepted protocol to determine if acceptable boiler efficiency is being maintained

If boilers are found to be out of compliance, a combustion analysis will be administered and minimum stack temperature will be in accordance with manufacturer specifications

Objective(s):

Increase the operational efficiency of the system

Improve occupant comfort

5.3104.2h – Occupant health

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

All homes will have a carbon monoxide (CO) alarm

Objective(s):

Ensure ambient CO does not exceed acceptable levels after completion of work

- The *Nebraska Weatherization Assistance Program* requires the installation of Carbon Monoxide Detectors, as per manufacturer's instructions, on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

5.3104.2i – Occupant education

Desired Outcome:

Boiler service improves safety, efficiency, and performance

Specification(s):

Occupants will be educated on the operation and maintenance of the carbon monoxide (CO) alarm

Completed work and recommended maintenance will be reviewed

Objective(s):

Ensure occupant is informed of the safe and efficient operation and maintenance of the work performed

5.3104.3 Maintenance: Checklist

5.3104.3a – Health and safety

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the (Standard Work Specifications for Single Family Housing) or other equivalent practice

Objective(s):

Identify potential health and safety issues

5.3104.3b – Visual inspection

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

The following conditions will be inspected:

- Water, steam, and fuel leaks
- Damaged or missing pipe insulation
- Venting issues—draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)
- Corrosion (e.g., rust, mineral deposits)
- General condition of components

Objective(s):

Observe general conditions to determine needed repairs or maintenance

5.3104.3c – Pipe insulation inspection

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Pipe insulation will be inspected, including:

- Integrity—complete coverage, no holes or tears
- Damage—holes or tears
- Complete coverage—insulation missing

If asbestos is suspected, occupants will be notified and asbestos will not be disturbed

Required repair or replacement will be performed in accordance with the following conditions:

- Materials will be approved for steam heating pipes
- Materials will be approved for hot water heating pipes
- Insulation will completely cover pipe

Pipe insulation will be installed in accordance with manufacturer specifications

Objective(s):

Minimize heat loss

Improve performance of the system

5.3104.3d – Check system pressure

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Check system pressure will be verified

Check system pressure will be 1 pound per square inch gauge (psig) per 28" of system height

Objective(s):

Keep system operating within pressure parameters

5.3104.3e – Purge system

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Devices that are under performing or have need of purging will be purged as needed

Objective(s):

Remove air from the system to maximize performance

5.3104.3f – Automatic fill

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Automatic fill valve will be inspected to ensure it maintains system pressure

If pressure is not maintained, replacement will be made in accordance with the following criteria:

- Valve will be replaced and include backflow prevention; existing backflow protection shall be tested to verify operation
- Components will be installed in accordance with manufacturer specifications
- Correct system pressure will be verified

Objective(s):

Maintain optimal system pressure to maximize performance

5.3104.3g – Gauge glass

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Gauge glass will be inspected for erosion, cracks, or drying

Damaged gauge glass on boiler will be replaced in accordance with manufacturer specifications

Gauge glass that is coated with dirt or sediment, making it difficult to observe the water level of the boiler, will be removed, cleaned, and replaced

Objective(s):

Ensure gauge glass is in safe operating condition to allow observation of water level in boiler

5.3104.3h – Low water cut-off: float type

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Operation of low-water cutoff on steam boilers will be observed by opening blow-off valve

If combustion is not extinguished, remediation will be accomplished by the following procedure:

- Electricity will be disconnected from boiler
- Problem will be diagnosed
- Low-water cutoff will be repaired, serviced, or replaced in accordance with manufacturer specifications
- A blow-down valve will be added, if not already present
- Boiler will be retested for proper operation

Operation of low-water cutoff on hot water boilers is applicable only if proper test setup is available on-site, to avoid draining the system

Occupants will be educated on the correct method to drain the low water cutoff weekly (must drain once per week to remove sediment from float chamber of low-water cutoff)

Objective(s):

Ensure safe minimum water level of the boiler

Maintain safe operation of the low water cut-off on ongoing basis

5.3104.3i – Low water cut-off: immersion

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

An immersion low-water cutoff will be installed and operable

Objective(s):

Ensure safe minimum water level of the boiler

5.3104.3j – Expansion tank: non-bladder and bladder

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

An expansion tank will be installed and operable

Tanks that leak or have excessive corrosion will be replaced, and non – bladder tanks will include an expansion tank drain

Tank will be installed in accordance with manufacturer specifications

Expansion tanks will be properly supported with strapping

Tanks that are full of water will be drained; after expansion tank is drained, re-establish the correct water level in relation to system pressure

Expansion tanks with bladders will have air charged to the manufacturer pressure specifications while water is not present in the tank

Bladder tanks that have water inside of the air bladder will be replaced in accordance with manufacturer specifications

Objective(s):

Absorb water expansion of the system

5.3104.3k – Flush or skim steam boiler

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Manufacturer specifications for flushing or skimming steam boiler will be followed

Objective(s):

Ensure boiler produces dry steam

5.3104.3l – System temperature or pressure gauge

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

The temperature or pressure gauge will be inspected for erosion, cracks, or dirt

Damaged temperature or pressure gauges will be replaced in accordance with manufacturer specifications

Objective(s):

Allow for accurate observation of system temperature and pressure

5.3104.3m – Circulators

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Non-working motors that cannot be serviced will be replaced with a new motor

New motors will be installed in accordance with manufacturer specifications

Oil-lubricated circulators will be installed in proper alignment with the pump coupler and will be supported so they do not sag

Bearings will have free movement without binding

Shaft seals will not leak

Bearings in inoperable, water-lubricated circulators will be freed, if possible, before replacement with a new circulation pump

Objective(s):

Ensure circulation of water at designated velocity in system without leaks in the circulators

5.3104.3n – Zone valves

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Zone valves will be inspected for the following conditions:

- Leaking water
- Not responding to a call for heat

New equipment will be replaced in accordance with manufacturer specifications

Objective(s):

Ensure proper zonal control of the system for comfort and efficiency

5.3104.3o – Condensate

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

If boiler is 90% efficient or more, condensate discharge will be an acceptable pH level, in accordance with local code, and will be drained to the exterior of the house, away from the foundation

Condensate pumps will be installed, if needed, to ensure proper drainage

Objective(s):

Bring the condensate to an acceptable pH and discharge to appropriate location

5.3104.3p – Temperature, pressure valves, and air vents

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Occupant will be informed that air vents have potential to cause moisture problems if not operating properly

Occupant will be reminded to call for maintenance if vents discharge steam or have moisture issues

Objective(s):

Maintain efficient operation of the system

5.3104.3q – Maintenance records

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Keeping records of all maintenance will be recommended to occupants

Copies or access to installation and operation manuals will be provided

Objective(s):

Provide a history of system installation and maintenance to improve future maintenance or repair

5.3104.3r – Occupant health and safety

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

All homes will have a carbon monoxide (CO) alarm

Objective(s):

Ensure occupant health and safety

- The *Nebraska Weatherization Assistance Program* only reimburses the costs associated with installing battery operated carbon monoxide detectors in homes where combustible appliances are present and/or the home has an attached garage.

5.3104.3s – Occupant education

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Completed work will be reviewed

Occupants will be educated on the safe and efficient operation and maintenance of the system

Objective(s):

Ensure occupant is informed of the safe, efficient operation and maintenance of the system

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6 Ventilation

6.60 Exhaust

6.6002 Components

6.6002.1 Ducts

6.6002.1a – Duct design and configuration

Desired Outcome:

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

Specification(s):

Ventilation ducts will be as short, straight, and smooth as possible

Ventilation ducts will not be smaller than the connections to which they are attached

Objective(s):

Effectively move the required volume of air

Before
Duct work for exhaust fans should be short, smooth, and not pinch down

After
Duct is the same size as the outlet and makes shortest run possible

Tools:
1. Metal snips
2. Drill

Materials:
1. Metal duct piping
2. Fasteners

- Kitchen and bathroom exhaust fans shall be vented to the exterior whenever possible.
- Horizontal runs and elbows should be avoided.
- If the exhaust vented is terminated through the soffit, caution must be taken to avoid moisture collecting in the vent pipe.
- Metal flexible duct for exhaust fan ventilation is limited to 6 foot or less.
- Flexible plastic ducting is not allowed.

- See also ASHRAE 62.2-2013.

6.6002.1b – Termination fitting

Desired Outcome:

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

Specification(s):

Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes

Objective(s):

Prevent condensation from forming or collecting inside of the ductwork

Before
Uninsulated ducts in unconditioned spaces are an energy drain

After
R-8 insulation with a vapor barrier should be securely wrapped around ducts

Tools:

1. Utility knife
2. Metal snips

Materials:

1. R-8 insulation with vapor barrier
2. Nylon twine
3. Wire
4. UL-181 duct tape

- See also ASHRAE 62.2-2013.
- Check local codes to see if R-8 is accepted level of insulation.

6.6002.1c – Duct support

Desired Outcome:

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

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" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart

Objective(s):

Effectively move the required volume of air

Preserve the integrity of the duct system

Eliminate falling and sagging

Before
Ducts should not be allowed to droop or sag to maximize efficiency

After
Supports should be evenly spaced to allow for minimal distance of run

Tools:

1. Drill
2. Metal snips
3. Utility knife

Materials:

1. Durable straps at least 1 1/2" wide
2. 18 gauge metal strap at least 1/2" wide
3. 12 gauge galvanized wire
4. Staples
5. Fasteners

- Metal flexible duct for exhaust fan ventilation is limited to 6 foot or less. Flexible plastic ducting is not allowed
- See also ASHRAE 62.2-2013.

BAD:
Make sure supports DO NOT compress insulation or duct

Flex ducts should have support straps at least every 4 feet

Support straps should be at least 1 1/2 inches wide

Metal ducts should be supported at 10 feet or less with wire or metal strap

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

Metal wire should be at least 12 gauge and galvanized

6.6002.1d – Duct Connections

Desired Outcome:

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

Specification(s):

Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws

Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic – plus-embedded-fabric systems, or tapes

Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool

PVC-to-PVC materials will be fastened with approved PVC cement

Other specialized duct fittings will be fastened in accordance with manufacturer specifications

In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Objective(s):

Effectively move the required volume of air

Preserve the integrity of the duct system

- Exhaust vent piping shall be fastened at all connections with sheet metal screws or rivets.

6.6002.1e – Duct Materials

6.6002.2 Terminations

6.6002.2a – Hole in building shell

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

A hole no greater than a 1/4" greater than the fitting will be cut to accommodate termination fitting

Objective(s):

Allow for ease of weatherproofing

Before
Exhaust fans need exterior ventilation, often through roofs and walls

After
Hole should be no more than 1/4" larger than termination fitting diameter

Tools:

1. Hole saw
2. Drill
3. Tape measure

- When exhaust vents penetrate the roof, the shingles shall overlap the top half of the roof vent flange. The bottom half of the vent's flange shall be exposed on top of the shingles.

6.6002.2a – Hole in building shell

1
Locate the center of your vent hole by drilling from inside through roof

2
Measure the termination fitting to determine proper hole saw diameter

3
Based on termination fitting size (in this case, 4"), mark to cut hole

4
Hole should be no more than 1/4" larger than termination fitting diameter

5
Verify hole size is correct before installation

6.6002.2b – Termination fitting

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

A termination fitting with an integrated collar will be used

Collar will be at least the same diameter as the exhaust fan outlet; if collar is larger than exhaust fan outlet, a rigid metal transition will be used

Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable

Objective(s):

Effectively move the required volume of air to the outside

Preserve integrity of the building envelope

Ensure durable installation

Before
Termination fittings with no collar are to be avoided

After
Properly sized ducts with snug connections to collared fittings last longer

Tools:
1. Drill

Materials:
1. Fasteners

BAD:
Termination fittings without collars should be avoided

Termination fittings with collars should be used for exhaust ventilation

Collared fittings extend through the roof to fasten securely with duct

6.6002.2c – Duct to Termination Connection

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Duct will be connected and sealed to termination fitting as follows:

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool
- PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M
- listed material

Fasteners will not inhibit damper operation

Objective(s):

Effectively move the required volume of air to the outside

Preserve integrity of the building envelope

Ensure durable installation

6.6002.2d – Weatherproof installation

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Exterior termination fitting will be flashed or weather sealed

Water will be directed away from penetration Installation will not inhibit damper operation Manufacturer specifications will be followed

Objective(s):

Preserve integrity of the building envelope

Ensure a weather tight and durable termination installation

Ensure unrestricted air flow

Before
Holes for termination fitting need to be sealed to weatherproof

After
Termination installation should follow shingling to deter water penetration

Tools:

1. Hole saw
2. Caulk gun
3. Drill

Materials:

1. Fasteners
2. Caulk

- When exhaust vents penetrate the roof, the shingles shall overlap the top half of the roof vent flange. The bottom half of the vent's flange shall be exposed on top of the shingles.

1
Termination fitting is installed to repel water and sealed

6.6002.2e – Pest exclusion

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Screen material with no less than ¼" and no greater than ½" hole size in any direction will be used

Installation will not inhibit damper operation or restrict air flow

Objective(s):

Prevent pest entry

Ensure proper air flow

Before
Exhaust terminations without screens are an invitation to pest intrusion

After
Screen mesh should be between 1/4" and 1/ 2" in either direction

6.6002.2f – Termination location

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Terminations will be ducted to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors.

Terminations will be installed:

- A minimum of 3' away from any property line
- A minimum of 3' away from operable opening to houses
- A minimum of 10' away from mechanical intake
- As required by authority having jurisdiction

Objective(s):

Prevent exhaust from reentering house

Before
Exhaust vent has been improperly mounted too close to mechanical vent

After
Exhaust vent was properly mounted over 3ft from door, window, and deed line

Tools:

1. Measuring tape
2. Hole saw
3. Drill

6.6002.2g – Kitchen exhaust

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Galvanized steel, stainless steel, or copper will be used for termination fitting for kitchen exhaust

Objective(s):

Prevent a fire hazard

Before
Kitchen exhaust vents should not be made from highly combustible materials

After
This roof-mounted kitchen exhaust fan is galvanized steel--heat resistant

- Galvanized steel, stainless steel, or copper shall be used for termination fitting for kitchen range exhaust.

