

Retrofitting Nebraska 2018

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Installation Standards for **Single Family** and *Manufactured Housing*

created by

**The Nebraska Weatherization
Assistance Program**



Installation Standards for Single Family and *Manufactured Housing*

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MH 6.6188.2b - Patching of the hole in the duct system created by removal

MH 6.6188.2c - Sealing of the patch

MH 6.6188.2d - Removal of discarded ducts

MH 6.6188.2e - Patching of the register hole in garage

MH 6.6188.2f - External static pressure testing

MH 6.6188.2g - CAZ testing

MH 6.62 Whole Building Ventilation

MH 6.6205 Exhaust-Only System

MH 6.6205.1 *Manufactured Housing* Exhaust-Only Strategies

MH 6.6205.1a - Assessment

MH 6.6205.1b - Selection

MH 6.6205.1c - Location

MH 6.6205.1d - Climate considerations

MH 6.6205.1e - *Combustion Appliance Zone* (*CAZ*) testing

MH 6.6205.1f - Occupant education

MH 6.6205.1g - Total exhaust airflow

MH 6.6288 Special Considerations

MH 6.6288.2 Sound Ratings - New Fan Installation

MH 6.6288.2a - Primary ventilation
system/continuously operating fan

MH 6.6288.2b - Intermittent spot ventilation system

NeWap Installation Standards - Field Guide

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 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 installing energy efficiency measures through the *Nebraska Weatherization Assistance Program* (NeWAP).

1.01 Inspection

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.

- Inspecting the exterior of the building and documenting:
 - 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

[2.0102.1 \(a, b, c, d\) Health & Safety - Safe Work Practices - Insulation - Vermiculite \(SF\) \(MH\)](#)

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

[2.0105.1 \(a\) Health & Safety - Safe Work Practices - Baseload - Baseload Worker Safety \(SF\) \(MH\)](#)

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

[2.0203.1 \(a, b, c\) Health & Safety - Combustion Safety -](#)

[Vented Gas Appliances - Combustion Air for Natural Draft Appliances \(SF\) \(MH\)](#)

- Completing *Combustion Appliance Zone* (CAZ) Testing
 - [2.0103.1 \(a, b, c\) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Combustion Worker Safety \(SF\) \(MH\)](#)
- 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 Area
------------------	---------------------------

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 Vent	Net Free Vent Area
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 Area
4" x 16"	32 square inches
8" x 16"	64 square inches
4" x 8"	16 square inches

Triangular Gable Vent	Net Free Vent Area
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 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 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 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 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 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 (Form WX3)
 - Completion of a mold and moisture assessment (Form WX5)
 - Appropriate completion and documentation of combustion appliance testing (Form WX9)
 - 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 & 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 subgrantee 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, the Field Guide and Installation Standards.

1.02 Energy Audit

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

- Use 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 approved for use in the NeWAP are:
 - The National Energy Audit Tool (NEAT), for single family homes
 - The Manufactured Home Energy Audit (MHEA), for *manufactured housing*, or
 - The Multi-Family Energy Audit Tool (MulTEA) for *multi-family buildings*
- Perform a site-specific **Energy Audit** on all frame, masonry, modular, and *manufactured housing* and verify 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.
 - No Health and Safety measures shall be performed in a home unless ECMs are also part of the scope of work.
- Retain a copy of the **Energy Audit** in the client file.
- Use local weather data when running the site-specific audits.
- Use average state fuel costs when running site-specific audits.
 - The Energy Office will provide updated fuel costs to

subgrantees on an annual basis.

- Use local material and labor costs when running site-specific audits.
 - If subgrantees cannot use actual material and labor costs, use estimated material and labor costs updated a minimum of every 12 months.
 - Use the following Lawrence Berkley National Laboratory (LBL) provided Heating and Cooling Equipment Efficiency table (see below) or actual efficiency testing for existing equipment efficiency when running site-specific audits.

Lawrence Berkley National Labo Heating and Cooling Equipment Ef Pre-1970 - 1989

Year	Heating Equipment					
	Central Furnace / Room (Wall) Furnace				Central Heat Pump	Electrica Resistanc
	Natural Gas	Propane	Oil/ Kerosene	Electricity	Electricity	Electricit
	AFUE	AFUE	AFUE	Percent	HSPF	Percent
Pre-1970	60	60	70	98	6.21	98
1971	61.4	61.4	71.8	98	6.21	98
1972	62.7	62.7	73.6	98	6.21	98
1973	62.7	62.7	73.6	98	6.21	98
1974	62.7	62.7	73.6	98	6.21	98
1975	65.8	62.7	73.6	98	6.21	98
1976	66.1	63	74.1	98	6.21	98
1977	66.4	63.3	74.5	98	6.21	98

1978	66.7	63.6	75	98	6.21	98
1979	68.7	64.8	75.5	98	6.21	98
1980	70.6	65.9	76	98	6.21	98
1981	70.4	67.1	76.8	98	6.21	98
1982	70.3	68.4	77.5	98	6.21	98
1983	70.1	69.6	78.3	98	6.2	98
1984	72.6	73	78.6	98	6.36	98
1985	72.9	73.8	78.6	98	6.39	98
1986	73.7	74.3	79.6	98	6.55	98
1987	74.3	75.1	79.8	98	6.71	98
1988	74.9	75.8	80.4	98	6.88	98
1989	74.7	75.5	80.4	98	6.92	98

Lawrence Berkley National Labo Heating and Cooling Equipment Ef 1990 - Present Day

Year	Heating Equipment					
	Central Furnace / Room (Wall) Furnace				Central Heat Pump	Electrica Resistanc
	Natural Gas	Propane	Oil/ Kerosene	Electricity	Electricity	Electricit
	AFUE	AFUE	AFUE	Percent	HSPF	Percent
1990	76.7	75.7	80.3	98	7.03	98
1991	77.5	76.9	80.8	98	7.06	98
1992	82.1	83.2	80.8	98	7.1	98
1993	82.4	83.8	80.9	98	7.1	98

1994	82.4	83.9	80.9	98	7.1	98
1995	82.3	84.1	80.9	98	7.1	98
1996	82.7	84.1	80.9	98	7.4	98
1997	82.9	84.1	80.9	98	7.1	98
1998	82.6	84.1	80.9	98	7.4	98
1999	82.6	84.1	80.9	98	7.4	98
2000	82.6	84.1	80.9	98	7.4	98
2001	83.1	84.1	80.9	98	7.4	98
2002	83.1	84.1	80.9	98	7.4	98
2003	82.5	84.1	80.9	98	7.4	98
2004	82.6	84.1	80.9	98	7.4	98
2005	82.9	84.1	80.9	98	7.4	98
2006	82	84.1	80.9	98	7.9	98
2007	84.1	84.1	80.9	98	7.9	98
2008	84.8	84.1	80.9	98	7.9	98
2009	84.8	84.1	80.9	98	7.9	98
2010 & later	84.8	84.1	80.9	98	7.9	98

Verify that the **Energy Audit** measures recommended for implementation by the NEAT, the MHEA or the MulTEA audit have individual *SIRs* of 1.0 or greater.

Verify that the **Energy Audit** measures with an *SIR* of less than 1.0 **are not** to be implemented; Installing a measure(s) with a lower *SIR* without installing others with greater *SIRs* is not allowed.

Verify that the cumulative *SIR* for the home exceeds 1.0 or

the home ***must not*** be weatherized.

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

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

- In **single family homes**: NEAT Candidate Measures mandated for use by all subgrantees:
 - 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
- Refrigerator replacements
- Lighting retrofits
- Low flow shower heads

- In ***Manufactured Housing***: MHEA Candidate Measures mandated for use by all subgrantees:
 - 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
- Refrigerator replacements
- 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 housing* 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.

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

Verify 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

Verify that, pursuant to DOE Guidance:

- ALL *multi-family building* 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.

Verify that the Nebraska Energy Office has reviewed the submission from the subgrantee 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*. Common areas in *Multi-family Buildings* may be weatherized like the closest

living unit.

- 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 and do not require approval from the DOE Project Officer.

Verify and document all repair costs necessary for the installation or preservation of an energy saving weatherization measure are included in the audit.

Keep in mind that:

- The cost of the 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 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.

Verify that the home complies with ASHRAE Standard 62.2 as per DOE Guidance requirement.

- 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.
- *Continuous ventilation* is installed as required.

1.03 Deferrals

The decision to defer work in a dwelling is difficult but necessary in some cases. Subgrantees 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 & 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 (Form WX4).
- 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 subgrantees are required to adhere to their agency's grievance policies. If the grievance cannot be resolved through the subgrantee's process, the applicant will file a complaint with the Energy Office.

A "walk-away/deferral" is not a completion. Reimbursement for costs associated with a "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", not a completion 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 subgrantee'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

1.04 Client Education

The NeWAP provides subgrantees with opportunities 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 are 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 & Safety Educational Material

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

2 Health & Safety

Health & Safety measures **must** be performed in conjunction with cost-effective weatherization. Allowable Health & 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 deferral is necessary, provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence. A copy of this notification **must** also be placed in the client file.

When Not to Weatherize a Dwelling

There are some conditions and situations under which a subgrantee **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 subgrantee makes a determination that there are circumstances that prevent the weatherization process from proceeding, they **must**:

- Provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence.
- A copy of this notification **must** also be placed in the client

file and, if possible, refer the client to other service organizations that may be able to assist in solving the problem.

- Provide the client with a completed copy of the Nebraska WAP Weatherization Deferral Notice (Form WX4).
- 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 An unreasonable delay in acting on an application for assistance will constitute grounds for a hearing.

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 subgrantees are required to adhere to their agency's grievance policies. If the grievance cannot be resolved through the subgrantee's process, the applicant may file a complaint with the Nebraska Energy Office.

A subgrantee ***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 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 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 cost-effectively.
- The occupant or client is abusive or threatening to the crew, contractors, auditors, inspectors or others who **must** work on or visit the house.

A subgrantee **may choose not** to weatherize a dwelling unit if:

- The building 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 in close proximity to the house would potentially create further Health & 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 contractor, the work should not proceed until the condition is correct.
- There are unusual situations which, in the judgment of the auditor/subgrantee, **must** be corrected before providing weatherization

Client Health & Safety

There are a number of important Health & Safety issues related to weatherization work that can impact clients as well

as weatherization employees. 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 subgrantees **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. Subgrantees **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 & 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 & Safety risks. The initial home inspection **must** include a Health & 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.

Health & Safety Home Screening Questionnaire (Form WX7)

- Subgrantee personnel will interview and assist clients in completing a Health & Safety Home Screening Questionnaire 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.

If it is determined through the Health & 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 of the measure with no impact on weatherization measures with lower *SIRs*, **with prior Nebraska Energy Office approval**.

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. Request that the client 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.

Weatherization funds **cannot** be used to relocate clients or reimburse them for such costs incurred because 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.

Subgrantees **must** take all reasonable precautions against performing work on homes that would subject clients to Health & Safety risks.

Clients will also receive the following publications and/or documents:

- Health & Safety Home Screening Questionnaire (Form WX7)
- Renovate Right (occupants of all buildings built pre-1978)
- Lead Hazard Pre-Renovation Form (Form WX3)
- 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)
- Client Education Confirmation of Receipt (Form WX2)
- Nebraska Radon Information Fact Sheet
- Radon Informed Consent (WX6)
- **EPA's** A Citizen's Guide to Radon

2.01 Universal Safe Work Practices

Worker Health & Safety

Weatherization staff are vitally important and staff **must not** be required to work in unsafe and/or unhealthy unsanitary conditions. Costs related to Grantee Health & Safety training **must** be charged to Training & Technical Assistance.