6.6002.3 Exhaust-Only Ventilation—Fan Intake Grille Location

6.6002.3a – Primary whole house ventilation

Desired Outcome:

Exhaust grille location optimizes either primary or local ventilation

Specification(s):

Fan intake grille will be installed in a central location within the main body of the house

Ensure it is accessible for filter change and cleaning

Objective(s):

Provide whole house air exchange

6.6002.3b – Local ventilation

Desired Outcome:

Exhaust grille location optimizes either primary or local ventilation

Specification(s):

Fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are gene

Objective(s):

Remove contaminated air at the source

6.6003 Fans

6.6003.1 Surface-Mounted Ducted

6.6003.1a – Hole through interior surface

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

A hole no greater than a 1/4" greater than the assembly will be cut to accommodate fan assembly

Objective(s):

Minimize repair work

Ensure a secure installation

6.6003.1b – Wiring

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6003.1c – Fan mounting

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Fan outlet will be oriented toward the final termination location

Fan will be oriented so the equivalent length of the duct run is as short as possible

Fan will be mounted securely in accordance with manufacturer specifications

Objective(s):

Ensure short duct run to achieve optimum air flow

Ensure a secure installation

Ensure fan housing does not shake, rattle, or hum when operating

6.6003.1d – Backdraft damper

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):

Prevent reverse air flow when the fan is off

6.6003.1e – Duct to fan connection

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Duct-to-fan outlet will be connected and sealed as follows:

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool
- PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened according to manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Objective(s):

Exhaust to outside

6.6003.1f – Fan housing seal

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Gaps and holes in fan housing will be sealed with caulk or other sealants in accordance with manufacturer recommendations

Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications

Objective(s):

Prevent air leakage through fan housing

Ensure a permanent seal

Prevent a fire hazard

6.6003.1g – Fan to interior surface seal

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

Objective(s):

Prevent air leakage between house and fan

6.6003.1h – Air flow

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Air flows in cubic feet per minute (CFM) will be measured and adjusted to meet the whole house upgrade design requirements

Objective(s):

Exhaust sufficient air from desired locations to outside

6.6003.1i – Preventing air leakage caused by exhaust fans

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

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

Objective(s):

Ensure occupant health and safety

6.6003.1j – Combustion safety

Desired Outcome:

Surface-mounted ducted fans installed to specification

Specification(s):

Pressure effects will be assessed and corrected on all combustion appliances

Objective(s):

Ensure safe operation of combustion appliances

6.6003.2 Inline

6.6003.2a – Wiring

Desired Outcome:

Inline fans installed to specification

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6003.2b – Access

Desired Outcome:

Inline fans installed to specification

Specification(s):

Fan and service switch will be accessible for maintenance according to NFPA 70 National Electric

Code or local authority having jurisdiction

Objective(s):

Fan and service switch will be accessible for maintenance

6.6003.2c – Fan mounting

Desired Outcome:

Inline fans installed to specification

Specification(s):

Fan outlet will be oriented toward the final termination location

Fan will be oriented so the equivalent length of the duct run is as short as possible

Fan will be mounted securely in accordance with manufacturer specifications

Fan will be isolated from the building framing unless specifically designed to be directly attached

Fan will be installed remotely by installing ducting from intake grille

Objective(s):

Ensure short duct run to achieve optimum air flow

Ensure fan is installed securely

Ensure fan housing or building framing does not shake, rattle, or hum when operating

Minimize noise

6.6003.2d – Backdraft damper

Desired Outcome:

Inline fans installed to specification

Specification(s):

A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):

Prevent reverse air flow when the fan is off

6.6003.2e – Duct connections

Desired Outcome:

Inline fans installed to specification

Specification(s):

Ducts will be connected and sealed to the intake fan and termination fitting as follows:

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool
- PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Objective(s):

Exhaust from desired location to outside

Preserve integrity of the duct system and building envelope

6.6003.2f – Boot to interior surface seal

Desired Outcome:

Inline fans installed to specification

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

Objective(s):

Prevent air leakage around intake housing

Prevent a fire hazard

6.6003.2g – Air flow

Desired Outcome:

Inline fans installed to specification

Specification(s):

Air flows in CFM will be measured and adjusted to meet the design requirements

Objective(s):

Exhaust sufficient air from desired locations to outside

6.6003.2h – Preventing air leakage caused by exhaust fans

Desired Outcome:

Inline fans installed to specification

Specification(s):

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

Objective(s):

Ensure occupant health and safety

6.6003.2i – Combustion safety

Desired Outcome:

Inline fans installed to specification

Specification(s):

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

Exhaust fans and other exhausting systems shall be provided with makeup air or other pressure relief

Objective(s):

Ensure safe operation of combustion appliances

6.6003.3 Through the Wall

6.6003.3a – Hole in Building Shell for Fan Through the Wall

Desired Outcome:

Through the wall fans installed to specification

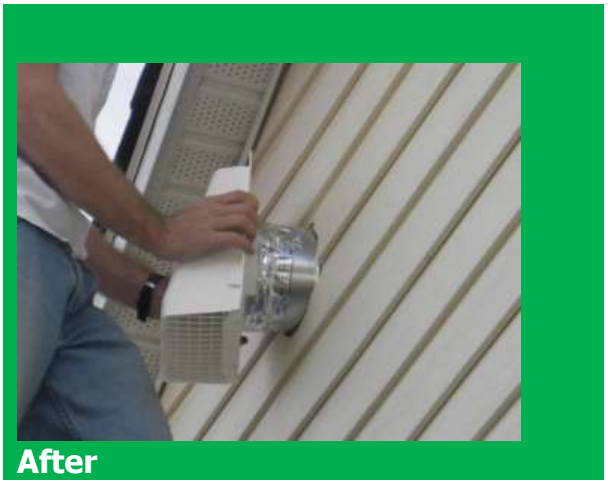
Specification(s):

A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly

Objective(s):

Allow for ease of weatherproofing

Determine size to cut hole by measuring fan assembly and ducting



A snug fit should be ensured to minimize weatherproofing required

Tools:

1. Tape measure
2. Saw

1
Measure the termination fitting to determine proper hole diameter (in this case, 4")

2
Hole should be no more than 1/4" larger than assembly diameter

3
Clear wall surface and mark hole size 1/4" larger than termination fitting

4
Since opening is larger than most hole saws, precision cutting is important

6.6003.3b – Wiring

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6003.3c – Fan Mounting

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

Fan outlet will be oriented toward the final termination location

Fan will be oriented so the equivalent length of the duct run is as short as possible Fan will be mounted securely according to manufacturer specifications Objective(s):

Install mounting fan securely

Ensure fan housing does not shake, rattle, or hum when operating

6.6003.3d – Weatherproof Installation of Fans through the Wall

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

Exterior termination fitting will be flashed or weather sealed

Water will be directed away from penetration

Termination fitting installation will not inhibit damper operation

Manufacturer specifications will be followed

Objective(s):

Preserve integrity of the building envelope Ensure a weather tight and durable installation Ensure unrestricted air flow

6.6003.3e – Backdraft damper

Desired Outcome:

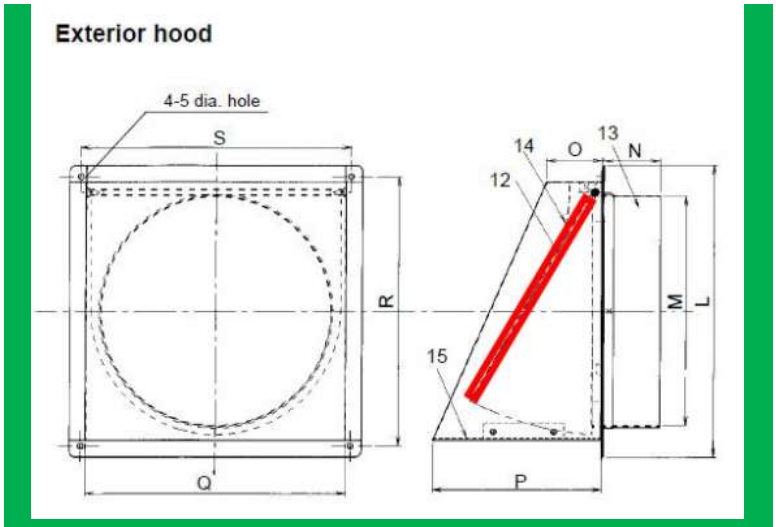
Through the wall fans installed to specification

Specification(s):

A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):

Prevent reverse air flow when the fan is off



Best Practice

Damper should be installed to maintain exterior air barrier

6.6003.3f – Fan Housing Seal

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

Objective(s):

Prevent air leakage through fan housing

Ensure a permanent seal to the building air barrier

6.6003.3g – Fan to Interior Surface Seal

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

Objective(s):

Prevent air leakage around intake housing

Prevent a fire hazard

6.6003.3h – Insulation

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

All components outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local code

Exception: If system operates continuously, fan housing need not be insulated

Objective(s):

Preserve integrity of the duct system

6.6003.3i – Air Flow

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

Air flows in CFM will be measured and adjusted to meet the design requirements

Objective(s):

Exhaust sufficient air from desired locations to outside

6.6003.3j – Preventing air leakage caused by exhaust fans

Desired Outcome:

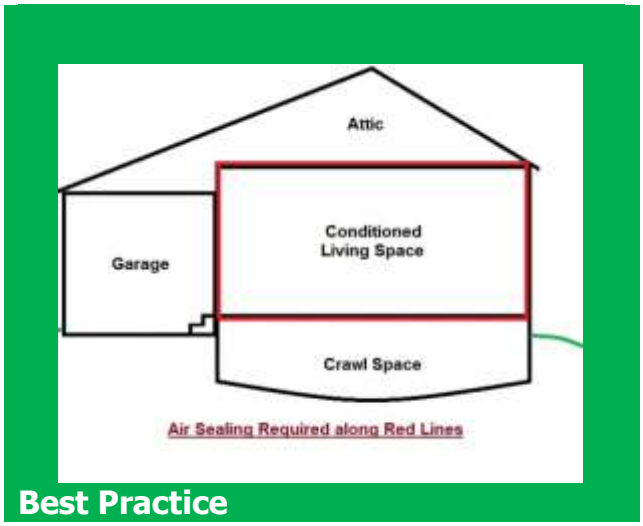
Through the wall fans installed to specification

Specification(s):

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

Objective(s):

Ensure occupant health and safety



Best Practice

The barrier between conditioned and unconditioned spaces should be sealed

See also SWS 3.1501.1 Air Sealing Garage Penetrations.

6.6003.3k – Combustion safety

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

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

Make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

Objective(s):

Ensure safe operation of combustion appliances

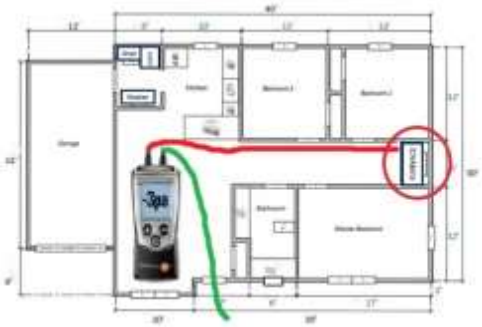
Installing new ventilation can cause imbalances within the house

Test that depressurization limit is not being exceeded by new ventilation

Tools:

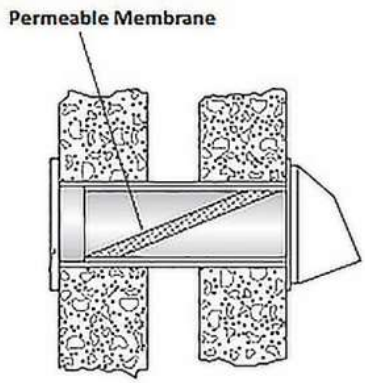
1. Manometer

See SWS 2.0299.1a-i for *CAZ* depressurization limits



1

2



3

Run depressurization testing on house to ensure new ventilation isn't causing Unsafe conditions	If depressurization limit is exceeded, mitigate to eliminate safety risk	Mitigate safety risk with make-up air or other pressure relief

4
After mitigation, verify that depressurization limits are not being exceeded

6.6005 Appliance Exhaust Vents

6.6005.1 Clothes Dryer

6.6005.1a – Clothes Dryer Ducting

Desired Outcome:

Dryer air exhausted efficiently and safely

Specification(s):

Clothes dryers will be ducted to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors

As short a run as practical of rigid sheet metal or semi-rigid sheet metal venting material will be used in accordance with manufacturer specifications

Dryer ducts exceeding 35' in duct equivalent length will have a dryer booster fan installed

Plastic venting material will not be used

Uninsulated clothes dryer duct will not pass through unconditioned spaces such as attics and crawl spaces

Ducts will be connected and sealed as follows:

- UL listed foil type or semi-rigid sheet metal to rigid metal will be fastened with clamp
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

In addition:

- Sheet metal screws or other fasteners that will obstruct the exhaust flow will not be used

- Condensing dryers will be plumbed to a drain

Objective(s):

Preserve integrity of building envelope

Effectively move air from clothes dryer to outside

- Existing unvented clothes dryers shall be vented to the exterior of the home.
- Dryer vent pipe shall not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint. Acceptable fasteners include clamps, straps and duct mastic with mesh tape.
- Dryer vent pipe shall be metal.
- Dryer vent ductwork shall be smooth surfaced and whenever possible and shall not exceed 14 feet in length.
- No more than two 90 degree elbows may be used in the vent system.
- Relocation of dryers may need to be considered to meet this vent pipe length limitation.
- Flexible metal vent pipe not exceeding 8 feet in length may be used to vent a dryer. It shall not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.

6.6005.1b – Termination fitting

Desired Outcome:

Dryer air exhausted efficiently and safely

Specification(s):

Termination fitting manufactured for use with dryers will be installed

A backdraft damper will be included, as described in termination fitting detail

Objective(s):

Preserve integrity of building envelope

Effectively move air from clothes dryer to outside

Termination fittings for dryers should have backdraft dampers

- Existing unvented clothes dryers shall be vented to the exterior of the home.
- Dryer vent pipe shall be metal and the termination cap shall be dampered and attached with rust proof fasteners.

Most modern dryer vents have a built-in backdraft damper

To minimize pest intrusion, mesh >1/4" square can be used (see 6.6002.2e)

6.6005.1c – Make-up air

Desired Outcome:

Dryer air exhausted efficiently and safely

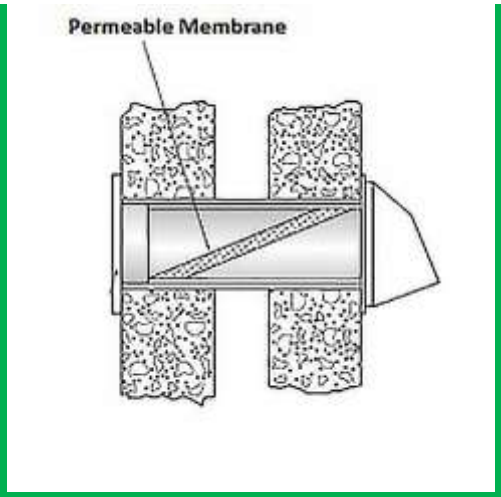
Specification(s):

Make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction

Objective(s):

Preserve integrity of building envelope

Effectively move air from clothes dryer to outside



Best Practice

A passive inlet vent can provide make-up air for dryer exhaust

Tools:

1. Drill
2. Hole saw
3. Caulk gun

Materials:

1. Caulk sealant
2. Fasteners

6.6005.1d – Combustion safety

Desired Outcome:

Dryer air exhausted efficiently and safely

Specification(s):

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

Objective(s):

Ensure safe operation of combustion appliances

Ensure occupant health and safety

After

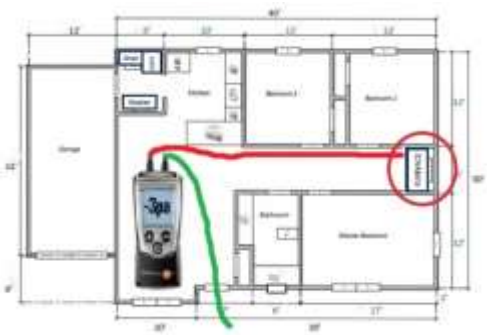
Appliance exhaust, such as that for a dryer, can cause depressurization

Test to verify combustion appliances are within depressurization limits

Tools:

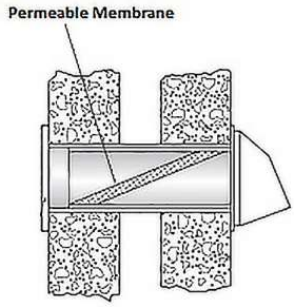
1. Manometer

See SWS 2.0299.1a-i for *CAZ* depressurization limits.



1
Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions

2
If depressurization limit is exceeded, mitigate to eliminate safety risk



3
Install make-up air, such as a passive inlet vent, or other pressure relief

4
After mitigation, verify that depressurization limit is not being exceeded

6.6005.1e – Occupant education

Desired Outcome:

Dryer air exhausted efficiently and safely

Specification(s):

Occupant will be instructed to keep lint filter and termination fitting clean

Occupant will be instructed to keep dryer booster fan clean, if present

Occupant will be instructed on clothes dryer operation safety including information on items that

must not be placed in the clothes dryer (items with any oil or other flammable liquid on it, foam, rubber, plastic or other heat-sensitive fabric, glass fiber materials)

Objective(s):

Effectively move air from clothes dryer to outside

Unsafe

Neglect of clothes dryer maintenance can cause fire hazards

Best Practice

Occupants should be taught to clean lint filters and termination fittings

In homes with booster fans, occupant should know location and how to clean

Occupants should be taught never to put flammable articles in dryer (in this case, oily rags)

6.6005.2 Kitchen Range

6.6005.2a – Wiring

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

Wiring will be installed in accordance with local regulations or the 2012 IRC in the absence of such regulations or where those regulations are not as stringent as the 2012 IRC

Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6005.2b – Fan venting

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

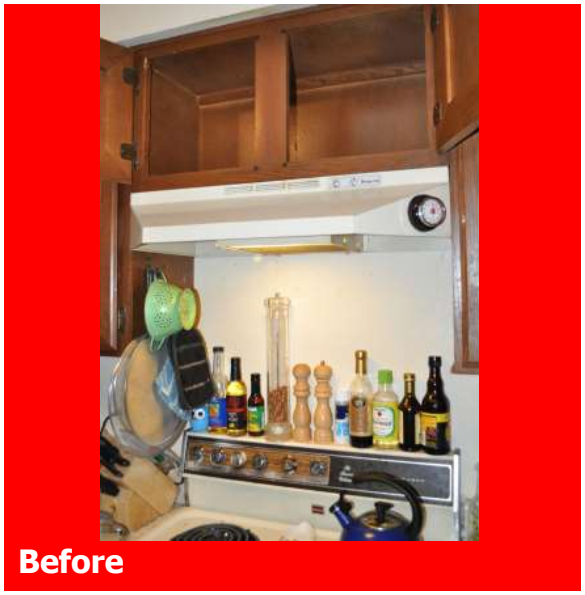
Kitchen range fans will be vented to the outdoors

Recirculating fans will not be used as a ventilating device

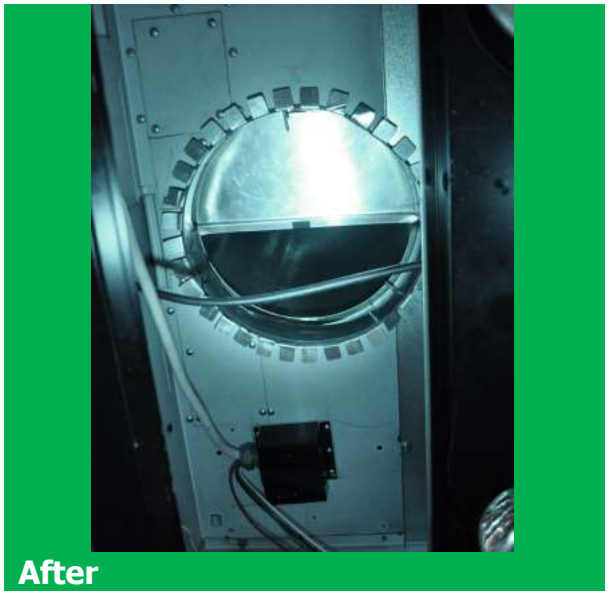
Objective(s):

Remove cooking contaminants from the house

Preserve integrity of building envelope



Recirculating fans over ranges do not actually remove contaminants



Daylight visible through dampered kitchen exhaust proves venting access

6.6005.2c – Fan ducting

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

Kitchen range fans will be ducted to the outdoors

As short a run as practical of smooth wall metal duct will be used, following manufacturer specifications

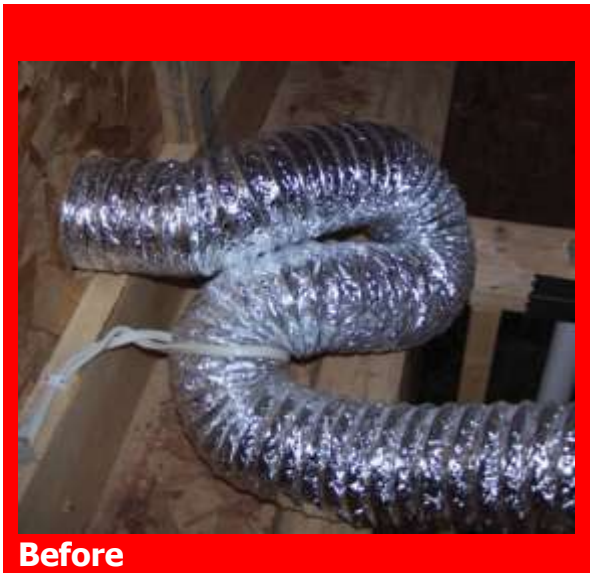
Ducting will be connected and sealed as follows:

- Metal-to-metal will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
- For down-draft exhaust systems, PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M
- listed material

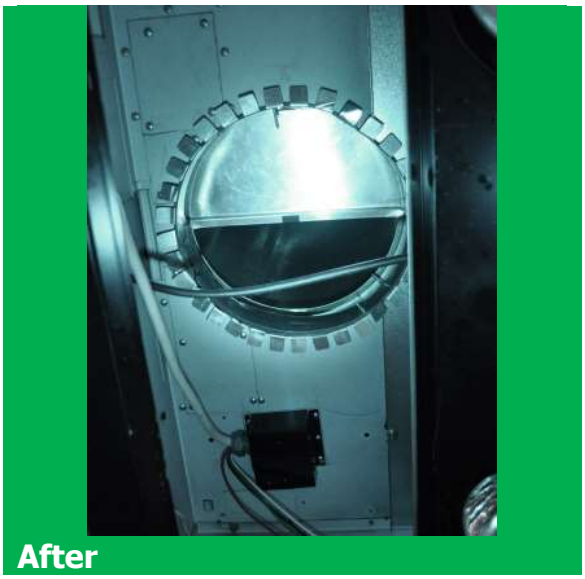
Objective(s):

Preserve integrity of building envelope

Effectively move air from range to outside



Exhaust duct should be smooth-walled and in as short a run as possible



Daylight visible through dampered kitchen exhaust proves outside access

Tools:

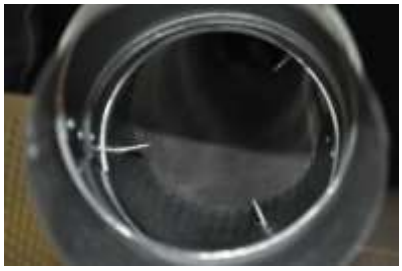
1. Drill
2. Putty knife
3. Tape measure
4. Metal snips
5. Saw

Materials:

1. Round metal ducting
2. Mastic
3. Fiberglass mesh tape
4. Fasteners

- See also 6.6002.1d.
- Note: Only smooth-wall metal duct will be used, except for down-draft exhaust systems where
- PVC is acceptable as well. Flex duct is NOT acceptable for kitchen fan exhaust application.
- Existing kitchen exhaust fans shall be vented to the exterior whenever possible.
- Horizontal runs and elbows should be avoided.

1
Duct run should be as smooth and short as possible



2
Duct should be fastened securely with three evenly-spaced screws

3
Then joints should be secured with fiberglass tape

4
Finally, joint should be secured with UL-181 mastic

6.6005.2d – Termination fitting

Desired Outcome:

Kitchen range fan installed to specification

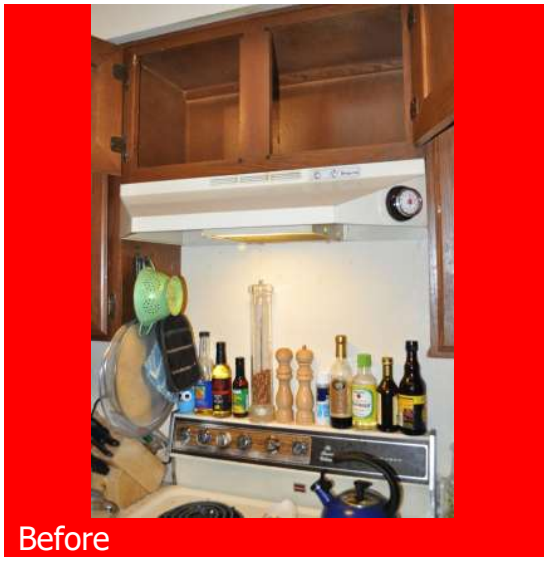
Specification(s):

Termination fitting will be installed including a backdraft damper, as described in termination fitting detail

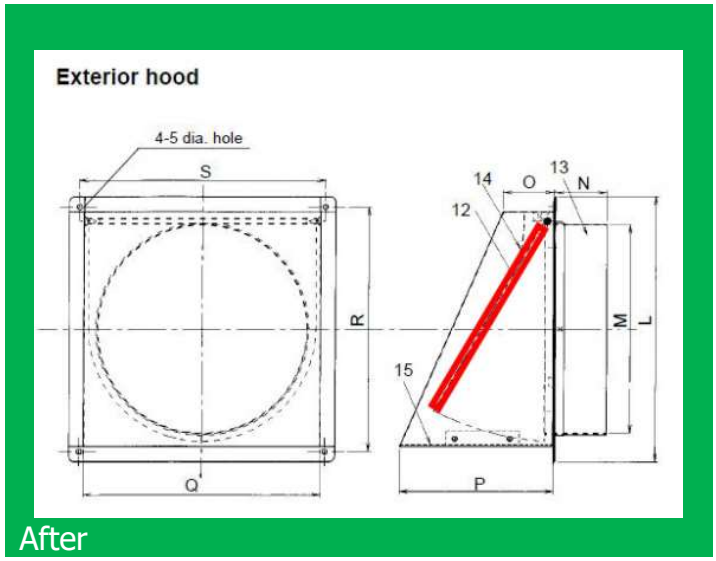
Objective(s):

Ensure safe operation of combustion appliances

Ensure occupant health and safety



Kitchen fans should exhaust to the exterior, not just recirculate air



Exhaust fans should have backdraft dampers

Backdraft damper on roof mounted exhaust fan

An interior backdraft damper can also be installed for good measure

6.6005.2e – Make-up air

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

Make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction

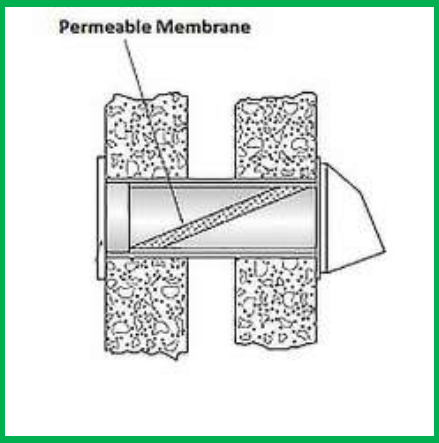
Objective(s):