- Subgrantee 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 & safety of themselves and other workers, including the use of personal protection equipment.
- Costs incurred by subgrantees to comply with OSHA requirements may be charged to the Health & 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.
- Subgrantees **must** consult OSHA standards for further
- MSDS documentation for all materials installed through the *Nebraska Weatherization Assistance Program* **must** be maintained on site during the weatherization of the home and on file by each program

[2.0106.1 \(a, b, c\) Health & Safety - Safe Work Practices -](#)

[Material Safety - Material Selection, Labeling, and Material Safety Data Sheets \(MSDSs\) \(SF\) \(MH\)](#)

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

[2.0100.1b \(b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, r\) Health & Safety - Safe Work Practices - Global Worker Safety \(SF\) \(MH\)](#)

[2.0103.2 \(d\) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Heating and Cooling Worker Safety - Personal Protective Equipment \(SF\) \(MH\)](#)

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

- Global Worker Safety

[2.0100.1 \(b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, r\) Health & Safety - Safe Work Practices - Global Worker Safety \(SF\) \(MH\)](#)

[2.0101.1 \(a\) Health & Safety - Safe Work Practices - Air Sealing - Air Sealing Worker Safety \(SF\) \(MH\)](#)

[2.0104.1 \(a\) Health & Safety - Ventilation Equipment - Ventilation Worker Safety \(SF\) \(MH\)](#)

- Tool Safety

[2.0100.1 \(h\) Health & Safety - Safe Work Practices - Global Worker Safety - Power Tool Safety \(SF\) \(MH\)](#)

- Electrical Safety

[2.0100.1 \(d\) Health & Safety - Safe Work Practices - Global Worker Safety - Electrical Safety \(SF\) \(MH\)](#)

- Ergonomic and Repetitive Stress Injuries

[2.0100.1 \(j\) Health & Safety - Safe Work Practices - Global Worker Safety - Ergonomic Safety \(SF\) \(MH\)](#)

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 \(b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, r\) Health & Safety - Safe Work Practices - Global Worker Safety \(SF\) \(MH\)](#)

2.0101 Air Sealing

[2.0101.1 \(a, b, c, d\) Health & Safety - Safe Work Practices - Air Sealing - Air Sealing Worker Safety \(SF\) \(MH\)](#)

2.0102 Insulation

[2.0102.1 \(a, b, c, d\) Health & Safety - Safe Work Practices - Insulation - Insulation Worker Safety \(SF\) \(MH\)](#)

2.0103 Heating and Cooling Equipment

[2.0103.1 \(a, b, c\) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Combustion Worker Safety \(SF\) \(MH\)](#)

[2.0103.2 \(d\) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Personal Protective Equipment \(PPE\) \(SF\) \(MH\)](#)

[2.0201.1 \(a, b, c, d, e\) Health & Safety - Combustion Safety - Combustion Safety General - Combustion Appliance Zone \(CAZ\) Testing \(SF\) \(MH\)](#)

[2.0203.1 \(a, b, c\) Health & Safety - Combustion Safety - Vented Gas Appliances - Combustion Air for Natural Draft Appliances \(SF\) \(MH\)](#)

[2.0204.1 \(a, b, c, d\) Health & Safety - Combustion Safety - Isolation - Isolating Combustion Water Heater Closet \(MH\)](#)

2.0105 Baseload

[2.0105.1 \(a\) Health & Safety - Safe Work Practices - Baseload - Baseload Worker Safety \(SF\) \(MH\)](#)

[2.0602.1 \(a, b\) Health & Safety - Electrical - Electrical Hazard - Static Electric Shock \(SF\) \(MH\)](#)

[2.0602.2 \(a, b, c, d\) Health & Safety - Electrical - Electrical Hazard - House Current Electric Hazard \(MH\)](#)

2.0106 Material Safety

[2.0100.1 \(o\) Health & Safety - Global Worker Safety - Safe Work Practices - Asbestos-containing materials \(ACM\) \(SF\) \(MH\)](#)

[2.0102.1 \(b\) Health & Safety - Safe Work Practices - Insulation - Insulation Worker Safety - Worker Safety - \(ACM\) \(SF\) \(MH\)](#)

[2.0106.1 \(a\) Health & Safety - Safe Work Practices - Material Safety - Material Selection, Labeling, and Material Safety Data Sheets \(MSDSs\) \(SF\) \(MH\)](#)

2.0107 Basements and Crawl Spaces

[2.0107.1 \(a\) Health & Safety - Safe Work Practices - Basements and Crawl Spaces - Basements and Crawl Spaces Worker Safety \(SF\)](#)

[2.0107.2 \(a, b, c, d, e, f, g\) Health & Safety - Safe Work Practices - Basements and Crawl Spaces - Crawl Spaces - Pre-Work Qualifications \(SF\)](#)

[2.0107.3 \(a, b\) Health & Safety - Safe Work Practices - Basements and Crawl Spaces - Crawl Spaces - Debris Removal \(SF\)](#)

[2.0107.4 \(a\) Health & Safety - Safe Work Practices - Basements and Crawl Spaces - Negative Pressure Contamination Control \(SF\)](#)

[2.0107.5 \(a, b\) Health & Safety - Safe Work Practices - Basements and Crawl Spaces - Prework Qualifications \(Home Installation\) \(MH\)](#)

2.02 Heating System Guidance

NeWAP subgrantees' *Trained 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 Budget Category Determination

NeWAP subgrantees **must** perform a full-DOE approved energy audit **prior** to deciding how to categorize the cost of space heat repair or replacement. If the measure is an approved NeWAP expenditure and the audit justifies the costs with an *SIR* equal to or greater than 1.0, the measure **must** be performed and costs charged as an Energy Conservation Measure (ECM). If the measure is not an eligible ECM, the measure may be charged as a Health & Safety (H&S) measure.

2.0202 Code Compliance and Heating System Inspection Requirements

2.0202.1 Code Compliance

Installation of space heating requires knowledge of appropriate industry standards and compliance with the applicable building code(s) in the jurisdiction where the installation is taking place. Building permits shall be secured,

where required for all space heater work. This is a program operations cost. Also see [2.0807 Code Compliance](#).

2.0202.2 Inspection Requirements

Action/Allowability:

- Prior to weatherizing the *building envelope*, all *eligible heating plants* **must** be inspected by a *Qualified Heating Technician*, utility company or *Trained Weatherization Staff*.
- Manufacturer approved initial start-up procedures **must** be followed before any heater is put into operation.
- Inspect venting of combustion appliances and confirm adequate clearances.
- Inspect for adequate floor protection.
- The State of Nebraska's annual heating degree day normal, over the forty seven year period from 1970-2017 is 6322, with January average °F high and low temperatures of 35 to 12. 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.
- 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 \(a, b, c, d, e\) Health & Safety - Combustion Safety - Vented Gas Appliances - Combustion Flue Gas - Orphaned Water Heaters \(SF\)](#)

Testing:

- A backdraft test **must** be performed at the time of Initial Inspection, the *Quality Control* and at the end of each work day in which envelope or duct sealing measures have been performed, 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.
- Test naturally drafting appliances for draft and spillage under worst case conditions before and after air tightening.
- See [2.04 System Safety Testing, Inspection, Verification, and Documentation](#)

Client Education:

- When deferral is necessary, provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence. A copy of this notification **must** also be placed in the client file.
- Provide client with combustion safety and hazards information.
- Provide client with verbal and written information on the use of the CO and smoke detectors.

[2.0103.1 \(b\) Health & Safety - Safe Work Practices -](#)

[Heating and Cooling Equipment - Combustion Worker Safety - Carbon Monoxide \(SF\) \(MH\)](#)

[2.0201.2 \(c\) Health & Safety - Combustion Safety General - Combustion Safety - Make-up Air - CO detection and warning equipment \(SF\) \(MH\)](#)

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.
- *Manufactured homes* that have non-manufactured home combustion water heaters.
- *Manufactured homes* that have non-manufactured home or incorrectly installed solid fuel combustion *heating homes system*

2.0203 Electric Space Heaters

Action/Allowability:

- Repair, replacement or installation is not allowed.
- Removal is recommended.

Testing:

- 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.

2.0204 Fireplaces - Special Considerations

Fireplaces present special hazards that are affected by weatherization. If draft is poor, smoke may downdraft into living space causing poor indoor air quality, which can be appropriately ventilated by the client. However, near the end of a wood fire glowing coals remain, radiating heat; while the draft lowers and allows the top of the chimney to cool, further reducing draft. The reduced draft also reduces oxygen available to glowing coals causing production of CO without the smoke that encourages appropriate space ventilation. This creates a dangerous situation as the CO enters the living space due to the lowered draft, causing drowsiness, and sometimes more dangerous situations for the occupants.

Action/Allowability:

- *Manufactured homes that have non-manufactured home or incorrectly installed solid fuel combustion heating systems **must** be deferred.*

Inspecting/Evaluating/Testing:

Inspection

- Fireplaces **must** be inspected pre- and post-weatherization.
- The inspection shall include, but not be limited to:
 - System clearances to combustibles, inside and outside of the home.
 - The type and condition of the flooring material where the unit is installed.
 - Visual signs of wear or missing or malfunctioning components.

- Evidence of ash deposit build-out.
- Evidence of creosote build-up.
- Signs of structural failure.
- Evidence of blockage, restriction, leakage, corrosion and/or flame roll-out.
- Visual evidence of soot on the walls, mantel or ceiling or hearth.

Evaluating

- Assessing solid fuel fired appliances involves inspecting the venting/chimney and the overall installation to ensure it adheres to applicable state and local codes.
- State code requires that the flue areas and chimney requirements of masonry fireplaces meet the following requirements:
 - Flue area requirements of masonry fireplaces (excluding sealed combustion/direct vented units) **must** meet the following requirement:
 - Round chimney flues shall have a minimum cross-sectional area of at least 1/12 of the fireplace opening.
 - Square chimney flues shall have a minimum cross-sectional area of at least 1/10 of the fireplace opening.
 - Rectangular chimney flues with an aspect ratio less than 2 to 1 shall have a minimum cross-sectional area of at least 1/10 of the fireplace opening.
 - Rectangular chimney flues with an aspect ratio of 2 to 1 or more shall have a minimum cross-sectional area of at least 1/8 of the fireplace opening.

Cross-sectional areas of round, square and rectangular flue sizes are provided in the following tables.

Net Cross-sectional Area of

Round Flue Sizes

Flue Size, Inside Diameter (Inches)	Cross-sectional Area (square inches)
6	28
7	38
8	50
10	78
10.75	90
12	113
15	176
18	254

Net Cross-sectional Area of Square and Rectangular Flue Sizes

Flue Size, Outside Nominal Dimensions (Inches)	Cross-sectional Area (square inches)
4.5 X 8.5	23
4.5 X 13	34
8 X 8	42
8.5 X 8.5	49
8 X 12	67
8.5 X 13	76

12 X 12	102
8.5 X 18	101
13 X 13	127
12 X 16	131
13 X 18	173
16 X 16	181
16 X 20	222
18 X 18	233
20 X 20	298
20 X 24	335
24 X 24	431

- State code requires chimney terminations extend at least 2 feet higher than any portion of a building within 10 feet, but shall not be less than 3 feet above the highest point where the chimney passes through the roof.
- Appropriate chimney caps and/or rain caps **must** be in place.
- Homes with fireplaces and solid fuel fired appliances that do not meet state and local code requirements regarding flue area and chimney terminations **must** not be weatherized.
- Homes with fireplaces and solid fuel fired appliances that are indicated in the pre-inspection of having any deficiency that could cause an unsafe condition **must not** be weatherized.

Testing:

Gas Fireplaces:

- Non-sealed combustion type and venting into a conventional chimney with or without a pre-constructed liner.
 - A spillage test is required and is to be performed when the CAZ is under worst case depressurization.
 - Complete using moving a smoke stick directly in front of the fireplace in a traverse-like pattern.
 - Any spillage after one minute is a failure.
 - If spillage occurs under worst case depressurization, spillage testing would then be performed under natural conditions.
 - CO is to be tested in ambient air directly in front of and above the fireplace if the inspector is unable to place the test probe in the exhaust vent or exterior termination point.
- Sealed combustion insert.
 - A spillage test is not required, but it is recommended to use a smoke stick directly in front of the fireplace while operating. Any sign of spillage may indicate an issue and should be appropriately documented.
 - CO is to be tested in ambient air directly in front of and above the unit if the inspector is unable to place the test probe in the exhaust vent or exterior termination point.

Gas Stoves:

- If the gas stove is specified for use as a heating appliance:
 - A spillage test is required and is to be performed when the CAZ is under worst case depressurization.
 - Any spillage after one minute is a failure.
 - If spillage occurs under worst case depressurization, spillage testing would then be performed under natural conditions.
 - If the vent pipe is accessible, carbon monoxide testing is

required.

- If the vent pipe is accessible, draft testing is required.

Wood Fireplaces and Pellet Stoves:

- Non-sealed combustion type and venting into a conventional chimney.
 - A backdraft test **must not** be performed on wood fireplaces and pellet stoves.
 - A spillage test **must not** be performed on wood fireplaces and pellet stoves.
 - CO tests **must not** be performed on wood fireplaces and pellet stoves.