Ensure safe operation of combustion appliances

Ensure occupant health and safety

Before

If kitchen exhaust is venting at more than 200 cfm, provide make-up air



After

A passive inlet vent can provide make-up air for kitchen exhaust

Tools:

1. Drill
2. Hole saw
3. Caulk gun

Materials:

1. Caulk sealant
2. Fasteners

6.6005.2f – Combustion safety

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

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

Objective(s):

Ensure safe operation of combustion appliances

Ensure occupant health and safety

After

Before

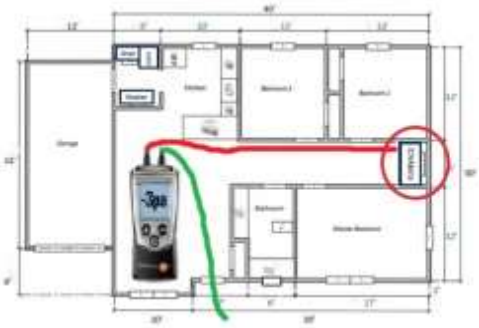
Kitchen exhaust fans can cause combustion appliances to depressurize

Test that combustion appliances are operating within depressurization limit

Tools:

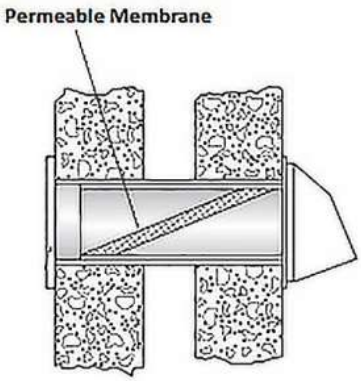
1. Manometer

See SWS 2.0299.1a-i for *CAZ* depressurization limits



1
Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions

2
If appliances exceed depressurization limit, mitigate to reduce risk



3
Install a source of make-up air, such as a passive inlet vent

4
After mitigation, verify that depressurization limits are not being exceeded

6.6005.2g – Occupant education

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

Occupant will be instructed to keep grease filters and termination fitting clean

Objective(s):

Effectively move air from kitchen range to outdoors

6.61 Supply

6.6102 Components

6.6102.1 Outside Air Ventilation Supply Ducts

6.6102.1a – Duct design and configuration

Desired Outcome:

Ventilation supply ducts effectively move the required amount of air and prevent condensation

Specification(s):

Ventilation ducts will be as short, straight, and smooth as possible

Ventilation ducts will not be smaller than the connections to which they are attached

Objective(s):

Effectively move the required volume of air

6.6102.1b – Duct insulation

Desired Outcome:

Ventilation supply ducts effectively move the required amount of air and prevent condensation

Specification(s):

Ventilation supply ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes

Objective(s):

Prevent moisture condensation

6.6102.1c – Duct support

Desired Outcome:

Ventilation supply ducts effectively move the required amount of air and prevent condensation

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" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart

Objective(s):

Effectively move the required volume of air

Preserve integrity of the ventilation supply duct system

Eliminate falling and sagging

6.6102.1d – Duct connections

Desired Outcome:

Ventilation supply ducts effectively move the required amount of air and prevent condensation

Specification(s):

All connections will have a contact overlap of at least 1" Ducts will be connected and sealed as follows:

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded – fabric systems, or tapes
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool
- Flexible duct between the cable tie and end of metal or PVC duct will be screwed
- PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications

Outdoor air ventilation supply ducts attached to the return side of forced air systems will be:

- Attached as close to the heating, ventilation, and air conditioning (HVAC) systems fan as possible while remaining in compliance with manufacturer specifications
- Set up to provide filtration of outdoor ventilation air before reaching the HVAC system (for minimum MERV 6 filter)
- Attached via a mechanically fastened takeoff collar

All joints and connections in ductwork will be fastened and sealed with UL181B or 181B-M welds, gaskets, adhesive mastics, or mastic-plus-embedded-fabric systems

Objective(s):

Effectively move the required volume of air

Preserve integrity of the ventilation supply duct system and building envelope

6.6102.1e – Duct materials

Desired Outcome:

Ventilation supply ducts effectively move the required amount of air and prevent condensation

Specification(s):

Flexible air duct material will meet UL 181, NFPA 90A/90B, International Mechanical Code, or the

Uniform Mechanical Code

Objective(s):

Effectively move the required volume of air

Preserve integrity of the duct system and building envelope

6.6102.1f – Outdoor air intake location

Desired Outcome:

Ventilation supply ducts effectively move the required amount of air and prevent condensation

Specification(s):

Outdoor air intake will be installed in accordance with the following:

- A minimum of 6" from grade
- A minimum of 10' from contaminant sources or exhaust outlets
- Above local snow or flood line
- A minimum of 18" above an asphalt based roof
- Never on a flat roof
- As required by authority having jurisdiction

Objective(s):

Prevent contaminants from entering house

Ensure unrestricted air flow

6.6102.2 Intakes

6.6102.2a – Hole in building shell

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

A hole no greater than a 1/4" greater than the fitting will be cut to accommodate intake fitting

Objective(s):

Ensure a weather tight installation

6.6102.2b – Intake fitting

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

Collar will be at least the same diameter as the duct; if collar is larger than duct, a rigid metal transition will be used

Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable

Objective(s):

Effectively draw the required volume of air from the outdoors

Preserve integrity of the building envelope

Ensure durable installation

6.6102.2c – Occupant education

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

Intake fitting will be labeled "ventilation air intake"

Occupant will be instructed to keep yard debris and other contaminants clear of the intake

Objective(s):

Ensure unrestricted air flow

6.6102.2d – Damper (if applicable)

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

The damper will be installed to open in the direction of the desired flow

Damper will close when system is off

Objective(s):

Ensure unrestricted air flow

6.6102.2e – Connection to intake fitting

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

Duct to intake fitting will be connected and sealed as follows:

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool
- Flexible duct between tie band and end of metal or PVC duct will be screwed into place
- PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications
- In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Ensure fasteners do not inhibit intake damper operation

Objective(s):

Preserve integrity of the building envelope

Ensure a weather tight and durable intake installation

Ensure unrestricted air flow

6.6102.2f – Weatherproofing

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

Exterior termination fitting will be flashed or weather sealed

Water will be directed away from penetration Installation will not inhibit damper operation

Manufacturer specifications will be followed

Objective(s):

Preserve integrity of the building envelope

Ensure a weather tight and durable intake installation

Ensure unrestricted air flow

6.6102.2g – Pest exclusion

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

Corrosion resistant screen, louver, or grille material no less than ¼" and no greater than ½" hole size in any direction will be used, or as specified by authority having jurisdiction

Screen will be installed so it does not inhibit intake damper operation

Objective(s):

Prevent pest entry

Ensure unrestricted air flow

6.6102.2h – Intake location

Desired Outcome:

Intake optimizes air flow while limiting the entry of insects, debris, and contaminants

Specification(s):

Intake will be installed according to the following:

- A minimum of 6" from grade
- A minimum of 10' from contaminant sources or exhaust outlets
- Above local snow or flood line
- A minimum of 18" above an asphalt based roof
- Never on a flat roof
- As required by authority having jurisdiction

Objective(s):

Prevent contaminants from entering house

Ensure unrestricted air flow

6.6102.3 Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

6.6102.3a – Forced air system requirements

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Existing forced air system leakage to outside will be less than 10% of the air handler flow when measured at 25 pascals with reference to outside

Any portion of the return located inside the combustion appliance

Zone will be air sealed

Objective(s):

Reduce migration of pollutants

6.6102.3b – Wiring

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6102.3c – Access

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Motorized damper and service switch will be accessible for maintenance in accordance with required code or authority having jurisdiction

Objective(s):

Ensure accessibility for maintenance

6.6102.3d – Mounting intake duct

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Ventilation duct will be attached as close to the HVAC system's fan as possible while remaining in compliance with HVAC manufacturer specifications

Filtration of ventilation air will be provided before passing through the thermal conditioning components

Duct will be connected to intake fitting

Connection and seal will be performed according to supply duct detail

Objective(s):

Ensure short duct run to achieve optimum air flow

Preserve integrity of the duct system and building envelope

6.6102.3e – Motorized damper

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

A motorized damper or equivalent technology will be installed between the intake fitting and the return side of the air handler

Air flow will be provided by sequenced operation of the damper or equivalent technology

Objective(s):

Prevent air flow when none is desired

6.6102.3f – Intake filter

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

An accessible filter will be installed

Filter will be able to remove contaminants consistent with at least minimum efficiency reporting value (MERV) 6 or better when tested in accordance with ANSI/ASHRAE 52.2-2007

Filter or air cleaning systems that intentionally produce ozone will not be allowed

Objective(s):

Ensure occupant health and safety

Preserve integrity of the building envelope

6.6102.3g – Occupant education

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Occupant will be educated on how and when to change filter

Objective(s):

Protect occupant health and safety

Preserve integrity of the building envelope

6.6103 Fans

6.6103.1 Inline or Multi-Port

6.6103.1a – Wiring

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6103.1b – Access

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

Fan and service switch will be accessible for maintenance, service, and replacement in accordance with applicable code or authority having jurisdiction

Objective(s):

Ensure accessibility for maintenance

6.6103.1c – Fan mounting

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

Fan will be oriented with inlet toward the fan intake fitting

Fan will be oriented so the equivalent length of the duct run is as short as possible

Fan will be securely mounted in accordance with manufacturer specifications

Fan will be isolated from the building framing unless specifically designed to be directly attached

Fan will be installed remotely by ducting from supply register or grilles

Objective(s):

Ensure short duct run to achieve optimum air flow

Ensure fan is mounted securely

Ensure fan housing or building framing does not shake, rattle, or hum when operating

Minimize noise

6.6103.1d – Damper (required for intermittent operation)

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

Damper will be installed to open in the direction of the desired flow

Damper will close when system is off

Objective(s):

Ensure unrestricted air flow

6.6103.1e – Duct connections

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

Ducts will be connected and sealed to the intake fitting, fan, and register or grilles as follows:

- Metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool
- Flexible duct between the cable tie and end of metal or PVC duct will be screwed
- PVC-to-PVC materials will be fastened with approved PVC cement
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications

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):

Provide desired air flow

Preserve integrity of the duct system and building envelope

6.6103.1f – Filter

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

An accessible filter will be installed between the intake fitting and the fan

Contaminant removal will be consistent with at least minimum efficiency reporting value (MERV) 6 or better when tested in accordance with ANSI/ASHRAE 52.2

Filter or air cleaning systems that intentionally produce ozone will not be allowed

Objective(s):

Ensure occupant health and safety

Preserve integrity of the building envelope

6.6103.1g – Occupant education

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

Occupant will be educated on how and when to change filter

Objective(s):

Ensure occupant health and safety

6.6103.1h – Boot to interior surface seal

Desired Outcome:

Inline or multi-port fan installed in accordance with specifications

Specification(s):

All gaps between boot and interior surface will be air sealed Gypsum edge will be wetted before applying water-based sealant Sealants will be continuous and be in accordance with 2012 IRC R302.9

Objective(s):

Prevent air leakage around intake housing

Ensure a permanent seal to the building air barrier

Prevent a fire hazard

6.6188 Special Considerations

6.6188.1 Removing Supply Vents from Garages

6.6188.1a – Removal of supply/return in garage

Desired Outcome:

Safe removal of supply garage vents

Specification(s):

Supply run feeding the register will be truncated as near to the supply plenum as possible If directly connected to the plenum, it will be truncated at the plenum If connected to a Y or T branch system, it will be truncated at the Y or T Return grille located in garage will be removed in the same manner as supply

Objective(s):

Minimize surface area of duct

6.6188.1b – Patching of the hole in the duct system created by removal

Desired Outcome:

Safe removal of supply garage vents

Specification(s):

All holes in sheet metal ducts will be patched with sheet metal and secured with sufficient screws to hold the patch flat without gaps

Holes left in any Y or T will be capped with sheet metal caps and fastened with at least three screws

Objective(s):

Ensure a secure and strong patch

6.6188.1c – Sealing of the patch

Desired Outcome:

Safe removal of supply garage vents

Specification(s):

All patches will be sealed with mastic meeting UL 181M and in accordance with manufacturer specifications

Objective(s):

Ensure an airtight patch

6.6188.1d – Removal of discarded ducts

Desired Outcome:

Safe removal of supply garage vents

Specification(s):

All abandoned ductwork will be removed from work area

Objective(s):

Provide a clean work site

6.6188.1e – Patching of the register hole in garage

Desired Outcome:

Safe removal of supply garage vents

Specification(s):

Hole created by the removal of the register and boot will be patched and taped using material meeting local codes

Objective(s):

Prevent a fire hazard

6.6188.1f – External static pressure testing

Desired Outcome:

Safe removal of supply garage vents

Specification(s):

Units will be tested for external static pressure (ESP) before and after work

If there is a significant rise in ESP, air flow testing will be required

Objective(s):

Ensure correct fan performance

6.62 Whole Building Ventilation

6.6201 Air Flow Requirements

6.6201.1 Installed System Air Flow

6.6201.1a – Separate exhaust for all baths and kitchens plus primary ventilation

Desired Outcome:

Installed system air flow meets required standard

Specification(s):

Air flows will be measured and adjusted to meet the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction. See [no-lexicon] Calculation of the Infiltration Credit [/no-lexicon] for calculation information and examples

Objective(s):

Provide sufficient flows in accordance with current ventilation standards

6.6201.1b – Separate exhaust for all baths and kitchens sufficient to meet primary ventilation requirements

Desired Outcome:

Installed system air flow meets required standard

Specification(s):

Air flows will be measured and adjusted to meet the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction. See [no-lexicon] Calculation of the Infiltration Credit [/no-lexicon] for calculation information and examples

Objective(s):

Provide sufficient flows per current ventilation standards

6.6201.1c – Single additional fan to meet all ventilation requirements

Desired Outcome:

Installed system air flow meets required standard

Specification(s):

Air flows will be measured and adjusted to meet the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction. See [no-lexicon] Calculation of the Infiltration Credit [/no-lexicon] for calculation information and examples

Objective(s):

Provide sufficient flows in accordance with current ventilation standards

6.6201.2 Primary Ventilation Air Flow between Rooms

6.6201.2a – Balancing pressure

Desired Outcome:

Air circulates freely between rooms

Specification(s):

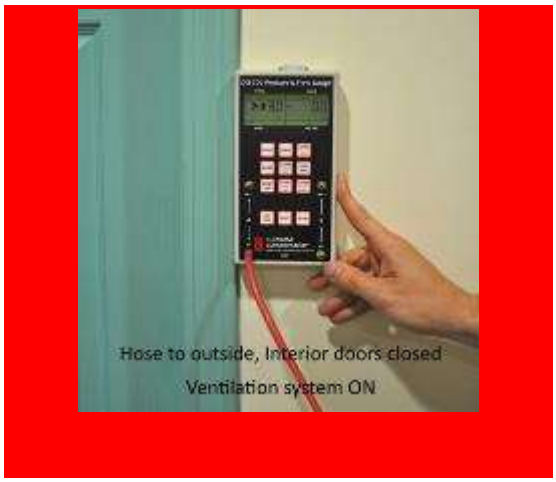
An appropriate means of pressure balancing will be installed (e.g., transfer grilles, jumper ducts, individual room returns)

No room will exceed +/ – 3 pascals with reference to the outdoors with all interior doors closed and ventilation systems running

Objective(s):

Ensure free flow of air between rooms

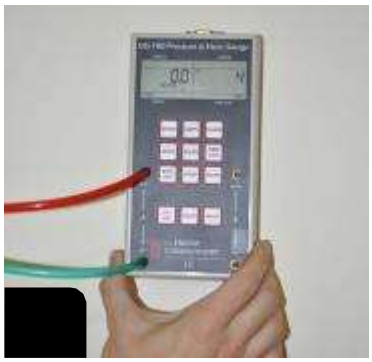
Preserve integrity of the building envelope



Before
If reading is >+/-3pa, interior ventilation needs to be installed

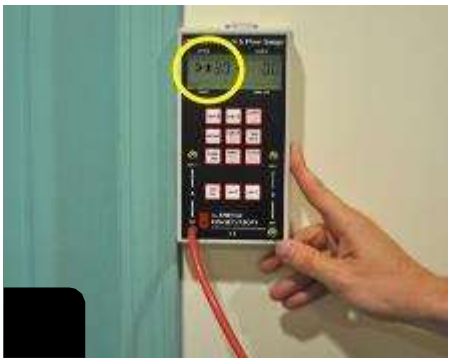
After
Passive door vents and individual room returns are two possibilities

1
With interior doors open, put reference hose to exterior



2
Take baseline reading

3
Turn on exhaust fans and close interior doors



4
With hose under door, check pressure again. Readings >+/-3pa are no good and require interior ventilation

6.6202 Components

6.6202.1 Controls

6.6202.1a – Primary ventilation fan (whole-house volume)

Desired Outcome:

Fan controls support ventilation strategy

Specification(s):

Controls will be used that can meet the following conditions:

- Run fan continuously or intermittently depending upon the intended schedule of operation
- Operate fan to produce the intended flow for each intended flow setting

Objective(s):

Deliver intended air exchange

Ensure fan controls meet intended ventilation strategy

6.6202.1b – Local exhaust—local fan

Desired Outcome:

Fan controls support ventilation strategy

Specification(s):

Controls will be used that meet the following conditions:

- Run fan continuously or intermittently depending on the intended schedule of operation
- Run fan for intended time for timed operation
- Operate fan to produce the intended flow for each intended flow setting

Objective(s):

Deliver intended air exchange

Ensure fan controls meet intended ventilation strategy

6.6202.1c – Wiring

Desired Outcome:

Fan controls support ventilation strategy

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

Ensure fan controls meet intended ventilation strategy

6.6202.1d – Manual override

Desired Outcome:

Fan controls support ventilation strategy

Specification(s):

A labeled switch for manual override will be included for the ventilation system

Objective(s):

Ensure fan controls meet intended ventilation strategy

6.6202.1e – Occupant education

Desired Outcome:

Fan controls support ventilation strategy

Specification(s):

A system operation guide designed for occupants (non-professionals) will be provided to explain how and why to operate system

A label indicating the presence and purpose of the ventilation system will be included or a copy of the system operation guide will be posted at the electrical panel

Objective(s):

Educate occupants about system operation and importance

Deliver intended air exchange

6.6288 Special Considerations

6.6288.1 Sound-Rating Limits

6.6288.1a – Primary ventilation system or any continuously operating fan

Desired Outcome:

Systems operate as quietly as possible

Specification(s):

System shall be rated for sound in accordance with current ASHRAE 62.2 standard

Objective(s):

Minimize noise

- Low sone (.5 or less) fans shall be installed to encourage the client to run them longer and particularly in those cases where a continuous exhaust fan is installed.

6.6288.1b – Intermittent local ventilation system

Desired Outcome:

Systems operate as quietly as possible

Specification(s):

Local ventilation will be rated for sound at a maximum of 3 sone, unless their maximum rated airflow exceeds 400 cfm, in accordance with ASHRAE 62.2-2010

Objective(s):

Minimize noise

6.99 Additional Resources

6.9901 Codes and Standards Resources

6.9901.1 Supplemental Ventilation Information—ASHRAE 62.2

6.9901.1a – Ventilation fan flow rate

Desired Outcome:

To provide supplemental ventilation information—ASHRAE 62.2

Specification(s):

ASHRAE Standard 62.2-2013 and the calculation of the infiltration credit allow adjustments to primary ventilation fan flow rates for existing houses using a single fan.

Objective(s):

To provide supplemental ventilation information--ASHRAE 62.2

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7 Baseload

7.80 Plug Load

7.8003 Lighting

7.8003.1 Lighting Upgrade

7.8003.1a – Day lighting

Desired Outcome:

Energy used for lighting reduced while maintaining adequate and safe lighting levels

Specification(s):

Window coverings (e.g., blinds, shades, moveable insulation) will be replaced or maneuvered to maximize useful daylight where appropriate

Active and passive day lighting will be properly oriented, designed, and installed where appropriate

Objective(s):

Reduce energy use without negative consequences (e.g., glare, unintentional heating)

- The costs associated with window coverings are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

7.8003.1b – Selection

Desired Outcome:

Energy used for lighting reduced while maintaining adequate and safe lighting levels

Specification(s):

All bulbs, fixtures, and controls will be appropriate for the intended application (e.g., enclosed, orientation, dimmable, potential for breakage, indoor, and outdoor)

All bulbs, fixtures, and controls will be selected to provide the brightness and light quality required in that application (e.g., task lighting, trip-and – fall hazards, and nightlights)

Selected equipment should have the highest level of efficiency within a technology [e.g., compact fluorescent lamp (CFL), LED]

All bulbs, fixtures, and controls will be ENERGY STAR® rated where applicable

When possible, bulbs, fixtures, and controls will be selected that will facilitate the use of future lighting technologies (e.g., LEDs)

When incandescent bulbs cannot be replaced or when occupant chooses not to replace, a dimmer will be selected

Light/lamp wattage should not exceed rated wattage of fixture

Bulb replacements will be chosen based on expected durability, light quality, and lifetime energy use of the bulb

Controls to turn off lights when not needed (e.g., no one in room) will be provided

All bulbs, fixtures, and controls will be UL-approved and installed in accordance with local code(s) and NFPA 70 National Electric Code

Fluorescent light ballasts containing polychlorinated biphenyls (PCBs) will be replaced in accordance with the EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades

Objective(s):

Provide improved lighting quality at lower energy use

Select equipment that will not be an unnecessary barrier to future technologies

Avoid inferior products and unsatisfied occupants

- Generally, the costs associated with the replacement of light fixtures and controls are not eligible expenditures in the *Nebraska Weatherization Assistance Program*. In some instances, with prior Energy Office approval, these costs may be reimbursable.

7.81 Water Heating

7.8101 Water Use Reduction

7.8101.1 Shower Head and Faucet Aerator

7.8101.1a – Work assessment

Desired Outcome:

Energy and water use reduced while occupant needs for water flow maintained

Specification(s):

Installer pre-work assessment will be conducted to determine if plumbing needs correction before installing high-efficiency shower head or faucet

Objective(s):

Verify scope of work

- The costs associated with plumbing corrections are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

7.8101.1b – Selection

Desired Outcome:

Energy and water use reduced while occupant needs for water flow maintained

Specification(s):

The rated flow of new shower heads will be 2.5 gallons per minute (GPM) or less

If multiple heads are provided, the total flow rate will not exceed 2.5 GPM Aerator flow rate will be 2.2 GPM or less

Features will be selected that meet any special needs of the occupant (e.g., shut off, swivel, handheld showers)

Objective(s):

Reduce water and energy consumption

Ensure occupant satisfaction

7.8101.1c – Installation

Desired Outcome:

Energy and water use reduced while occupant needs for water flow maintained

Specification(s):

Equipment will be installed in accordance with manufacturer specifications and meet all applicable building codes

Water quality will be evaluated for debris that may clog the equipment

Once installed, high-efficiency shower heads or faucet aerators will be tested to determine if equipment is tightened adequately to prevent leakage at the point of connection

If needed, shower diverter will be repaired or replaced

Any penetrations to the exterior of the home created by the installation of the equipment will be sealed

Any damage done to the house during installation will be repaired

Specific information about proper maintenance of the equipment will be provided to the occupant

Warranty information, operation manuals, and installer contact information will be provided to the occupant

Water flow that satisfies the occupant will be provided by all shower heads and faucet aerators

Occupant's acceptance of the shower head and/or aerator will be documented

Objective(s):

Reduce water and energy consumption Ensure occupant satisfaction with water flow Eliminate water leakage

Prevent water damage

- The costs associated with water quality evaluation and shower diverter repair or replacements are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.

7.8101.1d – Decommissioning

Desired Outcome:

Energy and water use reduced while occupant needs for water flow maintained

Specification(s):

Replaced shower heads and faucet aerators will be recycled or disposed of properly

Objective(s):

Prevent the reuse of inefficient equipment and components

7.8102 Installation and Replacement

7.8102.1 Water Heater Selection

7.8102.1a – Selection parameters

Desired Outcome:

Safe, reliable, and efficient hot water source selected that meets occupant needs at lowest possible cost of ownership and operation

Specification(s):

Equipment will provide sufficient, affordable, safe, and healthy hot water for the occupant in accordance with 2012 IRC P2801

Potential for solar hot water heating or other renewable energy systems will be assessed in selecting the hot water equipment

Potential for health and safety hazards (e.g., back drafting, flame rollout, obstructions) will be assessed in selecting equipment and the cost of remedying such problems will be included in any cost and benefit calculations

If a combustion based system is selected, it will be either direct vented or power vented, and ENERGY STAR® qualified or an Energy Factor (EF) of 0.58 or higher

If combustion equipment is selected, a low nitrogen oxide burner will be included

Equipment will be functional at high efficiency under all load conditions

Standby losses will be reduced to maximum potential

Fuel type will be selected based on affordability to occupant

Equipment will be freeze resistant or installed in a conditioned space

Efficiency of equipment will be maintained throughout life of system

Occupant control of hot water temperature will be provided on the equipment

The following will be determined from the occupant:

- Lifestyle
- Current and future needs
- Space considerations
- Fuel options
- Health and safety considerations
- Appliance options
- Maintenance and operation costs
- Return on investment concerns

Objective(s):

Save energy and water

Protect the environment

Identify appliance options based on the needs and wants of the occupant

- Existing unvented gas water heaters shall be vented to the exterior.
- Unsafe water heaters that cannot be repaired shall be replaced.
- With Nebraska Energy Office approval, replacement water heaters may utilize a new fuel source.
- A maximum of $250 in material and labor may be spent to correct deficiencies in water heaters. If the material and labor exceeds $250, the unit shall be replaced in owner occupied homes.
- In renter occupied homes, the owner shall repair or replace the water heater. If replacement is made in accordance to these installation standards the Weatherization Assistance Program may contribute a maximum of $150.

- Weatherization of the building shall not proceed until the water heater has been repaired or replaced.
- The costs associated with solar water heating or other renewable energy systems are not eligible expenditures under the *Nebraska Weatherization Assistance Program*.
- New gas water heaters shall have a minimum efficiency of .59 and new electric water heaters shall have a minimum efficiency of .91.

7.8102.1b – Product selection

Desired Outcome:

Safe, reliable, and efficient hot water source selected that meets occupant needs at lowest possible cost of ownership and operation

Specification(s):

Water heater will be selected based on performance requirements of the occupant, available fuel sources, energy efficiency, and total life cycle cost

In very cold climates, on-demand water heaters will be sized to meet the demand of water flow at very low water intake temperatures

When evaluating an existing thermal solar water heating system, a solar expert should be consulted

The proper installation and maintenance of solar hot water systems is provided in the Uniform Solar Energy Code (USEC) and 2012 IRC Chapter 23

Objective(s):

Ensure equipment meets the occupant's expectations while providing efficient energy and water use

- New gas water heaters shall have a minimum efficiency of .59 and new electric water heaters shall have a minimum efficiency of .91.
- The costs associated with solar water heating systems are not eligible expenses in the *Nebraska Weatherization Assistance Program*.
- With Nebraska Energy Office approval, replacement water heaters may utilize a new fuel.

7.8102.2 Storage-Type Appliance

7.8102.2 Approved Variance

7.8102.2a – Hazardous material removal

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified

Written notification will be provided to occupants of the discovery of hazardous material, including contact information for regional EPA asbestos coordinator

Occupant will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation)

Objective(s):

Remediate health hazards using EPA-certified contractors

- The costs associated with remediation of hazardous materials in not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8102.2b – Equipment removal

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Accepted industry procedures and practices will be followed to:

- Remove old water heater and associated components in accordance with 2012 IRC R105.1 or authority having jurisdiction
- Seal any unused chimney openings and penetrations in accordance with 2012 IRC N1102.4.1.1 or authority having jurisdiction
- Remove unused oil tank, lines, valves, and associated equipment in accordance with 2012 IRC M2201.7 or authority having jurisdiction

All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards

Objective(s):

Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

- The costs associated with removal of oil tanks, lines, valves, and associated equipment are in eligible expenses in the *Nebraska Weatherization Assistance Program*.