Weatherized homes containing wood, gas or pellet fireplaces and/or stoves:

- **must** be evaluated for the impact of their operation on other combustion appliances. A blower door **must** be set to run at 300 *CFM* (set up as for depressurization testing) to mimic the worst case airflow dynamics likely when a fireplace or stove is in use.
- If spillage occurs in the other combustion appliances under the worst case depressurization test, spillage testing would then be performed under natural conditions and Carbon Monoxide Detectors will be installed, as per manufacturer's instructions, located adjacent to the fireplace and the back-drafting appliance.

Client Education:

- When deferral is necessary, provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence. A copy of this notification **must** also be placed in the client file.
- Provide client with verbal and written information on the

use of the CO and smoke detectors.

[2.0103.1 \(b\) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Carbon Monoxide \(SF\)](#)

2.0205 *Manufactured Homes* - Special Considerations

Manufactured Home Construction Safety Standards require all fuel-burning, heat producing appliances, except ranges and ovens, to be vented to the outside. All fuel burning appliances in *manufactured homes* (excluding ranges, ovens, illuminating appliances, clothes dryers, solid fuel-burning fireplaces and solid fuel-burning stoves) **must** be installed to provide separation of the combustion system from the interior atmosphere of the home (i.e. to draw their combustion air from the outside).

Action/Allowability:

- Replacement gas water heaters in *manufactured homes* **must** be specifically designed as *manufactured housing* water heaters.
- Replacement furnaces in *manufactured homes* **must** be specifically designed as *manufactured housing*
- See [Chapter 5 Heating and Cooling](#) and [Chapter 7 Baseload](#) for additional Heating and Water Heating System requirements.

Testing:

- See [2.04 System Safety Testing, Inspection, Verification, and Documentation](#)

Client Education:

- When deferral is necessary, provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence. A copy of this notification **must** also be placed in the client file.

2.0206 Masonry Chimneys

Masonry chimneys used by vented space heaters should be properly lined in compliance with the International Fuel Gas Code (IFGC). When NeWAP installs new equipment the installation **must** meet all local and state code requirements.

Masonry chimneys that have been retired (i.e. not being use by existing equipment) should be assessed for energy saving opportunities such as *infiltration* reduction, air sealing and capping to reduce thermal bypass.

2.0207 Solid-Fuel Space Heaters

Space heaters are self-contained devices that are generally used for heating a specific area. These types of heating devices are often associated with fires and carbon monoxide poisoning risks. Solid fueled space heaters including wood stoves, coal stoves, pellet stoves, and fireplaces and wood, coal, and pellet fired furnace and boiler systems are considered by DOE to be vented *heating systems*.

Action/Allowability:

- Access solid fuel-fired appliances to ensure safe installation prior to weatherization activities taking place.
- Repair or removal of primary and secondary heating units is allowed where occupant Health & Safety is concerned,

with prior Energy Office approval.

- Replacement of primary heating units is allowed, with prior Energy Office approval, but replacement of secondary units is **not** allowed.
- Install replacement units and flues according to state and local code requirements.
- Repair of flues and verification of proper installation (e.g. protection of combustibles) is required for both primary and secondary solid fuel heating appliances.

Client Education:

- Provide client with safety information.

2.0208 Unvented Gas - and Liquid-Fueled Space Heaters

Action/Allowability:

Primary Heat Sources:

- NeWAP **must** not provide weatherization services in any residence where the completed unit is heated with an unvented-gas and/or liquid-fueled space heater as the primary heat source.
- The primary unit **must** be replaced with a vented unit prior to weatherization.
- The replacement unit should be sized so it is capable of heating the entire dwelling unit, consistent with audit requirements described in 10 CFR 440.21(e)(2).
- 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 heater(s).

Secondary Heat Sources:

- Secondary unvented units that conform to the safety standards on ANSI Z21.11.2 may remain as back-up heat sources.
- Units that do not meet ANSI Z21.11.2 **must** be removed, and properly disposed of, prior to weatherization but may remain until a replacement *heating system* is in place.
- Secondary unvented units that conform to the safety standards on ANSI Z21.11.2, but are not operating safely, **must** be removed and properly disposed of.
- Repair of secondary unvented units is not allowed.
- An unvented gas-liquid-fueled space heater that remains in a completed single-family house after weatherization shall:
 - Not have an input rating in excess of 40,000 Btu/hour;
 - Not be located in, or obtain combustion air from sleeping rooms, bathrooms, toilet rooms, or storage closets, except:
 - One listed wall-mounted space heater in a bathroom if permitted by the authority having jurisdiction which:
 - has an input rating that does not exceed 6,000 Btu/hour;
 - Is equipped with an oxygen-depletion sensing safety shut-off system; and
 - The bathroom has adequate combustion air;
 - One listed wall-mounted space heater in a bedroom if permitted by the authority having jurisdiction which:
 - has an input rating that does not exceed 10,000 Btu/hour;
 - Is equipped with an oxygen-depletion sensing safety shut-off system; and
 - The bathroom has adequate combustion air.

Testing:

- Testing for air-free carbon monoxide (CO).
- Check units for ANSI Z21.11.2 label.

Client Education:

- If the need for *unvented combustion space heaters* cannot be eliminated, the subgrantee **must** instruct the client regarding the dangers of carbon monoxide and excessive moisture levels.
- Inform client of the dangers of unvented space heaters - CO, moisture, NO₂. CO can be dangerous even if the 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 \(SF\) \(MH\)](#)

2.0209 Vented Gas- and Liquid-Fueled Space Heaters

Treat vented gas- and liquid-fueled space heaters the same as furnaces in terms of combustion safety testing, repair and replacement. This policy applies to vented space heaters fueled by natural gas, propane, or oil. Venting should be tested consistent with furnaces.

2.03 Carbon Monoxide Testing, Inspection, Verification, and Documentation

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 and 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

Action/Allowability:

- 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 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 battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is

required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

- *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 200 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.
- Maintenance, repair and replacement of primary indoor heating units is allowed where occupant Health & Safety is concerned, with prior Energy Office approval.
- Maintenance and repair of secondary heating units is allowed.
- The home **must** be deferred 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.
- *Manufactured homes* that have non-*manufactured home* combustion water heaters **must** be deferred.
- *Manufactured homes* that have non-*manufactured home* or incorrectly installed solid fuel combustion *heating systems* **must** be deferred.

Client Education:

- When deferral is necessary, provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence. A copy of this notification **must** also be placed in the client file.

- 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.

2.0103.1 (b) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Carbon Monoxide (SF) (MH)

2.0301.1 (a) 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 System Safety Testing, Inspection, Verification, and Documentation

2.0401 Combustion Appliance Testing

Action/Allowability:

- Prior to weatherizing the *building envelope*, all eligible *heating plants* **must** be inspected by a *Qualified Heating Technician*, utility company or *Trained 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 in which envelope or duct sealing measures have been performed, if the project will require more than one day, on all vented naturally drafting combustion appliances.
- The State of Nebraska's annual heating degree day normal, over the forty seven year period from 1970-2017 is 6322, with January average °F high and low temperatures of 35 to 12. 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 \(a, b, c, d, e\) Health & Safety - Combustion Safety - Vented Gas Appliances - 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 subgrantee **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 & 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 & 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.

[2.0203.1 \(a, b, c\) Health & Safety - Combustion Safety - Vented Gas Appliances - Combustion Air for Natural Draft Appliances \(SF\) \(MH\)](#)

- The home ***must be deferred*** 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.
- *Manufactured homes* that have non-*manufactured home* combustion water heaters ***must*** be deferred.
- *Manufactured homes* that have non-*manufactured home* or incorrectly installed solid fuel combustion *heating systems* ***must*** be deferred.

Testing:

- 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.
- Inspect cooking burners for operability and flame quality.

Client Education:

- When deferral is necessary, provide information to the client, in writing, describing conditions that ***must*** be met in order for weatherization to commence. A copy of this notification ***must*** also be placed in the client file.
- 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.

[2.0103.1 \(b\) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Carbon Monoxide \(SF\) \(MH\)](#)

[2.0301.1 \(b\) Health & Safety - Combustion Safety Devices - Smoke Alarm \(SF\) \(MH\)](#)

[2.0301.2 \(a, b\) Health & Safety - Combustion Safety Devices - Carbon Monoxide Alarm or Monitor \(SF\) \(MH\)](#)

2.0402 Leak Testing Gas Appliances and Piping

Action/Allowability:

- 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.
- 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.

[2.0103.1 \(a, b, c\) Health & Safety - Safe Work Practices-](#)

[Heating and Cooling Equipment - Combustion Worker Safety \(SF\) \(MH\)](#)

Testing:

- Sniff all valves and joints with the gas sniffer.

[2.0201.1 \(b\) Health & Safety - Combustion Safety - Combustion Safety Testing - General - Combustion Appliance Zone \(CAZ\) Testing - Fuel Leak Detection \(SF\) \(MH\)](#)

- Accurately locate leaks using a non-corrosive bubbling liquid, designed for finding gas leaks.

2.0403 Verify the BTU Input on Natural Gas Appliances by Clocking (timing) the Gas Meter

Action/Allowability:

- 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: $(3,600 \times 1,000)/\text{number of seconds}$

- 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.

2.0404 Complete Initial Inspection of the *Heating System*:

Action/Allowability:

- 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.
- 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 and 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 and 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.

Testing:

- Test the pilot safety device to determine that it is operating properly.
- 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.

2.0405 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 backdrafting. *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 \(a, b, c\) Health & Safety - Combustion Safety - Vented Gas Appliances - Combustion Air for Natural Draft Appliances \(SF\) \(MH\)](#)

Action/Allowability:

- NeWAP subgrantees **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 **must**:
 - 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:

The furnace has an input rating of 100,000 Btu/hour.

The water heater has an input rating of 40,000 Btu/hour.

Therefore, there should be 280 in² of net free area of vent between the mechanical room and other rooms in the home. ($[100,000 + 40,000] \div 1,000 = 140 \times 2 \text{ in}^2 = 280 \text{ in}^2$).
- 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.

Manufactured housing specific work standards:

- The combustion air sleeves and air conditioner condensates to the underbelly **must not** be covered.
- The costs associated with installing the make-up fresh air **must** be charged to Health & Safety.

2.0406 Complete Combustion Appliance Zone (CAZ) Testing

Action/Allowability:

- NeWAP subgrantees **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 the CAZ Depressurization Test (Form WX9).

Testing:

CAZ testing **must** include, but not be limited to:

- Testing for carbon monoxide.
- Measuring house pressures in CAZ "Worst Case"

[2.0201.1 \(a, b, c, d, e\) Health & Safety - Combustion Safety - Combustion Safety General - Combustion Appliance Zone \(CAZ\) Testing \(SF\) \(MH\)](#)

- 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.
- Testing CAZ carbon monoxide levels.
 - 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.

2.0407 Inspecting and Testing Gas Ranges and Ovens

Action/Allowability:

- 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 *Trained Weatherization Staff* or *Qualified Heating Technician*.

- Replacement, repair and cleaning of gas ranges and ovens are **not** eligible expenditures thru the NeWAP.
- 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.

Testing:

- Inspect cooking burners for operability and flame quality.
- Test each stovetop 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.
 - If the CO reading for the oven is over 225 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.*

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.
- 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.

[2.0201.2 \(d, e\) Health & Safety - Combustion Safety General - Combustion Safety - Make-up Air - Gas Ovens & Gas Range Burners \(SF\) \(MH\)](#)

2.0408 Inspecting and Testing Vented Gas Appliances

Action/Allowability:

- Inspect, assess and appropriately document information on existing vented gas appliances within a home to ensure all equipment is operating safely and clients are educated on the proper use of the equipment.
- Verify isolation of water heater closets from *conditioned spaces* in *manufactured housing*.
- Document any work required to 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 & Safety - Combustion Safety - Isolation - Isolating Combustion Water Heater Closet \(MH\)](#)

2.07 Occupant Education and Access

2.0701 *Basements and Crawl Spaces*

[2.0701.2 \(a, b, c\) Health & Safety - Occupant Education and Access - *Basement and Crawl Spaces* - *Crawl Space Information Sign* \(SF\)](#)

[2.0701.3 \(a, b, c\) Health & Safety - Occupant Education and Access - *Basement and Crawl Spaces* - *Crawl Space - Occupant Education* \(SF\)](#)

2.08 DOE Health & Safety Program Guidance Requirements

2.0801 Air Conditioning and Heating Systems /Units

Action/Allowability:

When a space conditioning system does not qualify as an ECM, the following conditions **must** be met before the unit can be replaced or repaired with Health and Safety funds:

- "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.
 - 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.
- Using proper protocols (Manual J, NEAT/MHEA outputs, etc.) based on post-weatherization housing characteristics, including installing mechanical ventilation, when installing

or replacing a heating or cooling appliance.