7.8102.2c – New equipment installation

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

New water heater and associated components will be installed to accepted industry standards, in accordance with the 2012 IRC and manufacturer specifications

The system will be installed to be freeze resistant

Any existing water leaks will be repaired before installation begins

Any penetrations to the exterior of the home created by the installation of the equipment will be sealed

Objective(s):

Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

- All repairs and replacements shall be performed by a qualified heating or plumbing technician or utility company.
- A service label shall be placed on or near the water heater containing the name, business address and phone number of the company or agency performing the work, any repairs that were completed and the date the work was performed.

7.8102.2f – Temperature and pressure relief valve

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications

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

Objective(s):

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

Before
Water heaters should be not capped off at T&P valve

After
T&P discharge should be piped to a safe and observable location

Tools:

1. Pipe wrench
2. Hacksaw

Materials:

1. PVC
2. Plumber's epoxy

- Missing or damaged shall be replaced.
- Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage – the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

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

BAD:
T&P discharge should flow with gravity and be observable

BAD:
T&P discharge should not be piped into drainage system

7.8102.2g – Dielectric unions

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Dielectric unions will be installed in accordance with the 2012 IRC, authority having jurisdiction, and according to manufacturer specifications

Objective(s):

Break the stray voltage electrical circuit through the storage tank

7.8102.2h – Backflow prevention

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Backflow prevention will be installed in accordance with manufacturer specifications and all applicable codes

Objective(s):

Protect water supply from contamination

7.8102.2i – Thermal efficiency

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

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

If additional insulation is installed, it will be installed based on fuel type, making sure not to obstruct draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates

The first 6' of inlet and outlet piping will be insulated in accordance with manufacturer specifications

Pipe insulation must remain 3" from gas water heater vent

Heat traps will be installed on the inlet and outlet piping where not provided by manufacturer

Objective(s):

Reduce standby loss from near tank piping and storage tank

Ensure insulation does not make contact with flue gas venting

- Water lines that have asbestos pipe wrap shall not be insulated or sealed in the area containing the asbestos.
- Insulation shall not be installed on water heaters if doing so voids the warranty of the unit.
- Hydronic pipes shall be insulated with 1 inch material having a minimum R-4 pipe insulation specifically manufactured as hydronic pipe insulation. Joints and elbows shall be insulated.
- Water heater insulation shall be secured with tape and bound with a minimum of 2 wire, cord, plastic or nylon bands on the tank.
- Water lines shall be insulated a minimum of 18 feet of hot and 6 feet of cold in all directions from the water heater, using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.
- Electric water heaters shall have the top insulated and the thermostat control access panels accessible or marked and labeled.
- Each section of preformed pipe wrap shall be fastened with a minimum of 3 wire, cord, plastic or nylon bands.
- Joints and elbows shall be insulated.
- Duct tape shall not be used as a means of fastening the pipe wrap.
- Insulation shall not cover the pressure relief valve, end of the drip leg, draft hood, burner air inlet, pilot light access door, thermostat control, drain valve or the top of the water heater on natural gas or propane water heaters.
- Insulation shall not cover the pressure relief valve, end of the drip leg, high limit switch, plumbing pipes, or drain valve on electric water heaters.
- Pipe wrap shall not begin within 3 inches or farther than 4 inches of a flue and/or draft hood.

7.8102.2j – Fuel supply

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Electric or fossil fuel supply components will be installed to accepted industry standards as per NFPA 31 and 54, or NFPA 70 National Electric Code (NEC) for electric components, or authority having jurisdiction

Objective(s):

Provide sufficient fuel to the water heater, burner, or element

7.8102.2k – Discharge temperature

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of

ownership

Specification(s):

Discharge temperature will be set not to exceed 120° or as prescribed by local code

Objective(s):

Ensure safe hot water supply temperature to fixtures

Unsafe
Water heaters producing water over 120 degrees raise heating costs

Safe
Water heaters should produce water under 120 degrees to prevent scalding

Tools:

1. Thermometer

1
Test temperature of hot water at faucets in house

2
Hot water temperatures should not exceed 120 degrees Fahrenheit

3
Adjust water heater settings and insulate as needed

4
After adjustment and insulation, retest to verify temp is under 120 degrees

7.8102.2m – Occupant safety

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction

Occupant will be provided information regarding the health effects and risk of high CO concentrations as well as a list of monitors that can provide more detail regarding CO levels

Objective(s):

Ensure occupant life safety; CO alarms are designed to detect levels at which occupants might become unable to evacuate

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

7.8102.2n – Occupant education

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Completed work will be reviewed

Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature and target temperature in accordance with local code
- Periodic drain and flush
- Expansion tank and backflow preventer (no occupant maintenance required)
- Periodic inspection, maintenance, or replacement

Objective(s):

Ensure occupant is informed of the safe, efficient operation and maintenance of the system

7.8102.3 On-Demand Appliance

7.8102.3a – Hazardous material removal

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified

Written notification will be provided to occupants of the discovery of hazardous material, including contact information for regional EPA asbestos coordinator

Occupants will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation)

Objective(s):

Remediate health hazards using EPA-certified contractors

- The costs associated with remediation of hazardous materials in not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8102.3b – Equipment removal

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Accepted industry procedures and practices will be followed to:

- Remove old water heater and associated components in accordance with 2012 IRC R105.1
- Seal any unused chimney openings and penetrations in accordance with 2012 IRC N1102.4.1.1
- Remove unused oil tank, lines, valves, and associated equipment in accordance with 2012 IRC M2201.7

All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards

Objective(s):

Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

- The costs associated with removal of oil tanks, lines, valves and associated equipment are not eligible expenses in the *Nebraska Weatherization Assistance Program*.

7.8102.3c – New equipment installation

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of

ownership

Specification(s):

A new water heater and associated components will be installed to accepted industry standards, in accordance with the 2012 IRC, authority having jurisdiction and manufacturer specifications

Objective(s):

Ensure the safety of the workers and occupants

Preserve integrity of the building

Remove old equipment in a timely and efficient manner

7.8102.3e – Temperature and pressure relief valve

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications

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

Objective(s):

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

7.8102.3f – Dielectric unions

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Dielectric unions will be installed to accepted industry standards, in accordance with the 2012 IRC and according to manufacturer specifications

Objective(s):

Break the stray voltage electrical circuit through the storage tank

7.8102.3g – Backflow prevention and pressure regulator

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Backflow prevention will be installed in accordance with manufacturer specifications

House water pressure and volume will be verified as sufficient to be in accordance with manufacturer specifications

All applicable codes will be followed

Objective(s):

Protect the water supply from contamination

Provide for sufficient volume and pressure

- The costs associated with providing additional required volume and/or water pressure in not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8102.3h – Thermal efficiency

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Any accessible hot water lines at the appliance will be insulated to meet 2012 IRC N1103.4.2 or local requirements, whichever is greater.

Objective(s):

Reduce line losses

7.8102.3i – Required combustion air

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Electric or fossil fuel supply components will be installed to accepted industry standards as per Chapter 24 of the 2012 IRC, NFGC and NFPA 31 and 54 for gas and oil, or NEC for electric Energy input required by the appliance will be in accordance with manufacturer specifications. All on-demand appliances will be installed per manufacturer recommendations/specifications.

Objective(s):

Ensure adequate combustion air for operation of the appliance

- The costs associated with providing additional energy input for the appliance is not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8102.3j – Venting of flue gases

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Combustion byproducts will be removed in accordance with Chapter 24 of the 2012 IRC, authority having jurisdiction, and manufacturer specifications

Objective(s):

Ensure the safety and durability of the venting system

7.8102.3k – Flue gas testing

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012

If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to manufacturer specifications or local codes

Objective(s):

Confirm that combustion is occurring safely with maximum efficiency

7.8102.3l – Electric and fossil fuel supply

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Electric or fossil fuel supply components will be installed to accepted industry standards as per Chapter 24 of the 2012 IRC, NFGC and NFPA 31 and 54 for gas and oil, or NEC for electric

Energy input required by the appliance will be in accordance with manufacturer specifications

Objective(s):

Provide sufficient fuel to the water heater burner or element

7.8102.3m – Cold water supply

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

The volume and pressure of the water supplied to the appliance will be in accordance with manufacturer specifications

Objective(s):

Provide sufficient volume and pressure of water to the appliance

- The costs associated with providing additional required volume and/or water pressure in not an eligible expense in the Nebraska Weatherization Assistance Program.

7.8102.3n – Discharge temperature

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Discharge temperature will be set in accordance with manufacturer instructions and in compliance with local codes

Use extreme caution when temperature setting is above 120°F

Objective(s):

Ensure safe hot water supply temperature to fixtures

7.8102.3o – Commissioning of system

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

The following will be checked once the system has been connected and filled:

- Safety controls
- Combustion safety and efficiency
- Operational controls
- Fuel and water leaks
- Cycle unit
- Local code requirements

Manufacturer specifications and all relevant industry standards will be met in commissioning

Objective(s):

Ensure system functions safely with lowest possible cost of ownership

7.8102.3p – Ambient carbon monoxide (CO)

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

All homes will have a CO alarm

Objective(s):

Ensure occupant health and safety

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

7.8102.3q – Occupant education

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Completed work will be reviewed

Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature and target temperature in accordance with local code
- Operation of backflow preventer and pressure regulator (no occupant maintenance required)
- Importance of keeping operating manuals accessible

Objective(s):

Ensure occupant is informed of the safe, efficient operation and maintenance of the system

7.8103 Maintenance/Inspection

7.8103.1 Storage-Type Appliance

7.8103.1 Approved Variance

7.8103.1a – Health and safety

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

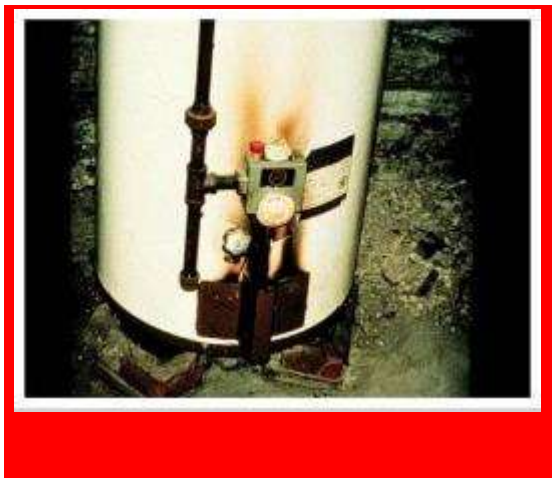
Specification(s):

Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single Family Housing or other equivalent practice

Electrical components will be verified to comply with NEC (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire)

Objective(s):

Identify potential health and safety issues



Before
Complete combustion safety testing to ensure healthy, safe work environment

After
When completed work, retest to verify home is still healthy and safe

Tools:

1. Personal CO monitor
2. Combustion analyzer with probe
3. Manometer
4. Smoke pencil

Materials:

1. CO alarm
2. Fasteners

See also SWS 2.0201.1a-2.0299.1i for all Combustion Safety details and SWS 2.0100.1d for General Electrical Safety.

7.8103.1b – Visual inspection

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Inspection will be conducted to show compliance with the 2012 IRC, including but not limited to:

- Water or fuel leaks
- Damaged wiring
- Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)
- Corrosion (e.g., rust, mineral deposits)
- General condition of components

Objective(s):

Determine needed repairs or maintenance

7.8103.1c – Thermal efficiency

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Water heater storage tanks shall have a minimum R-value of R-24, unless the SIR to add insulation is less than 1.0

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

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

Standard water heaters have built-in insulation ranging from R-7 to R-20.

Best Practice

Storage-type water heaters should be wrapped to bring total value to R-24

Objective(s):

Reduce standby losses from near tank piping and storage tank

Ensure insulation does not make contact with flue gas venting

Tools:

1. Utility knife

Materials:

1. Pipe wrap
2. Water heater blanket
3. Foil tape
4. Long zip ties

- Water lines that have asbestos pipe wrap shall not be insulated or sealed in the area containing the asbestos.
- Insulation shall not be installed on water heaters if doing so voids the warranty of the unit or if the water heater is lacking a pilot access door or pressure relief valve.
- Pipe wrap shall not be installed if the water heater lacks a pressure relief valve.
- Hydronic pipes shall be insulated with 1 inch material having a minimum R-4 pipe insulation specifically manufactured as hydronic pipe insulation. Joints and elbows shall be insulated.
- Water heater insulation shall be secured with tape and bound with a minimum of 2 wire, cord, plastic or nylon bands on the tank.
- Water lines shall be insulated a minimum of 18 feet of hot and 6 feet of cold in all directions from the water heater, using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.
- Electric water heaters shall have the top insulated and the thermostat control access panels accessible or marked and labeled.
- Each section of preformed pipe wrap shall be fastened with a minimum of 3 wire, cord, plastic or nylon bands.
- Joints and elbows shall be insulated.
- Duct tape shall not be used as a means of fastening the pipe wrap.
- Insulation shall not cover the pressure relief valve, end of the drip leg, draft hood, burner air inlet, pilot light access door, thermostat control, drain valve or the top of the water heater on natural gas or propane water heaters.
- Insulation shall not cover the pressure relief valve, end of the drip leg, high limit switch, plumbing pipes, or drain valve on electric water heaters.
- Pipe wrap shall not begin within 3 inches or farther than 4 inches of a flue and/or draft hood.