- Unsafe primary units **must** be repaired, replaced and removed, or rendered inoperable, or deferral is required.
- Replacement or installation of secondary units is not allowed.
- Unsafe secondary units, including space heaters, **must** be removed or deferral is required.
- See [2.0813 Hazardous Materials Disposal](#) for more information.

Testing:

- Make sure systems are present, operable, and performing correctly.
- Check DOE-approved audit to determine if the system can be installed as an energy conservation measure (ECM) prior to replacement as a Health & Safety measure.
- On combustion equipment, inspect chimney and flue and test for *Combustion Appliance Zone (CAZ)* depressurization.
- For solid fuel appliances look for visual evidence of soot on the walls, mantel or ceiling or creosote staining near the flue pipe.

Client Education:

- When deferral is necessary, provide information to the client, in writing, describing conditions that **must** be met in order for weatherization to commence. A copy of this notification **must** also be placed in the client file.
- Discuss appropriate use and maintenance of units.
- Provide all paperwork and manuals for any installed equipment.

- Discuss and provide information on proper disposal of bulk fuel tanks when not removed as part of the weatherization work.
- Where combustion equipment is present, provide safety information regarding how to recognize depressurization.

Training:

- WAP Health & Safety policy training on allowable activities.
- Licensing and/or certification for HVAC installers as required by authority having jurisdiction (AHJ).
- CAZ depressurization test and inspection training.

Asbestos

WAP staff members often encounter asbestos. Asbestos sources include, but are not limited to:

- Siding,
- Pipe or furnace coverings,
- Vermiculite mined from areas known to contain asbestos, or even in
- Some textured paints and interior finishes.

NeWAP subgrantees **must** follow these Health & Safety - Safe Work Practices:

[2.0100.1 \(o\) Health & Safety - Safe Work Practices - Global Worker Safety - Asbestos - Containing Materials \(SF\) \(MH\)](#)

[2.0102.1 \(b\) Health & Safety - Safe Work Practices - Insulation - Insulation Worker Safety \(SF\) \(MH\)](#)

2.0802 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.

Action/Allowability:

NeWAP Subgrantees **must** take all reasonable and necessary precautions to prevent asbestos contamination in the home, including but not limited to:

- Completing visual inspections of inspect exterior wall

surface and subsurface, floors, walls, and ceilings for suspected ACM.

- In homes where *friable* suspected ACM siding, as determined by an appropriately trained crew leader, auditor or inspector or testing, is present:
 - The subgrantee **must** take precautionary measures as if it contains asbestos, such as utilizing personal air monit
 - Blower door testing, using positive pressure techniques, **must** be completed.
 - Wall insulation measure work **must** be completed from the interior of the home.
 - The costs associated with asbestos testing, abatement or replacement with new siding are **not** eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- In homes with asbestos siding, as determined by an appropriately trained crew leader, auditor or inspector or testing, is present and in good condition:
 - Installing dense-pack insulation from the exterior is allowed.
 - Blower door testing, using either negative or positive pressure techniques, **must** be completed.
- Removal of siding is allowed to perform energy conservation measures; however precautions **must** be taken not to damage the Asbestos siding should never be cut, sanded or drilled. Where possible, insulate the exterior walls through the interior of the home. 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.
- Any testing results used to support the installation of ECM associated with the exterior walls of the homes **must** include appropriate documentation indicating the sample collection and testing was conducted by an Asbestos

Hazard Emergency Response Act of 1986 (AHERA) certified tester. A copy of the test results **must** be included in the client file.

- The costs associated with asbestos testing are **not** eligible expenditures in the *Nebraska Weatherization Assistance Program*.

Testing:

- Visually inspect exterior wall surface and subsurface, floors, walls, and ceilings for suspected ACM prior to drilling or cutting.

Client Education:

- Inform the client in writing that suspected ACMs are present and what precautions will be taken to ensure the occupants' and workers' safety during weatherization.
- Instruct client in writing not to disturb suspected ACM.
- Provide asbestos safety information to the client.
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for weatherization to commence.

Training:

- Safe practices for siding removal and replacement.
- How to identify suspected ACM.
- Licensing/certification for removal and reinstallation of asbestos siding if required by AHJ.
 - The costs associated with asbestos abatement, encapsulation or replacement with new siding are **not** eligible expenditures in the *Nebraska Weatherization Assistance Program*.

- Cost incurred by subgrantees to comply with asbestos inspection training requirements **may** be charged to the Health & Safety budget category.

2.0803 Asbestos in Vermiculite

Action/Allowability:

NeWAP Subgrantees **must** take all reasonable and necessary precautions to prevent asbestos contamination in the home, including but not limited to:

- Completing visual inspections of exterior wall surface and subsurface, floors, walls, and ceilings for suspected ACM.
- If the presence of asbestos has been previously confirmed or if the subgrantee believes that vermiculite insulation is present:
 - The subgrantee **must** take precautionary measures as if it contains asbestos, such as utilizing personal air monitoring while in attics.
 - When blower door tests are performed, it **must** be performed using pressurization instead of depressurization.
 - 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.
- The costs associated with vermiculite/asbestos testing is an eligible expenditures in the *Nebraska Weatherization Assistance Program*. Subgrantees are limited to a maximum cost of \$150 for vermiculite testing.
- The costs associated with vermiculite abatement or encapsulation are **not** eligible expenditures in the *Nebraska Weatherization Assistance Program*.

- 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.
- When deferral is necessary due to asbestos, the home owner/occupant **must** provide remediation documentation indicating the remediation was completed by an Asbestos Hazard Emergency Response Act of 1986 (AHERA) certified professional, prior to the implementation of the attic insulation ECMs.
- A copy of the documentation **must** be included in the client file.

Testing:

- AHERA sample collection and testing **must** be conducted by a certified tester and is an eligible expenditure in the *Nebraska Weatherization Assistance Program*.
 - Subgrantees are limited to a maximum cost of \$150 for vermiculite testing.
- Cost incurred by subgrantees to comply with asbestos training requirements may be charged to the Health & Safety budget category.

Client Education:

- Inform the client in writing that suspected ACMs are present and what precautions will be taken to ensure the occupants' and workers' safety during weatherization.
- Instruct client in writing not to disturb suspected
- Provide asbestos safety information to the client.
- Formally notify the client in writing of results, if testing was performed.
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for

weatherization to commence.

Training:

- Train on how to recognize vermiculite.
- AHERA or state certification to conduct testing.

2.0804 Asbestos on Pipes, Furnaces, other Small Covered Surfaces

Action/Allowability:

NeWAP Subgrantees **must** take all reasonable and necessary precautions to prevent asbestos contamination in the home including but not limited to:

- Completing visual inspections of all surfaces and subsurfaces, piping, and equipment for suspected ACM.
- Assume asbestos is present in suspect covering materials.
- In homes where *friable* suspected ACM, as determined by an appropriately trained crew leader, auditor or inspector or testing, is present:
 - The subgrantee **must** take precautionary measures as if it contains asbestos, such as utilizing personal air monit
 - Blower door testing **must not** be completed.
 - The costs associated with asbestos testing, abatement or encapsulation **not** eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- In homes with asbestos, as determined by an appropriately trained crew leader, auditor or inspector or testing, is present, encapsulated and in good condition:
 - Weatherization work may continue.

- Blower door testing, using either negative or positive pressure techniques, **must** be completed.
- 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.
- When deferral is necessary due to asbestos, the home owner/occupant **must** provide remediation documentation indicating the remediation was completed by an Asbestos Hazard Emergency Response Act of 1986 (AHERA) certified professional, prior to weatherization.
- A copy of the documentation **must** be included in the client file.

Testing:

- Visually inspections of all surfaces and subsurfaces, piping, and equipment for suspected ACM.
- AHERA sample testing **must** be conducted by a certified tester, however sampling, testing, encapsulation and remediation costs are **not** eligible expenditures in the *Nebraska Weatherization Assistance Program*.
- Cost incurred by subgrantees to comply with asbestos training requirements may be charged to the Health & Safety budget category.

Client Education:

- Inform the client in writing that suspected ACMs are present and what precautions will be taken to ensure the occupants' and workers' safety during weatherization.
- Instruct client in writing not to disturb suspected
- Provide asbestos safety information to the client
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for

weatherization to commence.

Training:

- How to identify suspected ACM.
- Cost incurred by subgrantees to comply with asbestos inspection training requirements **may** be charged to the Health & Safety budget category.

2.0805 Biological and Unsanitary Conditions - Odors, Bacteria, Viruses, Raw Sewage, Rotting Wood, etc.

Action/Allowability:

- Remediation of **minor** conditions that may lead to or promote biological concerns and unsanitary conditions is allowed. Subgrantees are limited to a maximum cost of \$300 to remediate these **minor** conditions, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- Addressing bacteria, viruses or major biological and/or unsanitary conditions **is not** an allowable reimbursable cost.
- Deferral may be necessary in cases where conditions in the home pose a health risk to occupants and/or weatherization workers.
- See [2.0816 Mold and Moisture](#) for more information.

Testing:

- Sensory inspection.

Client Education:

- Inform client in writing of observed conditions.
- Provide information on how to maintain a sanitary
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for weatherization to commence.

Training:

- How to recognize unsafe conditions and when to defer.
- Safe work practices when encountering such conditions.

2.0806 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.

Action/Allowability:

- Building rehabilitation is beyond the scope of the *Nebraska Weatherization Assistance Program*.
- Homes that require more than minor repairs, as described in this guidance, **must** be deferred.
- See [2.0816 Mold and Moisture](#), [2.0807 Code Compliance](#)

and [2.0818 Pests sections](#) for more information.

Testing:

- Visual inspection.
- Ensure that access to the portions of the home where weatherization will occur are safe for entry and performance of assessments, work, and inspections.

Client Education:

- Notify client in writing of structurally compromised areas.
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for weatherization to commence.

Training:

- How to identify structural and roofing issues.

2.0807 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.

Action/Allowability:

- Correction of preexisting code compliance issues is **not** an allowable cost unless triggered by weatherization measures being installed in a specific room or area of the home.
 - It is each subgrantee'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.
- When correction of preexisting code compliance issues is triggered and paid for with WAP funds, cite specific code requirements with reference to the weatherization measure(s) that triggered the code compliance issue in the client file.
- Follow State and local or AHJ codes while installing weatherization measures, including H&S measures.
- Condemned properties and properties where "red tagged" Health & Safety conditions exist that cannot be corrected under this guidance **must** be deferred.

Testing:

- Visual inspection.

Client Education:

- Inform client in writing of observed code compliance issues when it results in a deferral.

- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for weatherization to commence.

Training:

- How to determine what code compliance may be required.

2.0808 Combustion Gases

Action/Allowability:

- Proper venting to the outside for combustion appliances, including gas dryers and refrigerators, furnaces, vented space heaters and water heaters is required.
- Correct venting when testing indicates a problem.
- If unsafe conditions, associated with furnace and water heaters exist, whose remediation is necessary to perform weatherization cannot be remedied by repair, replacement is an allowed Health & Safety measure.
- A **maximum** of \$250 in material and labor may be spent to correct deficiencies in water heat. 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.
- Maintain documentation justifying the replacement with a cost comparison between replacement and repair in the client file.

- Replacement and repair 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:

- Combustion safety testing is required when combustion appliances are present.
- Test naturally drafting appliances for spillage and CO during CAZ depressurization pre- and post-weatherization and before leaving the home on any day when work has been done that could affect draft (e.g. tightening the home, adding exhaust) Include copies of all required CAZ Depressurization Test (WX9) and Daily Safety Test Out (WX10) testing WX forms in client file requirement.
- Inspect venting of combustion appliances and confirm adequate clearances.
- Check DOE-approved audit to determine if the appliance can be justified as an ECM prior to replacement as a Health & Safety measure.

Client Education:

- Provide client with combustion safety and hazards information.

Training:

- How to perform appropriate testing, determine when a building is excessively depressurized, and the difference air free and as-measured CO.
- CO action levels.

2.0809 Electrical

Electrical Issues:

The two primary energy-related Health & 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.

Action/Allowability:

Knob-and-Tube Wiring in Attics:

- The Nebraska State Electrical Board does not permit directly covering knob and tube wiring with insulation.
- In attics where knob-and-tube wiring has been previously covered and it has been determined to be cost-effective to install additional insulation, the insulation work **must** be completed:
 - when it has been determined where the wiring is located,
 - following a determination that it is actually still "active", and
 - after the wiring has been appropriately covered to prevent direct contact with the insulation and to provide adequate air space (a minimum of 3 1/2" 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 \(SF\)](#)

- 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.

[2.0601.1 \(a, b, c, d\) Health & Safety - Electrical - Knob & Tube Wiring \(SF\)](#)

Knob-and-Tube Wiring in Sidewalls:

- 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.

Overloaded Electrical, Fuses and Splices:

- 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
- 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 table shows the gauge wire required for the

following fuse sizes:

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.

[2.0105.1 \(a\) Health & Safety - Safe Work Practices - Baseload - Baseload Worker Safety \(SF\) \(MH\)](#)

[2.0602.1 \(a, b\) Health & Safety - Electrical - Electric Hazards - Static Electric Shock \(SF\) \(MH\)](#)

[2.0602.2 \(a, b, c, d\) Health & Safety - Electrical - Electric Hazards - House Current Electric Hazard \(MH\)](#)

- When the Health & Safety of the occupant/worker(s) is at risk, minor repairs may be completed as necessary to allow for the implementation of weatherization measures. Subgrantees are limited to a maximum cost of \$300 to implement these **minor** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- Evaluate and if necessary provide sufficient over-current protection and damming (if required) prior to insulating building components containing knob and tube wiring, as required by the AHJ.

Testing:

- Visual inspection for presence and condition of knob-and-tube wiring.
- Check for alterations that may create an electrical hazard.
- Voltage drop and voltage detection are allowed

Client Education:

- When electrical issues are the cause of a deferral, provide information to client on over-current protection, overloading circuits, and basic electrical safety/risks.

Training:

- How to identify electrical hazards.
- Local (or AHJ) code compliance

2.0810 Formaldehyde, Volatile Organic Compounds (VOCs), and other Air Pollutants

Action/Allowability:

- Removal of pollutants is allowed and required if they pose a risk to workers.
- If pollutants pose a risk to workers and removal cannot be performed or is not allowed by the client the unit *must* be deferred.
- Refer to Hazardous Material Disposal section for more information.

Testing:

- Sensory inspection.

Client Education:

- Inform client in writing of observed hazardous condition and associated risks.
- Provide client written materials on safety and proper disposal of household pollutants.
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for weatherization to commence.

Training:

- How to recognize potential hazards and when removal is necessary.

2.0811 Fuel Leaks

Action/Allowability:

- When a minor gas leak is found on the utility side of the service, the utility service **must** be contacted before work can proceed.
- Fuel leaks that are the responsibility of the client (vs. the utility) **must** be repaired before weatherizing a unit.
- Notify utility and temporarily halt work when leaks are discovered that are the responsibility of the utility to address.

Testing:

- Test exposed gas lines for fuel leaks from utility coupling into, and throughout the home.

- Conduct sensory inspection on bulk fuels to determine if leaks exist.

Client Education:

- Inform client in writing if fuel leaks are detected.

Training:

- Fuel leak testing.

2.0812 Gas Ovens/Stovetops/Ranges

- Maintenance on or repair gas cooktops and stoves is not allowed.
- Replacement is not allowed.

Testing:

- Test gas ovens for CO.
- Inspect cooking burners and ovens for operability and flame quality.

Client Education:

- Inform client of the importance of using exhaust ventilation when cooking and the importance of keeping burners clean to limit the production of CO.
- 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.

[2.0100.1 \(e\) Health & Safety - Safe Work Practices - Global Worker Safety - Carbon Monoxide \(SF\) \(MH\)](#)

[2.0201.2 \(d, e\) Health & Safety - Combustion Safety General - Combustion Safety Make-up Air - Gas Ovens & Gas Range Burners \(SF\) \(MH\)](#)

Training:

- Testing techniques.
- CO action levels.

2.0813 Hazardous Materials Disposal - Refrigerant, Asbestos, Lead, Mercury, including CFLs/Fluorescents

Action/Allowability:

- Hazardous Waste Materials generated in the course of weatherization work shall be disposed of according to local laws, regulations and/or Federal guidelines, as applicable.
- Document proper disposal requirements in contract language with responsible party.
- Refer to Lead and Asbestos sections for more information on those topics.

Testing:

- Not applicable.
- Refer to Lead and Asbestos sections for more information

on those topics.

Client Education:

- Inform client in writing of hazards associated with hazardous waste materials being generated/handled in the home.

Training:

- Appropriate Personal Protective Equipment (PPE) for working with hazardous waste materials.
- Disposal requirements and locations.
- Health and environmental risks related to hazardous materials.

2.0814 Injury Prevention of Occupants and Weatherization Workers - Repairing Stairs, Replacing Handrails, etc.

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.

Action/Allowability:

- When necessary to effectively weatherize the home, workers may make ***minor*** repairs and installations to allow for the implementation of weatherization measures. Subgrantees are limited to a maximum cost of \$200 to

implement these **minor** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.

Testing:

- Inspect for dangers that could prevent weatherization.

Client Education:

- If conditions will not be repaired, inform client in writing of the observed hazard and associated risks.

Training:

- Hazard identification.

2.0815 Lead Based Paint

On April 10, 2010, the Environmental Protection Agency (EPA) "Lead; Renovation, Repair and Painting Program" (LRRPP) Final Rule became effective in the Weatherization Program. By adopting basic safety precautions workers and the occupants of the homes they weatherize will be protected from lead exposure. The U.S. Department of Energy requires subgrantees to follow specified EPA and Occupational Safety and Health Administration (OSHA) standards for worker safety.

Action/Allowability:

- Crews **must** follow EPA's Lead; Renovation, Repair and Painting Program (RPP) when working in pre-1978 housing unless testing confirms the work area to be lead free.

- Deferral is required when the extent and condition of the lead-based paint in the house would potentially create further Health & Safety hazards, the subgrantee will inform the client of the of the issues associated with a deferral in the Weatherization Deferral Notice (Form WX4) completed by the Weatherization Representative and signed by the client or building owner.
- Only those costs directly associated with the testing and lead safe practices for surfaces directly disturbed during weatherization activities are allowable
- Documentation in the client file **must** include Certified Renovator certification: any training provided on-site; description of specific actions taken; lead testing and assessment documentation; and, photos of site containment set up. Include the location of photos referenced is not in the file.

Testing:

- Testing to determine the presence of lead in paint that will be disturbed by WAP measure installation is allowed with EPA-approved testing methods.
- Testing methods **must** be economically feasible and justified.
- Job site set up and cleaning verification by a Certified Renovator is required.
- Grantees **must** verify that crews are using lead safe work practices during monitoring.

Client Education:

- Follow pre-renovation education provisions for RRP.
- When deferral is necessary, provide information in writing describing conditions that **must** be met in order for

weatherization to commence. Provide a Weatherization Deferral Notice (Form WX4) completed by the Weatherization Representative and signed by the client or building owner.

Training Requirements:

- All employees and contractors working on pre-1978 homes must receive training to install measures in a lead-safe manner in accordance with SWS and EPA protocols, and installation **must** be overseen by an EPA Certified Renovator. Grantee Monitors and Inspectors **must** be Certified Renovators.

2.0816 Mold and Moisture - Including but not limited to: gutters, down spouts, extensions, flashing, leaking roofs, vapor retarders, moisture barriers, etc.

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. Install or improve 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 greatly impact poorly insulated homes.

Alleviating drainage and major drainage issues are 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.

Action/Allowability:

- Subgrantees ***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.

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.
- Mold cleanup is not an allowed Health & Safety cost.
- Surface preparation where weatherization measures are being installed (e.g., cleaning mold off window trim in order to apply caulk) must be charged as part of the ECM, not to the Health & Safety budget category.
- All clothes dryers and exhaust fans **must** be vented to the exterior.
- The NeWAP requires a full ground laid moisture barrier **must** be installed whenever possible in accessible *crawl spaces* and under manufactured and modular homes *except* when one exists or the space has a concrete floor.
 - 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, the joints **must**

overlap a minimum of 12 inches and be sealed with appropriate sealants.

- 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 \(a, b, c, d, e, f\) 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 \(MH\)](#)

- Mold testing is not an allowable cost.

Testing:

- Visual assessment including exterior drainage.
- Diagnostics such as moisture meters are recommended pre-weatherization and at final inspection.
- Mold testing is not an allowable cost.

Client Education:

- Provide client written notification and disclaimer on mold and moisture awareness.
- Provide information on the importance of cleaning and maintaining drainage systems.

- Provide information on proper landscape design and how this impacts site drainage and moisture control.
- When deferral is necessary, provide information in writing describing conditions that must be met in order for weatherization to commence.
- Subgrantees **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 (Form WX5).
- 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

Training:

- National curriculum on mold and moisture or equivalent.
- How to recognize drainage issues.

[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 Barriers \(SF\)](#)

[2.0403.2 \(a, b, c, d, e, f\) 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)

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

2.0817 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 subgrantee 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.

Action/Allowability:

- When a person's health may be at risk and/or WAP work activities could constitute a H&S hazard, the occupant will be required to take appropriate action based on severity of risk.
- Failure or the inability to take appropriate actions must result in a deferral.

Testing:

- Screen occupants to reveal known or suspected health concerns either as part of the initial application for weatherization, during the audit, or both (Health & Safety

Client Home Screening Questionnaire Form WX7)

Client Education:

- Inform client in writing of any known
- Provide client with Subgrantee point of contract information in writing so client can inform of any issues.
- When deferral is necessary, provide information in writing describing conditions that must be met in order for weatherization to commence.

Training:

- How to access occupant preexisting conditions and determine what action to take if the home is not deferred.
- Awareness of potential hazards.

2.0818 Pests

Action/Allowability:

- Pest removal is allowed only where infestation would prevent weatherization. Subgrantees are limited to a maximum cost of \$300 for pest removal, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- Infestation of pests may be cause for deferral where it cannot be reasonably removed or poses H&S concern for workers.
- Screening of windows and points of access, and incorporating pest exclusion into air sealing practices to prevent intrusion is allowed.

Testing:

- Assessment of presence and danger of infestation and risk to worker.

Client Education:

- Inform client in writing of observed condition and associated risks.
- When deferral is necessary, provide information in writing describing conditions that must be met in order for weatherization to commence.

Training:

- How to assess presence and degree of infestation, associated risks, and deferral policy.

2.0819 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.

Action/Accountability:

- Radon mitigation is **not** an allowable Health & Safety cost.
- Clients must sign a radon informed consent form (WX6) prior to receiving weatherization services. This form must be kept in the client file.
- The following radon precautions will be implemented in **all** weatherized homes to reduce the possibility of exacerbating any potential radon issues:
 - Whenever site conditions permit, cover exposed dirt floors within the pressure/thermal boundary with 6 mil

(or greater) polyethylene sheeting, lapped at least 12" and sealed with appropriate sealants at all seams, walls and penetrations.

- Air seal existing sumps in such a way that water can drain from above and below the sump cover.
- Seal and caulk visible, accessible penetrations, openings or cracks in below-grade walls and floors that contact the ground with a sealant that meets the requirements of ASTM C920.
- Other precautions may include, but are not limited to, sealing any observed floor and/or foundations penetrations isolating the *basement* from the *conditioned space*, and ensuring crawlspace venting is installed.
- The following additional radon precautions will be implemented in ***all*** weatherized homes equipped with active radon mitigation systems:
 - Verify that the radon vent fan is operating.
 - If a previously installed radon mitigation system is ***not*** operating correctly advise the client to consult the system installer of the state radon office.

Testing:

- Radon testing is not an allowable cost.

Client Education:

- Provide all clients EPA's *A Citizen's Guide to Radon* and inform them of radon related risks.
- Provide all clients with the Nebraska Radon Information Fact Sheet.
- Review with all clients the radon informed consent form (WX6). The form must be signed with a copy of the included in the client file prior to receiving weatherization

services.

Training:

- Auditors, assessors and inspectors must have knowledge of radon, what it is and how it occurs, including factors that may make radon worse, and precautionary measures that may be helpful.
- Workers must be trained in proper *vapor retarder* installation.

2.0820 Safety Devices: Smoke, Carbon Monoxide Detectors, Fire Extinguishers

Action/Allowability:

- Battery operated smoke alarms may be installed where alarms are not present or are inoperable.
- CO detectors ***must be installed where*** detectors are not present or are inoperable.
- Replacement of operable CO Detectors is ***not*** an allowable cost.
- Installation of Smoke Alarms and 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.