Check occupant's water heater model to see what R-value is built-in

Blanket does not obstruct draft diverter or plumbing pipes and elements

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

Data plate should still be accessible after wrapping

Both hot and cold water pipes should be insulated, a minimum of 18 ft. of hot and the first 3 ft. of cold

7.8103.1e – Temperature and pressure relief valve

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications

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

Objective(s):

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

Before

Water heaters should be not capped off at t&p valve

After

T&P discharge should be piped to a safe and observable location

Tools:

1. Pipe wrench
2. Hacksaw

Materials:

1. PVC
2. Plumber's epoxy

- Missing or damaged shall be replaced.
- Check local jurisdictional codes. Paraphrased from 2012 IRC P2803.6.1: Temperature and pressure relief valve discharge pipes should not be connected to drainage system. T&P discharge pipes should be a clean line without valve or tee, flowing with gravity to an observable and safe location that cannot cause personal injury or structural damage – the floor, an existing drain pan, a waste receptor, or to the outdoors. Pipe should not terminate more than 6" from floor, pan or waste receptor.

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

BAD:
T&P discharge should flow with gravity and be observable

BAD:
T&P discharge should not be piped into drainage system

7.8103.1f – Maintenance records

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Occupants will be advised to keep records of all maintenance done to their system

Copies of or access to installation and operation manuals will be provided

Objective(s):

Provide a history of system installation and maintenance to improve chance of successful future maintenance or repair

7.8103.1g – Occupant safety

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction

Occupant will be provided information regarding the health effects and risk of high CO

concentrations as well as a list of monitors that can provide more detail regarding CO levels

Objective(s):

Ensure occupant life safety

Inform occupant regarding possible CO hazards

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

7.8103.1h – Occupant education

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Completed work will be reviewed

Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature and target temperature in accordance with local code
- Periodic drain and flush
- Periodic inspection, maintenance, or replacement of anode rod

Objective(s):

Ensure occupant is informed of the safe, efficient operation and maintenance of the system

7.8103.2 On-Demand Appliance

7.8103.2a – Health and safety

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single Family Housing or other equivalent practice

Electrical components will be verified to comply with NEC (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire)

Objective(s):

Identify potential health and safety issues

7.8103.2b – Visual inspection

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Inspection will be conducted to show compliance with the 2012 IRC, including but not limited to:

- Water or fuel leaks
- Damaged or missing pipe insulation and tank insulation, where applicable

- Damaged wiring
- Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)
- Corrosion (e.g., rust, mineral deposits)
- General condition of components

Objective(s):

Determine needed repairs or maintenance

7.8103.2c – Temperature and pressure relief valve

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Correct temperature and pressure relief valve will be installed in compliance with P2803 of the 2012 IRC and according to manufacturer specifications

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

Objective(s):

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

7.8103.2d – Flue gas testing

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012

If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to manufacturer specifications or local codes

Objective(s):

Perform combustion testing

7.8103.2e – Required combustion air

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

If sealed combustion has not been installed:

Combustion and ventilation (excess air) requirements of gas-fired appliances, including provision of outside and inside air to account for building tightness, will be provided

The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with 2012 IRC G2407.5.1

If needed, additional combustion air will be provided in accordance with 2012 IRC G2407

Objective(s):

Ensure adequate combustion air for operation of the appliance

7.8103.2f – Venting of flue gases

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Condition of venting will be inspected in accordance with Section 504 IFGC for gas water heaters or NFPA 31 for oil water heaters

Objective(s):

Verify proper venting of flue gases

7.8103.2g – Fuel supply

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Condition of fuel supply components will be checked in accordance with NFPA 31 for oil, NFPA 54 for gas, NFPA 58 for propane, or NFPA 70 National Electric Code for electric, and authority having jurisdiction

Objective(s):

Verify sufficient fuel to the water heater burner and element

7.8103.2h – Cold water supply

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Water supplied to the appliance will be of sufficient volume and pressure to be in accordance with manufacturer specifications

Objective(s):

Verify sufficient volume and pressure of water to the appliance

- The costs associated with providing additional required volume and/or water pressure in not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8103.2i – Discharge temperature

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Discharge temperature will be set not to exceed 120°F or in accordance with local code, whichever is lower

Objective(s):

Ensure safe hot water supply temperature to fixtures

7.8103.2j – Test the system safety and operation

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

The following will be tested:

- Safety controls (e.g., water, air pressure switches)
- Combustion safety and efficiency
- Operational controls
- Fuel and water leaks
- Unit runs through complete cycle
- Local code requirements

Manufacturer specifications and all relevant industry standards will be met

Objective(s):

Ensure system functions safely with lowest possible cost of ownership

7.8103.2k – Maintenance records

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Occupants will be advised to keep records of all maintenance done to their system

Copies of or access to installation and operation manuals will be provided

Objective(s):

Improve chance of successful future maintenance or repair

7.8103.2l – Occupant health and safety

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

All homes will have a carbon monoxide (CO) alarm

Objective(s):

Ensure occupant health and safety

- Installation of Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Battery operated or plug-in 110 Volt Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

7.8103.2m – Occupant education

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

Specification(s):

Completed work will be reviewed

Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature
- Target temperature in accordance with local code

Objective(s):

Ensure occupant is informed of the safe, efficient operation and maintenance of the system

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program Specifications will state: Ground moisture barrier must be fastened, in its entirety, to the ground with durable fasteners or ballast(s) if exposed to wind effects or the slope of the ground will cause movement of the ground moisture barrier. In crawl spaces that contain equipment/appliances where routine maintenance is performed, the Nebraska Weatherization Assistance Program Specifications will require the ground moisture barrier material to be secured or ballasted, as needed to secure the barrier along the access corridor.
Relevant SWS(s)	Health and Safety - Moisture - Vapor Barriers -Vented Crawl Spaces - Ground Moisture Barriers - Fastening 2.0403.1(e) http://sws.nrel.gov/spec/204031 Health and Safety - Moisture - Vapor Barriers -Closed Crawl Spaces - Ground Moisture Barriers - Fastening 2.0403.2(e) https://sws.nrel.gov/spec/204032
Objective of Relevant SWS	Prevent movement of the ground moisture barrier
Difference between Proposed and SWS Language	The SWS requires that all-ground moisture barrier material be secured to the ground with mechanical fasteners or ballasts. The Nebraska Weatherization Assistance Program will require ground moisture barrier material to be secured or ballasted, in its entirety, when necessary due to wind exposure or sloped ground. In crawl spaces that contain equipment/appliances where routine maintenance is performed, the Nebraska Weatherization Assistance Program will require the ground moisture barrier material to be secured or ballasted, as needed to secure the barrier along the access corridor.
Specific Conditions Where Variance will Apply	Crawl spaces under all housing types
Reasoning/Justification (Include supporting technical materials as appropriate)	Securing ground cover is not necessary in most cases and in areas of our state may create moisture issues. The vast majority of crawlspaces in Nebraska are flat and not exposed to wind. In many areas of Nebraska, seasonal ground water is a problem. When ground cover is installed and not secured, the ground cover will rise with the water level due to the water's surface tension. This keeps the majority of water beneath the ground cover. If ground cover is secured, the seasonal ground water will be forced to the top side of the ground cover and will not easily be drain. The only option when the water makes it to the top of the ground cover is evaporation. Thus causing the potential for moisture issues.

DOE Review Notes:

Required Signatures:

6/18/15

Grantee Representative submitting request *Date*

Kelly Cutchin 6/18/15

DOE Technical Approval *Date*

SWS Variance Request Form

Proposed State Standard	The Nebraska State Electrical Board permits covering knob and tube wiring with insulation ***after*** the wiring has been appropriately covered to prevent direct contact with the insulation. The covering must provide adequate air space (a minimum of 3 ½" clearance) for "cooling" of the wire. The Nebraska Installation Standards will require: • Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring • Non-contact testing methods be used to determine if wiring is live • Attic areas with knob-and-tube wiring that are indicated as cost-effective for implementation on the energy audit be insulated ***after*** the wiring has been appropriately covered to prevent direct contact with the insulation and to provide adequate air space (a minim u m of 3 ½," clearance) for "cooling" of the wire. • Signs will be placed at all attic entries warning about the presence of knob and tube wiring. • Appropriate shielding materials be used for concealing the knob-and-tube wiring will include gypsum board (5/8" or thicker), plywood or oriented strand board. • I n attics where knob and tube wiring has been previously covered with insulation and where the energy audit indicates that it is cost-effective, additional insulation may be installed when the wiring is located and it has been determined that it is still live. Once the wire locations are documented in the client file, the wiring may be appropriately shielded, as indicated above, to provide adequate air movement space for the "cooling" of the wire and insulated. This determination may be completed by: ▪ a licensed electrician ▪ the use of a thermal imager/scanner ▪ visually or physically locating the wires or ▪ another verifiable option determined by the sub- grantee and approved by the Nebraska Energy Office. • In attic areas where knob and tube wiring penetrates the plane of the attic and extends up into a side or knee wall, a fire resistant baffling will be installed around the wire to provide sufficient space for air movement around the wire to provide adequate air space to accommodate the "cooling" of the wire. (See attached Details) • If attic installation is being installed as per the directive above, the Nebraska State Electrical Board recommends the

	use of a licensed electrician for the installation of safety fuses as is indicated in the National Electrical Code. • Existing fuses will remain intact if no insulation is being completed in the home.
Relevant SWS(s)	Health and Safety - Electrical - Knob and Tube Wiring - Isolation and Protection SWS 2.0601.1 Rows c and d © https://sws.nrel.gov/spec/206011 Insulation -Attics - General Preparation - Knob and Tube Wiring
Objective of Relevant SWS	To ensure occupant safety and to preserve the integrity and safety of the house.
Difference between Proposed and SWS Language	The Nebraska State Electrical Board determination allowing insulation to be installed over appropriately covered knob and tube wiring provides Nebraska weatherization clients with energy saving benefits that would exceed those they would receive with strict adherence to the SWS 2.0601.1. This is an energy saving opportunity that the Nebraska Weatherization Assistance Program would like to continue to offer clients. When wiring cannot be appropriately covered as per the Nebraska Electrical Board determination, the wiring will be protected as per SWS 2.0601.1to prevent insulation contact.
Specific Conditions Where Variance will Apply	Homes with active (live) Knob & Tube wiring in attic spaces.
Reasoning/Justification (Include supporting technical materials as appropriate)	Knob and tube wiring is routinely found in attics in Nebraska. To simply dam the knob and tube wiring and insulate the areas of the attic not dammed is allowable, but the option to have the wiring appropriately shielded to allow for insulation coverage gives the Nebraska Weatherization Assistance Program the opportunity to provide full R-value over the entire attic area. Providing full attic R-value provides the clients with a more effective building envelope and also helps to avoid possible future attic moisture concerns.

DOE Review Notes:

Note that reviewer added specific row references to Relevant SWS portion of table above.
Variance applies to those rows.

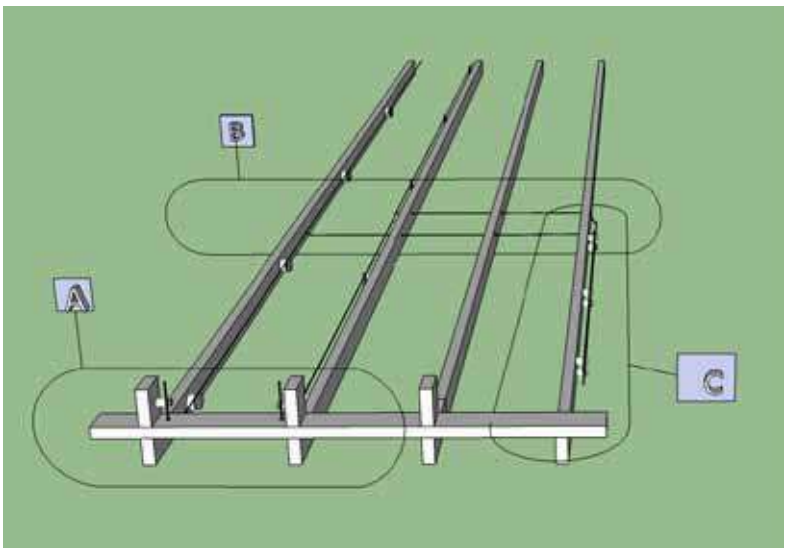
Required Signatures:

Lynn K. Chamberlin 5/16/2015

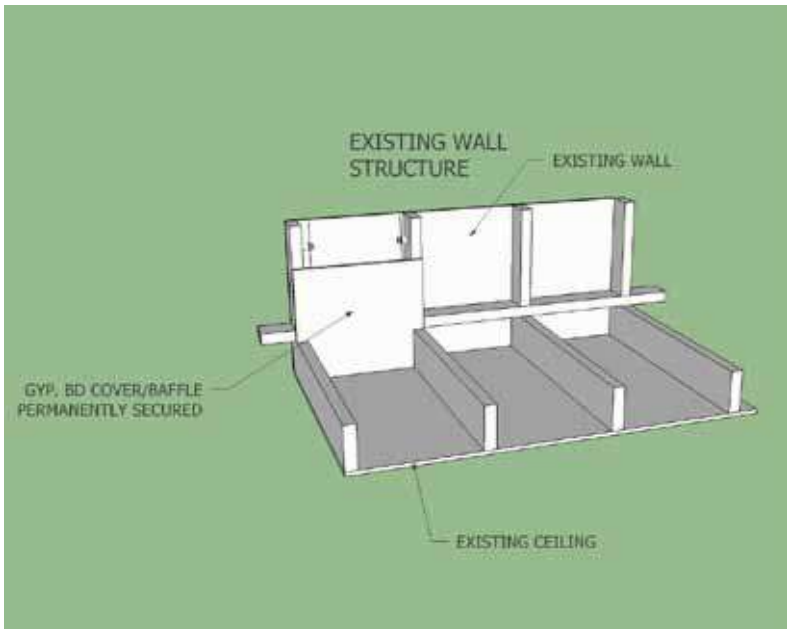
Grantee Representative submitting request Date