[2.0301.1 \(b\) 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 \(SF\) \(MH\)](#)

- Propane gas detectors **must** be installed in homes and *manufactured housing* on permanent foundations that have propane combustion appliances. The gas detectors **must** be permanently installed according to the manufacturer's instructions and 110 volts.
- The costs associated with providing fire extinguishers are **not** allowable Health & Safety Costs.

Testing:

- Check existing smoke alarms for operation.
- Check for operation of existing CO detectors.
- Verify operation of installed alarms.

Client Education:

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

[2.0100.1 \(e\) Health & Safety - Safe Work Practices - Global Worker Safety - Carbon Monoxide \(SF\) \(MH\)](#)

[2.0201.2 \(c, d, e\) Health & Safety - Combustion Safety - Combustion Safety Make-up Air \(SF\) \(MH\)](#)

Training:

- Where to install smoke alarms and CO detectors.
- Local code compliance.

2.0821 Ventilation and Indoor Air Quality

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

[2.0104.1 \(a\) Health & Safety - Safe Work Practices - Ventilation Equipment - Ventilation Worker Safety \(SF\) \(MH\)](#)

Action/Allowability:

- Install ventilation as required by the last DOE approved ASHRAE 62.2.
- Grantees may voluntarily elect to adopt the most recent version of ASHRAE 62.2 as soon as they are prepared to implement the Standard.
- If the ASHRAE normative Appendix A is employed and an existing fan is being replaced or upgraded to meet whole-house ventilation requirements, take actions to prevent zonal pressure differences greater than 3 pascals across the closed door, if one exists.
- Exhaust fans **must** be vented to the outdoors, and never into building attics or *crawl spaces*. They should have tight-fitting *backdraft dampers*.
- Low sone (1.0) fans should be installed to encourage the client to run them longer.

Testing:

- ASHRAE 62.2 evaluation to determine required ventilation.

- Measure fan flow of existing fans and of installed equipment to verify performance.

Client Education:

- Provide client with information on function, use, and maintenance (including location of service switch and cleaning instructions) of ventilation system and components.
- Provide client with equipment manuals for installed equipment.
- Include disclaimer that ASHRAE 62.2 does not account for high polluting sources or guarantee indoor air quality.

Training:

- ASHRAE 62.2 training, including proper sizing, evaluation of existing and new systems.
- If the Grantee opts to adopt a new version of ASHRAE 62.2 then training and technical assistance should be planned to prepare crews to implement the new Standard.

2.0822 Window and Door Replacement, Window Guards

General Information:

- Replacement, repair, or installation is ***not*** an allowable Health & 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.

2.0823 Worker Safety

Action/Allowability:

- Workers must follow OSHA standards where required and take precautions to ensure the Health & Safety of themselves and other workers.
- All Subgrantees and contractors must maintain compliance with the current OSHA Hazard Communication Standard, including on-site organized Safety Data Sheets (SDS) (formerly called MSDS).

Testing:

- Grantees must verify that Subgrantees, crews and contractors follow safe work practices.

Client Education:

- Not applicable.

Training:

- Awareness of guidance.
- Safety training appropriate for job requirements. OSHA 10

hour training meets this requirement.

- Ongoing training as required in Hazard Communication Program.

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*** identify 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 *crawl space* 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 planes 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.

[2.0101.1 \(a\) Health & 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 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 \$50.00 per 100 CFM , continue looking for air sealing opportunities. If the dollar/ CFM^{50} Ratio is greater than \$50.00 per 100 CFM , stop air sealing.

Example process for *Cost Effective Blower Door Guided Air Sealing:*

First Blower Door reading:	5500 CFM⁵⁰
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, 1/4 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 \div 1400 \times 100 = \8.96 per 100 CFM
<i>The ratio is less than \$50 per 100 CFM. Keep looking for air sealing opportunities.</i>	

Second Blower Door reading:	4100 CFM⁵⁰
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:	$\$215.00 \div 650 \text{ CFM} \times 100 =$ \$33.07 per 100 CFM
<i>The ratio is less than \$50.00 per 100 CFM. Keep looking for air sealing opportunities.</i>	

Third Blower Door reading:	3450 CFM⁵⁰
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 reduction of 750 CFM
Saving ratio:	$\$186.00 \div 750 \text{ CFM} \times 100 =$ \$24.80 per 100 CFM
<i>The ratio is less than \$50.00 per 100 CFM. Keep looking for air sealing opportunities.</i>	

Fourth Blower Door reading:	2700 CFM⁵⁰
Air Sealing Work Done:	Seal rim joist and seal unused coal chute.

Labor Cost:	2 hours at \$35.00 = \$70.00
Material Cost:	13 tubes of caulking @ \$4.50, 20 feet of backer rod @ \$1.50 = total materials \$88.50
Total Measure Cost:	\$158.50
Fifth Blower Door reading:	2400 CFM a reduction of 300 CFM
Savings ratio:	$\$158.50 \div 300 \text{ CFM} \times 100 =$ \$52.80 per 100 CFM
<i>The ratio is more than \$50 per 100 CFM. Stop air sealing.</i>	

- Air sealing blower door readings should be appropriately recorded in the client file.
- A maximum of \$50 in material and labor per 100 CFM⁵⁰ 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 \$50 per 100 CFM⁵⁰.

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 be 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

[3.1001.2 \(a, b, c, d, e, f\) Air Sealing - Attics - Penetrations and Chases - Penetrations and Chases \(SF\)](#)

- Cantilevered floors
- Kitchen or bathroom soffits

[3.1001.2 \(a, b, c, d, e, f\) Air Sealing - Attics - Penetrations and Chases - Chase Capping \(SF\)](#)

- 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 \(a, b\) Air Sealing - Windows and Doors - Maintenance, Repair, and Sealing - Pocket Door \(SF\)](#)

- 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 and Boot to Gypsum (SF)

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

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

[3.1001.2 \(c, d\) Air Sealing - Attics - Penetrations and Chases - Chase Capping - Non-standard chase \(interior walls covered with wood or paneling\) and Support \(SF\)](#)

[3.1004.1 \(a, b, c\) Air Sealing - Attics - Cathedralized Attic Ceilings - Cathedralized Attic Air Sealing \(Insulation Installed at roof Deck\) \(SF\)](#)

[3.1005.1 \(a, b, c\) Air Sealing - Attics - Other Ceiling Materials - Tongue and Groove 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 and Doors - Maintenance, Repair, and Sealing - Exterior Doors \(SF\)](#)

- Tightening and/or installing window weather-stripping.

[3.1201.1 \(a, b, c, d, e, f, g\) Air Sealing - Windows and Doors - Maintenance, Repair, and Sealing - Double-Hung Wood Windows \(SF\)](#)

[3.1201.2 \(a, b, c, d, e\) Air Sealing - Windows and Doors - Maintenance, Repair, and 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 and Doors - Maintenance, Repair, and Sealing - Fixed Frame with Wood Sash - Older House \(SF\)](#)

[3.1202.2 \(a, b, c, d\) Air Sealing - Windows and Doors - Maintenance, Repair, and 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)

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 - Basements and Crawl Spaces - Crawl Spaces - Sealing Floor Penetrations \(SF\)](#)

Subgrantees **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 Housing 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

Subgrantees **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.

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, and Sealing - Double-Hung Wood Windows - Lead Paint Assessment \(SF\)](#)

[3.1201.2 \(a\) Air Sealing - Windows & Doors - Maintenance, Repair, and 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 and 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 and Doors - Replacement - Replacement Windows in Existing Frame - Lead Paint Assessment (SF)

3.1203.2 (a, b, c, d, e, f) Air Sealing - Windows and Doors - Replacement - Single-Unit Window, Mounted on Rough Opening - Newer House - Lead Paint Assessment (SF)

3.1203.3 (b) Air Sealing - Windows and Doors - Replacement - Replacement of *Manufactured Housing* Windows and Doors - Lead Paint Assessment (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.
- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 and Doors - Replacement - Replacement Window in Existing Window Frame Air Sealing - \ Windows and Doors - Repairing/Replacing Cracked & Broken Glass - Fixed Frame with Wood Sash - Older House \(SF\)](#)

[3.1202.2 \(a, b, c, d\) Air Sealing - Windows and 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 and Doors - Maintenance, Repair, and Sealing - Double-Hung Wood Windows - Replacement Sills \(SF\)](#)

[3.1201.1 \(e\) Air Sealing - Windows & Doors - Maintenance, Repair, and 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 and Doors - Maintenance, Repair, and Sealing - Double-Hung Wood Windows - Adjust stops \(SF\)](#)

- Weather-stripping sashes and sills.

[3.1201.1 \(b\) Air Sealing - Windows and 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.
 - Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.
- adjusting door hardware to reduce air leakage

[3.1201.3 \(b\) Air Sealing - Windows and Doors - Maintenance, Repair, and Sealing - Exterior Doors - Door operation and fit \(SF\)](#)

[3.1201.5 \(d\) Air Sealing - Windows and Doors - Maintenance, Repair, and 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 and Doors - Maintenance, Repair, and Sealing - Exterior Doors \(SF\)](#)

[3.1201.5 \(d, e\) Air Sealing - Windows and Doors - Maintenance, Repair, and 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 and Doors - Maintenance, Repair, and Sealing - Exterior Doors - Lead Paint Assessment \(SF\)](#)

[3.1201.5 \(b\) Air Sealing - Windows and Doors - Maintenance, Repair, and Sealing - Manufactured Housing Windows and Doors - Lead Paint Assessment \(MH\)](#)

- Water heater compartment doors, on *manufactured 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 and Doors - Replacement - Replacement Window in Existing Window Frame \(SF\)](#)

[3.1201.2 \(a, b, c, d, e, f\) Air Sealing - Windows and Doors - Replacement - Single-Unit Window, Mounted on Rough Opening - Newer House \(SF\)](#)

Windows replaced in *manufactured 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 and 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 *manufactured 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 and Doors - Maintenance, Repair and 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:

- an NFRC (National Fenestration Rating Council) tested U-factor of 0.17 or lower.
- 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.
- 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.
- foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.
- 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 and Doors - Maintenance, Repair, and Sealing - Exterior Doors \(SF\)](#)

Exterior doors replaced through the NeWAP in *manufactured homes* **must** have:

- an NFRC (National Fenestration Rating Council) tested U-factor of 0.17 or lower.
- 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.
- 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 and Doors - Replacement - Replacement of Manufactured Housing Windows and Doors (MH)

Below and Grade Level doors replaced through the NeWAP in single family, *manufactured housing*, or *multi-family buildings* **must**:

- be constructed of $\frac{3}{4}$ 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.
- foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.

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 subgrantees air sealing penetrations in floors:

3.1301.1 (a, b, c, d, e) 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 subgrantees 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 - Basements and Crawl Spaces - Basements Connected to Crawl Spaces - Sealing and Insulating \(SF\)](#)

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 Homes \(MH\)](#)

Insulated Skirting Installation Requirements

If 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.
- All seams and joints in the skirting **must** be caulked.
- The access **must** be constructed of $\frac{3}{4}$ 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 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 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 subgrantees **must**:

- 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 subgrantees **must** verify and make reasonable attempts to ensure that

duct systems are providing balanced, adequate airflow to living spaces. When airflow is a problem subgrantees **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 ductwork* **must** be sealed before insulating.
- *Crossover 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.

Manufactured housing specific work

standards

- If the connection between the new furnace and the trunk line will not be accessible after installation, the heating contractor **must** seal the connection.
- When the return air system is blocked and sealed a minimum 16 inch x 24 inch vent **must** be installed in the furnace compartment door.
- If the vent is not installed, the mobile home floor **must not** be insulated.
- Interior doors may need to be *under-cut* to provide adequate return air to the furnace.

[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 non-toxic 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 subgrantees air seal 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 taped with no more than two (2) coats of drywall mud applied.
- 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 subgrantees **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 - Unvented Roof Deck - Preparation for Spray Polyurethane Foam \(SF\)](#)

[4.1001.7 \(a, b, c, d\) Insulation - Attics - General Preparation - Vented Roof Deck - Preparation for SPF \(SF\)](#)

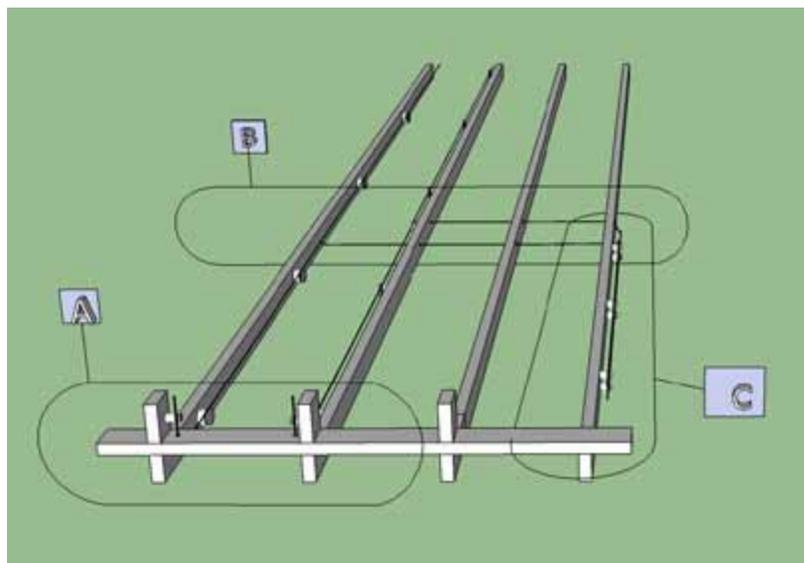
[4.9901.1 \(a, b, c\) Insulation - Additional resources - Materials - General Information on Spray Polyurethane Foam \(SPF\) \(SF\) \(MH\)](#)

Knob & Tube Wiring

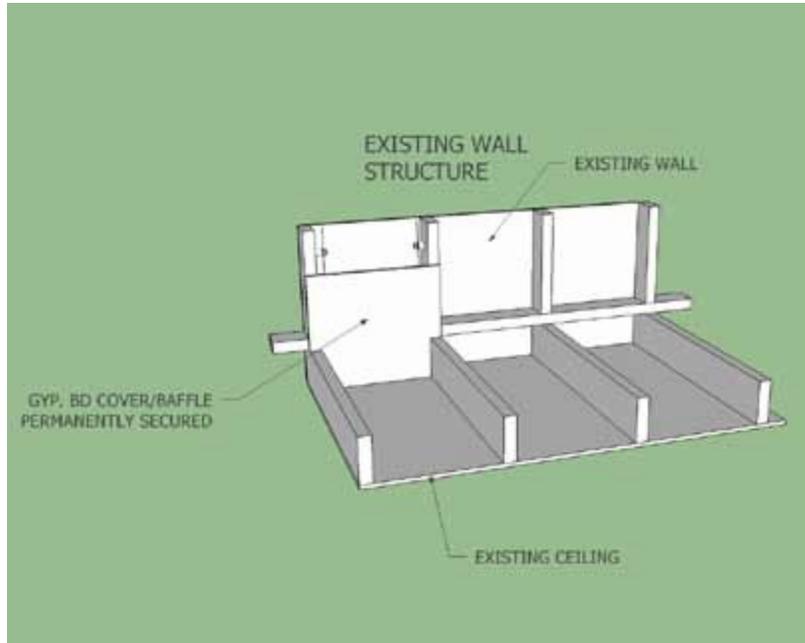
- Complete appropriate shielding procedures of any active Knob & Tube Wiring. The Nebraska State Electrical Board does not permit directly covering knob and tube wiring with insulation. Subgrantees **must** comply with the following fire and electrical safety procedures before insulating.

[4.1001.2 \(a, b, c\) Insulation - Attics - General Preparation - Knob and Tube Wiring \(SF\)](#)

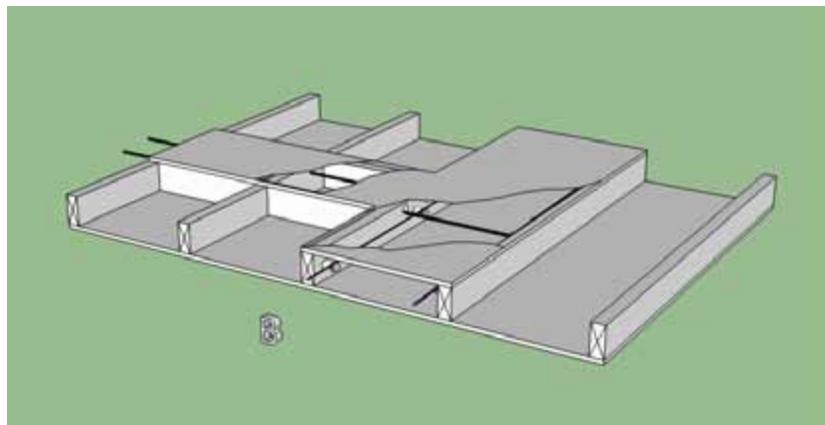
- Inspect all attic areas for knob-and-tube wiring.
- Attic areas with knob-and-tube wiring that are indicated as cost-effective for implementation on the Energy Audit **must** be insulated after the wiring has been appropriately covered to prevent direct contact with the insulation and to provide adequate 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.



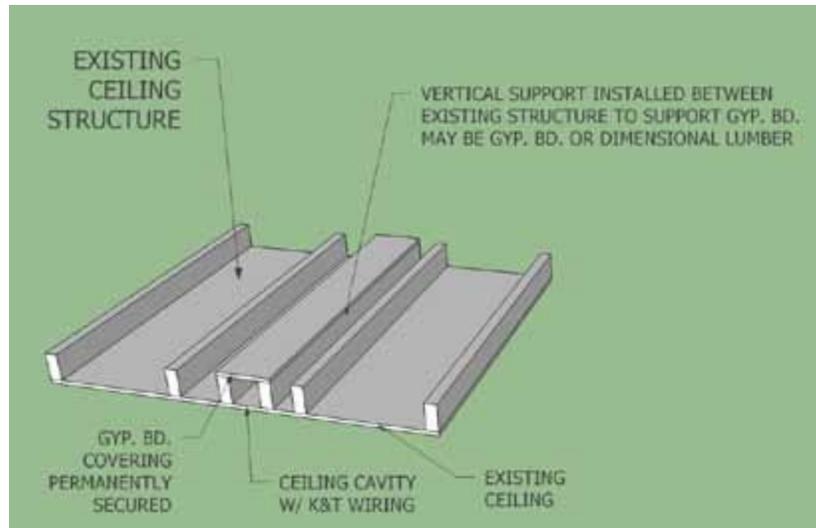
Knob and tube critical wiring points



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 subgrantee 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 insulation 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 or install a pre-manufactured unit designed to provide appropriate air sealing and fire protection for non-ic-rated can lights.

[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, subgrantees **must** install shielding around heat and *high-heat sources* with costs incurred being charged to Health & Safety.
- Shielding **must** be kept a minimum of 3 inches from any *heat source* and a minimum of 6 inches 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 existing and/or 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 existing and/or 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.

Manufactured housing specific work standards

- If a **manufactured home** has a double sleeve flue, the chimney does not need to be shielded.

[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 \(a, b, c, e\) 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 $\frac{3}{4}$ 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 $\frac{3}{4}$ 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 $\frac{3}{4}$ 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 $\frac{3}{4}$ inch plywood with a hinged $\frac{3}{4}$ 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.
- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.

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.

[2.0102.1 \(a, b, c, d\) 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.
 - **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case-by-case basis by the Nebraska Energy Office **prior** to any work being implemented.
- If roof leaks cannot be appropriately or cost-effectively 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 manufacturer's 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 subgrantees 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, and
 - the R-value.
 - This information **must** be included in the subgrantee client file.
- 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 Floor - 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 \(SF\)](#)

Manufactured housing specific work standards

- Interior entry holes ***must*** be sealed with wood or plastic plugs.
- The plugs ***must*** be caulked in place.
- Exterior entry methods ***must*** form a permanent and watertight seal.
- Flat roofs or roofs that do not have adequate slope to insure proper drainage ***must not*** be penetrated to install the insulation.
- If a minimum R-11 of additional insulation cannot be installed, the ceiling ***must not*** be insulated.

4.1004 Knee Walls

Preparation and Installation Standards

In *knee wall* attics or attics in one-and-a-half story homes subgrantees **must**:

- Adjust all existing batt insulation to ensure it is in full contact with the interior cladding and the top and bottom plates.
- Ensure that existing insulation is held in place with staples, twine, wire, hex netting or wire expanders and must be covered with an *air infiltration barrier*.
- 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 Packing \(SF\)](#)

[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 walls* with either batt or blown insulation or *spray-applied insulation*.
 - New and existing *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 *knee wall* floor and ceiling rafter cavities

with batt, blown, rigid or *spray-applied insulation*.

- If batt insulation is used to seal the base of the *knee walls*, 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.
 - Foam or felt tape door weather-strips are **not** eligible for reimbursement under the NeWAP.
 - 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 3/4 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, subgrantees **must**:

- 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, subgrantees **must**:

- 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 subgrantees 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 subgrantees **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 Packing \(SF\)](#)

[4.1101.5 \(a, b\) Insulation - Walls - Preparation - Exterior Wall Dense Packing \(MH\)](#)

- 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 Subgrantees **must**:

- 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 no more than two (2) coats 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 manufacturer's installation standards. In homes where exterior wall cavities are being blown, subgrantees **must**:

- 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 EPA 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 manufacturer's 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 subgrantees **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

General 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 \(SF\)](#)

[4.1301.5 \(a, b, c, d, e\) 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 \(SF\)](#)

Non-Exposed Floor Installation Standards

- Cost-effective floor insulation must:
 - Be insulated with either batt or *spray-applied insulation*.
 - Batt insulation must be held in place with staples, twine, wire, hex netting or wire expanders and must be covered with an *air infiltration barrier*.
- In floors with existing insulation Subgrantees must:
 - Adjust all existing batt insulation to ensure it is in full contact with the floor.
 - Ensure that existing insulation is held in place with staples, twine, wire, hex netting or wire expanders and must be covered with an *air infiltration barrier*.

Exposed Floor Insulation Installation Standards

- *Exposed floors*, except over garages, **must** be insulated and covered with exterior grade plywood or tar impregnated fiberboard. All seams **must** be caulked.
- *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 subgrantees **must** complete an inspection of the floor assembly and document any issues/concerns found.

- Prior to weatherizing the underbelly, the owner **must**

repair plumbing leaks that will directly affect the weatherization of the underbelly.

- Underbellies that have 2 inches or less of existing insulation are considered uninsulated.
- When 50% or less of the existing insulation is missing, deteriorated or damaged the damaged areas **must** be repaired.
- When more than 50% of the existing insulation is missing, deteriorated or damaged, the entire underbelly **must** be reinsulated.
- Existing insulation in undamaged areas does not need to be removed, but additional blown insulation **must** be installed.
- Insulation **must** be installed the full cavity depth whenever possible.
- Replace all deteriorated or damaged insulation with unfaced batt insulation and new *weatherboard* or by replacing the *weatherboard* and then installing blown insulation.
- The *weatherboard* **must** form an airtight seal and adequately support the insulation.
- If plywood is used as *weatherboard*, the plywood **must** be exterior grade.
- If insulation is installed through the rim joist, a rigid tube **must** be used.
- Entry holes in the rim joist **must** be plugged with wood plugs and glued in place.
- If insulation is installed through the *weatherboard*, the entry holes **must** be covered with plastic plugs or 30# felt paper. Both should be sealed with caulking.
- Rim joists that are 2 inches x 4 inches or less in construction **must not** be drilled.

- Special care needs to be taken so as not to isolate water pipes outside the envelope.

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 subgrantees **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 and Crawl Spaces* - Band/Rim Joists - Spray Polyurethane Foam \(SPF\) \(SF\)](#)

[4.1401.2 \(a, b, c\) Insulation - *Basements and 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 subgrantees **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.
- Appropriate accessibility to *crawl spaces / accessible foundation*:
 - Accesses **must** be installed in all accessible *crawl spaces*.
 - 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 *crawl spaces*:
 - 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.

- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.
- 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 3/4 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 *crawl space* 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.

[4.1401.1 \(a, b\) Insulation - Basements and Crawl Spaces - Band/Rim Joists - Spray Polyurethane Foam \(SPF\) \(SF\)](#)

- 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 and Crawl Space Walls - Basement Wall Insulation - No Groundwater Leakage \(SF\) \(MH\)](#)

Crawl Space and Ledged Basement Walls Installation Requirements

- *Crawl space* and *ledged basement* wall **must** be insulated with faced batt foam board or *spray-applied insulation*.
- The insulation **must** fill the sill box and extend down the foundation wall.
- If faced batt insulation is installed, the *vapor barrier* **must**

be to the warm side.