Kelly Cutchin 6/16/15

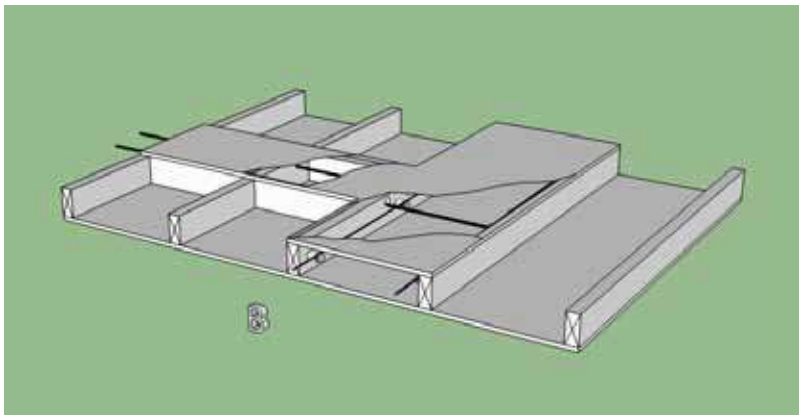
DOE Technical Approval Date



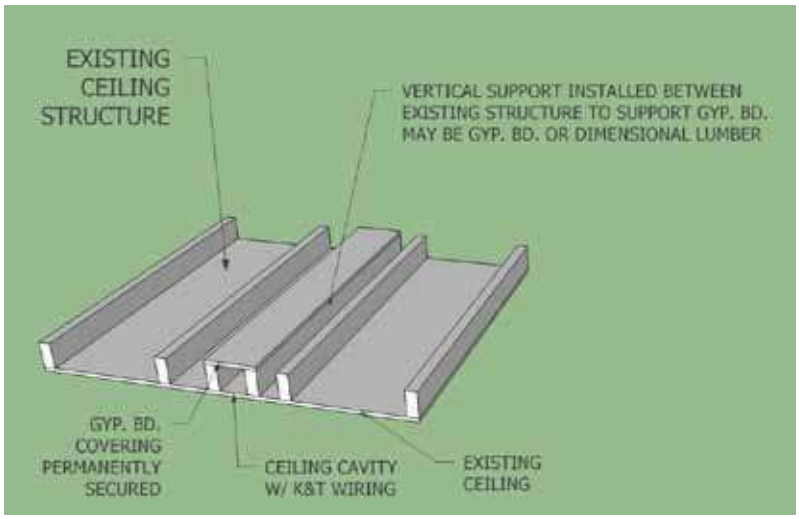
Knob and Tube Wiring



Detail A



Detail B



Detail C

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program Specifications will not include Section b of the 2.0702.1SWS. As written this Section would require our sub-grantees or their contractors to offer an annual inspection and renewal of warranty and service agreement or a 10 year period on installed equipment. The Nebraska Weatherization Assistance Program intends to implement SWS guidance 2.0702.1a and 2.0702.1c.
Relevant SWS(s)	2.0702.1(b) Health & Safety - Occupant Education – Installed Equipment – Warranty and Service Agreement - Warranty renewal and Service Agreement https://sws.nrel.gov/soec/207021
Objective of Relevant SWS	Provide occupants with an option for extending the warranty and service agreement
Difference between Proposed and SWS Language	Nebraska's intention is to remove the requirement outlined in Section b of SWS 2.0702.1.
Specific Conditions Where Variance will Apply	II Weatherization completions within Nebraska.
Reasoning/Justification (Include supporting technical materials as appropriate)	Nebraska feels that the requirement to provide an option of a 10 year extended warranty and service agreements sets an unrealistic expectation and excessive burden on our sub-grantees and their crews and/or contractors. This requirement seems to go above and beyond normal expectations and creates the opportunity for misunderstanding and misapplication with the clients the Weatherization Assistance Program serves. While Nebraska does understand that this an "option" for which the client would be financially responsible, we fear that offering or mentioning this option would lead to client assumption that the extended warranty and service agreement is indeed in place. This would create an increased burden on Nebraska their sub-grantees and/or contractors in properly responding to client concerns beyond the one year warranty required by SWS guidance 2.0702.1a.

DOE Review Notes:

Required Signatures:

Grantee Representative submitting request — Date: 5/6/2015

DOE Technical Approval — Date: 6/16/15

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program specifications SWS 3.1203.3c will state: Window or door units will be designed for manufactured home use and will be ENERGY STAR qualified. *In cases where the exterior waits in the manufactured home will accept house type replacement windows, they may be installed.* The Nebraska Weatherization Assistance Program intends to implement the remaining SWS guidance 3.1203.3 requirements.
Relevant SWS(s)	Air Sealing - Windows & Doors - Replacement - Replacement of Manufactured Housing Windows and Doors SWS 3.1203.3c https://sws.nrel.gov/spec/312033
Objective of Relevant SWS	Ensure proper size, type, and operation of window or door
Difference between Proposed and SWS Language	Nebraska's proposed language allows more flexibility in window selections/styles for manufactured homes where the exterior wall construction will accept a window not specifically manufactured for use in conjunction with manufactured housing.
Specific Conditions Where Variance will Apply	All applicable modular housing Weatherization completions within Nebraska.
Reasoning/Justification (Include supporting technical materials as appropriate)	Providing this option gives Nebraska's sub-grantees and contractors the opportunity to utilize alternative window types and manufacturers that may result in the installation more energy efficient windows at more competitive prices than those typically seen in the limited manufactured housing product market. This option also allows sub-grantees and contractors to utilize more readily available Energy Star® window products available from local distributors, rather than ordering manufactured home windows which may require substantial "lead times".

DOE Review Notes:

Required Signatures:

Steve K. Chamberlin 5/6/2015

Grantee Representative submitting request *Date*

Kelly Cutchin 6/16/15

DOE Technical Approval *Date*

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program specifications 3.1402.2a will state: Vent openings will be permanently closed and sealed except in cases where there is evidence of previous ground water intrusion. In those cases, documentation will be included in the client file and non-permanent vents covers will be installed. The occupants will be notified of the vent cover installation and will be educated on how to appropriately operate and maintain the covers.
Relevant SWS(s)	Air Sealing - Basements & Crawl Spaces - Crawl Spaces - Closed Crawl Spaces-Air Sealing Foundation Vents SWS 3.1402.2a https://sws.nrel.gov/spec/314022
Objective of Relevant SWS	Prevent air and moisture penetration
Difference between Proposed and SWS Language	The SWS requires that all vent openings in closed crawl spaces will be permanently closed and sealed. The Nebraska Weatherization Assistance Program will require vent openings in closed crawl spaces be permanently closed and sealed ***except*** in cases where there is evidence of previous ground water intrusion. In those cases, documentation will be included in the client file and non-permanent vents covers will be installed. The occupants will also be notified of the vent cover installation and will be educated on how to appropriately operate and maintain the covers.
Specific Conditions Where Variance will Apply	Crawl spaces under all housing types
Reasoning/Justification (Include supporting technical materials as appropriate)	In many areas of Nebraska, high ground water tables can cause water in a crawl space once or twice in a very extended period of time. Installing semi-permanent vent covers (i.e. secured with screws that can be removed if needed) will allow temporary removal of the cover and evaporation of any ground that may enter the crawl space and cause potential mold, rotting and indoor air quality issues.

DOE Review Notes:

Required Signatures:

Lynn K. Chamberlin 5/16/2015

Grantee Representative submitting request *Date*

Kelly Cutchin 6/16/15

DOE Technical Approval *Date*

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program Specifications will not include the requirement in Section a of the 3.1402.4 SWS requiring *"Re-venting exterior weep holes with wicking rope"*. However, Nebraska does intend to implement the remaining air sealing requirements specified in SWS 3.1402.4 to reduce the opportunities for moisture vapor, water and pests from entering the space.
Relevant SWS(s)	Air Sealing - Basements & Crawl Spaces - Crawl Spaces – Closed Crawl Spaces-Air Sealing Brick Curtain Wall SWS 3.1402.4 (a) https://sws.nrel.gov/spec/314024
Objective of Relevant SWS	Decrease probability of rot
Difference between Proposed and SWS Language	Nebraska's intention is to remove only the requirement associated with *"Re-venting exterior weep holes with wicking rope"* in Section a of SWS 3.1402.4 the remaining air sealing requirements of the Standard will be met.
Specific Conditions Where Variance will Apply	All Weatherization completions within Nebraska.
Reasoning/Justification (Include supporting technical materials as appropriate)	Nebraska believes that the benefits associated with the re-venting exterior weep holes with wicking rope, generally installed in Nebraska to provide wicking between the exterior of the building into a 1" air space between a face brick and an interior masonry wall, are minimal in comparison to the costs associated with re- venting. Typically cotton wicks are used to ensure that the weep hole is not inadvertently blocked during construction of the building and their rot is anticipated; after which an open drainage hole remains should moisture "build up" in the air space between the two masonry surfaces.

DOE Review Notes:

Required Signatures:

Lynn K. Chamberlin — 5/16/2015
Grantee Representative submitting request — *Date*

Kelly Cutchin — 6/16/15
DOE Technical Approval — *Date*

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program specifications 3.1402.Sb will state: When adding access to a crawl space: • Access openings through the floor will be a minim u m 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, *being installed as part of the weatherization services being provided,* 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 *all appliances installed as part of the weatherization services being provided* • If the depth of the passageway or the service space exceeds 12 inches below the adjoining grade *for an appliance being installed as part of the weatherization services,* the walls of the passageway will be lined with concrete or masonry extending 4 inches above the adjoining grade in accordance with Chapter 4 2012 *IRC*, • The rough-framed access opening dimensions *for appliances being installed as part of the weatherization services,* will be a minim u m of 22 inches by 30 inches and large enough to remove the largest appliance The Nebraska Weatherization Assistance Program intends to implement the remaining SWS guidance 3.1402.5 requirements.
Relevant SWS(s)	Air Sealing - Basements & Crawl Spaces - Crawl Spaces - Closed Crawl Spaces-Attached Crawl Space Under Unconditioned Spaces SWS 3.1402.5b https://sws.nrel.gov/spec/314025
Objective of Relevant SWS	Provide access to attached crawlspaces for inspections
Difference between Proposed and SWS Language	Nebraska's proposed language clarifies that service and access area for only appliances/equipment associated with completed weatherization work will be required to meet SWS 3.1402.5 requirements.

Specific Conditions Where Variance will Apply	All Weatherization completions within Nebraska.
Reasoning/Justification (Include supporting technical materials as appropriate)	This clarification parallels the Nebraska Weatherization Program guideline indicating that the program does not fund the costs of bringing homes "up to" the latest building code requirements. However, any eligible work that is completed as part of the weatherization work must meet all state and local building code and SWS 3.1402.Sb requirements. The costs associated with work that is not specifically associated with the implementation of an approved Weatherization Measure is beyond the scope of the Nebraska's Program.

DOE Review Notes:

This approval may technically be unnecessary, since existing program guidance clarifies when code requirements go into effect, but let this form indicate DOE's review and approval of NE's clarification.

Required Signatures:

Lynn K. Chamberlin 5/6/2015

Grantee Representative submitting request *Date*

Kelly Cutchin 6/16/15

DOE Technical Approval *Date*

SWS Variance Request Form

Proposed State Standard	Nebraska proposes to address the need for expansion tanks only when water heaters are leaking and require replacement or when temperature & pressure relief valves are leaking. Expansion tank installation will be as per local code requirements with water heater replacements.
Relevant SWS(s)	7.8102.2(e) Water Heating - Installation and Replacement - Storage Type Appliance - Expansion Tank https://sws.nrel.gov/spec/781022 7.8103.1(d) Water Heating - Maintenance/Inspection - Storage-Type Appliance - Potable Water Expansion Tank https://sws.nrel.gov/spec/781031
Objective of Relevant SWS	Absorb water expansion of the system and protect the storage tank from expansion
Difference between Proposed accordance with and SWS Language	Nebraska proposes to only install expansion tanks in local code on water heaters where the temperature & pressure relief valve is leaking and in conjunction with new water heater installations.
Specific Conditions Where Variance will Apply	New water heater installations and occurrences of leaking temperature & pressure relief valves.
Reasoning/Justification	The majority of the Weatherization homes in Nebraska are serviced by water systems that are not equipped with back flow protection (Include supporting technical and therefore would not meet the necessary elements for the mass materials as appropriate) installation of expansion tanks. Installing expansion tanks on every water heater tested by Nebraska's Weatherization Assistance Program would be an exorbitant drain on our resources and would, in many instances, be an unnecessary repair.

DOE Review Notes:

Required Signatures:

Lynn K. Chamberlin 5/6/2015

Grantee Representative submitting request — Date

Kelly Cutchin 6/16/15

DOE Technical Approval — Date

SWS Variance Request Form

Proposed State Standard	The Nebraska Weatherization Assistance Program specifications 3.1201.2b will state: All egress windows, maintained, repaired or sealed as part of weatherization services being provided, will be operable as required by local codes. The Nebraska Weatherization Assistance Program intends to implement the remaining SWS guidance 3.1201.2 requirements.
Relevant SWS(s)	Air Sealing - Windows & Doors - Maintenance, Repair & Sealing - Single-Unit Window and Fixed Frame with Wood Sash SWS 3.1201.2b https://sws.nrel.govLsec/312012
Objective of Relevant SWS	Maintain operability of egress windows
Difference between Proposed and SWS Language	Nebraska's proposed language clarifies that only windows associated with completed weatherization work will be guaranteed of providing appropriate egress operability.
Specific Conditions Where Variance will Apply	All Weatherization completions within Nebraska.
Reasoning/Justification (Include supporting technical materials as appropriate)	This clarification parallels the Nebraska Weatherization Program guideline indicating that the program does not fund the costs of bringing homes "up to" the latest building code requirements. However, any eligible energy efficiency work that is completed as part of the weatherization work must meet all state and local building code requirements. The costs associated with building work that is not specifically associated with the implementation of a cost-effective, approved Weatherization Measure is beyond the scope of the Program.

DOE Review Notes:

This variance is unnecessary, as program guidance (i.e., cost-effectiveness) still dictates which measures will be addressed. Let this note serve as record that DOE approves of NE's approach to treating egress windows.

Required Signatures:

Lynn K. Chamberlin 5/6/2015

Grantee Representative submitting request Date

DOE Technical Approval Date