[4.1402.1 \(a, b, d, g\) Insulation - Basements and Crawl Space Walls - Closed Crawl Spaces - Wall Insulation \(SF\)](#)

4.16 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.

Prior to sealing and/or insulating ducts NeWAP subgrantees **must**:

- 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 subgrantees **must** verify and make reasonable attempts to ensure that duct systems are providing balanced, adequate airflow to living spaces. When airflow is a problem subgrantees **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, manufactured for use as duct 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, *Trained 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 *Trained 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 U.S Department of Energy (if DOE funds are used) and 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*.
- Secondary unvented units that conform to the safety standards on ANSI Z21.11.2 may remain as back-up heat sources.
- Units that do not meet ANSI Z21.11.2 must be removed, and properly disposed of, prior to weatherization but may remain until a replacement *heating system* is in place.
- Secondary unvented units that conform to the safety standards on ANSI Z21.11.2, but are not operating safely, must be removed and properly disposed of.
- Repair of secondary unvented units is not allowed.
- An unvented gas-liquid-fueled space heater that remains in a completed single-family house after weatherization shall:
 - Not have an input rating in excess of 40,000 Btu/hour;
 - Not be located in, or obtain combustion air from sleeping rooms, bathrooms, toilet rooms, or storage closets, except:
 - One listed wall-mounted space heater in a bathroom if permitted by the authority having jurisdiction which:
 - has an input rating that does not exceed 6,000 Btu/hour;
 - Is equipped with an oxygen-depletion sensing safety shut-off system; and
 - The bathroom has adequate combustion air;
 - One listed wall-mounted space heater in a bedroom if permitted by the authority having jurisdiction which:
 - has an input rating that does not exceed 10,000 Btu/hour;
 - Is equipped with an oxygen-depletion sensing safety

- shut-off system; and
- The bathroom has adequate combustion air.

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 and 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 all equipment **must** be listed in the most current edition of the [Air-Conditioning, Heating, and Refrigeration Institute \(AHRI\) Directory of Certified Product Performance](#).
- 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 & 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 and 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.

Copies of CAZ Depressurization Test (WX9) or Daily Safety Test Out (WX10) forms verifying proper venting of the water heater **must** be included in the client file.

- 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 and 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 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 appropriately sized, 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.
- Three (3) filters are to be left with the client to help to ensure appropriate filter replacements following the completion of weatherization work.

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 and 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.
- Efficiency ratings for forced air-conditioners and heat pumps must be listed in the most current edition of the Air-Conditioning, Heating, and Refrigeration Institute

(AHRI) Directory of Certified Product Performance.

- 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.

Manufactured housing specific work standards

- The air conditioner condensates and combustion air sleeves to the underbelly ***must not*** be covered.

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 spaces* 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.
- Filters should be appropriately sized, 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.
- Three (3) filters are to be left with the client to help to

ensure appropriate filter replacements following the completion of weatherization work.

[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.

[2.0103.2 \(b\) Health and Safety - Safe Work Practices - Heating and Cooling Equipment - Heating and Cooling Worker Safety - Mercury \(SF\)](#)

- 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 and Cooling - Forced Air - System Assessment and 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 and Cooling - Forced Air - System Assessment and 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* **must** be inspected by a *Qualified Heating Technician*, utility company or *Trained 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 *Trained 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 subgrantee **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*.
- Filters should be appropriately sized, 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.
- Three (3) filters are to be left with the client to help to ensure appropriate filter replacements following the completion of weatherization work.

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, 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.

2.0103.1 (a, b, c) Health & Safety - Safe Work Practices - Heating and Cooling Equipment - Combustion Worker Safety (SF) (MH)

- 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.

2.0103.1 (a, b, c) Health & Safety - Safe Work Practices- Heating and Cooling Equipment - Combustion Worker Safety (SF) (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 and Cooling - Forced Air - System Assessment and 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 2 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 and Cooling - Forced Air - System Assessment and 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 and insulation.

[5.3003.5 \(a, b, c, d, e\) Heating and Cooling - Forced Air - System Assessment and 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 and Cooling - Forced Air - System Assessment and Maintenance - Data Plate Verification \(SF\) \(MH\)](#)

[5.3003.3 \(a, b, c, d, e, f, g, h\) Heating and Cooling - Forced Air - System Assessment and Maintenance - Evaluating Air Flow \(SF\) \(MH\)](#)

[5.3003.7 \(a, b, c, d, e, f, g, h, i\) Heating and Cooling - Forced Air - System Assessment and Maintenance - Occupant Education \(SF\) \(MH\)](#)

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

[5.3003.14 \(a, b, c, d, e, f, g, h\) Heating and Cooling - Forced Air - System Assessment and 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*:

- Tune and clean, indicated as cost-effective in the Energy Audit, 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 *Nebraska 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 subgrantee **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.
- Mercury, inoperable or malfunctioning thermostats may be replaced with digital thermostats.

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 and Cooling - Forced Air - System Assessment and Maintenance - Data Plate Verification \(SF\) \(MH\)](#)

[5.3003.3 \(a, b, c, d, e, f, g, h\) Heating and Cooling - Forced Air - System Assessment and Maintenance - Evaluating Air Flow \(SF\) \(MH\)](#)

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

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

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 subgrantees **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 - Fan Intake Grille Location \(SF\) \(MH\)](#)

[6.6002.4 \(a, b, c, d, e, f\) Ventilation - Exhaust - Components - Ducts \(Exhaust Fans\) \(MH\)](#)

6.6003 Fans

NeWAP subgrantees **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 Subgrantees **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 (not flexible fabric duct) 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 Subgrantees **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 subgrantees **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 \(a, b, c, d, e, f\) Ventilation - Supply - Components - 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 subgrantees **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)

6.6003.5 (b, c) Ventilation - Exhaust - Fans - Garage Exhaust
Fan (MH)

6.62 Whole Building Ventilation

Mechanical Ventilation to Ensure Acceptable Indoor Air Quality

NeWAP subgrantees **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

[6.6201.2 \(a\) Ventilation - Whole Building Ventilation - Air Flow Requirements - Primary Ventilation Air Flow between rooms \(SF\)](#)

6.6202 Components

[6.6202.1 \(a, b, c, d, e\) Ventilation - Whole Building Ventilation - Components - 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

Baseload is the energy consumed in the home that is not related to heating and/or cooling the home. Baseloads 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

7.8001 Refrigerators

The EPA estimates that replacing a 1980's refrigerator can save about \$140 per year and replacing a 1970's refrigerator can save about \$200 per year. Refrigerators built post 1990 use less electricity and can have a great impact on reducing a client's electric baseload.

7.8001.1 Refrigerator Replacement Inspection and Audit Requirements

Inspect the existing unit, there are two methods allowed to estimate the savings that result from replacing an existing refrigerator. These methods must be incorporated into the initial inspection and energy audit:

- Use a meter to determine the energy use of the appliance, or
- Locate the data plate on the existing unit documenting the Association of Home Appliance Manufacturers (AHAM) information for the unit.

The NEAT/MHEA Audit indicates a minimum of 60 minutes and a maximum of 360 minutes, the appliance must be metered for a minimum of 60 minutes (1 hours). Record the kWh usage and the number of minutes from the data logger on the Client Home Energy Audit.

- Caution: If the refrigerator is running when ready to install the power meter, allow refrigerator to sit for a minimum of

five (5) minutes before plugging into the Digital line logger. (This will allow compressor pressure to be relieved.)

If no manufacturer and model number information is available on the unit energy use of the existing unit must be verified by installing a digital power meter.

If the Energy Audit has determined that the replacement of multiple appliances is cost-effective, discuss the possibility with the client. Greater energy savings are realized if multiple appliances can be replaced with one (1) appliance.

7.8001.2 Refrigerator Replacement Requirements

- Replacements will be completed based on the metered usage of the existing unit and/or the estimated usage for that make and model (found in the AHAM look-up table) incorporated into the NEAT/MHEA Energy Audit and a 1.0 or better Savings-to-Investment Ratio (*SIR*) for replacing the unit.
- If the existing refrigerator is non-functional, it is ineligible to be replaced.
- The client must give up possession of the old refrigerator.
- One refrigerator per home may be replaced.
- Appliances located in *unconditioned areas* may **not** be replaced.
- Refrigerator replacement model(s) must be rated as ENERGY STAR[®]. All replacement refrigerators must meet the UL-250 standard.
- When making a straight one for one (1) replacement, the replacement refrigerator must not be larger than the size of the old refrigerator. For situations where two (2) or more refrigerators will be replaced by one (1) refrigerator,

the new refrigerator may be a larger capacity than those being replaced if needed in order to meet appropriately documented capacity needs and the unit meets the *SIR* requirement.

- Replacement of an existing side-by-side refrigerator with a side-by-side refrigerator is allowed if the replacement is determined to be cost effective with a 1.0 or better Savings-to-Investment Ratio (*SIR*).
- Existing refrigerators with additional features such as ice makers may be replaced with equivalent features is allowed if the replacement is determined to be cost effective with a 1.0 or better Savings-to-Investment Ratio (*SIR*). The cost of disconnecting the water using features must be included in the replacement *SIR* calculation. ***The client is responsible for completing the hook up of any water lines required for an icemaker included with a new appliance.***
- Replacement units with the through-the-door ice and/or water delivery option are not allowed under the NeWAP.
- Replacement refrigerators must include a one-year warranty that will provide a replacement appliance if repeated issues related to health, safety, or performance occur.
- The color of the replacement appliance should be white or off-white, unless the existing appliance is part of a "matched set" and the cost of replacing the refrigerator in a matching color is determined to be cost effective. Subgrantees must include appropriate documentation in the client file if a matching color unit is installed.
- Appliance replacement in rental units is allowed ***only when the renter owns the old appliance*** and/or ***the renter is responsible for paying the electric utility bill*** and a copy of the electric bill is provided for verification.
- Removal and proper disposal of all replaced appliances is

required. The appliances must be disposed of according to the environmental standards in the Clean Air Act (1990), Section 608, as amended by Final Rule, 40 CFR 82, May 14, 1993.

- Appliance repair is not allowed under the NeWAP.

[7.8001.1 \(a, b, c\) Baseload – Plug Load – Refrigerator – Refrigerator Replacement \(SF\) \(MH\)](#)

7.8001.3 Installation, Client Education and Client File Documentation Requirements

- Removal and proper disposal of all replaced appliances is required. The appliances must be disposed of according to the environmental standards in the Clean Air Act (1990), Section 608, as amended by Final Rule, 40 CFR 82, May 14, 1993.
- Install appliances in accordance with manufacturer specifications and local codes.
- Any penetrations to the exterior of the home created by the installation of the appliance will be sealed and the cost to complete such work must be included in the Energy Audit cost-effectiveness evaluation.
- Appliance must be ENERGY STAR[®] rated. Energy-related appliance controls will be demonstrated to the occupant.
- Provided specific information on the proper maintenance of the equipment to the occupant.
- Provide warranty information, operation manuals, and installer contact information to the occupant. Appliance will carry a minimum one-year warranty that will provide a replacement appliance if repeated issues relating to health, safety, or performance occur.

- Appliance will fit in the available space without blocking access to light switches, cabinets, etc.
- The Client Agreement Form (including the client's signature) lists the replaced existing appliance(s) and the newly installed appliance(s). Give One (1) copy of the signed Form to the client; keep one (1) copy for the agency, and give one (1) copy to the appliance vendor.

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 \(SF\) \(MH\)](#)

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 Technician* or *Qualified 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 and Replacement - Water Heater Selection \(SF\) \(MH\)](#)

[7.8102.2 \(a, b, c, f, g, h, i, j, k, m, n\) Baseload - Water Heating - Installation and Replacement - Storage-Type Appliances \(SF\) \(MH\)](#)

[7.8102.3 \(a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q\) Baseload - Water Heating - Installation and 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-](#)

Manufactured housing 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.
 - This maximum limitation **does not** apply to the addition of power vents to existing, operating units where drafting is negatively impacted by air sealing the home thru the weatherization process.
- 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 *Nebraska 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 \(a, b, c, f, g, h, i, j, k, l, m, n\) Baseload - Water Heating - Installation and Replacement - Storage-Type-Appliances \(SF\) \(MH\)](#)

[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 General - Combustion Appliance Zone - Fuel Leak Detection \(SF\) \(MH\)](#)

- 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.

[2.0201.1 \(c\) Health & Safety - Safe Work Practices - Combustion Safety General - Combustion Appliance Zone - Venting \(SF\) \(MH\)](#)

- 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 General - Combustion Appliance Zone - Assessment \(SF\) \(MH\)](#)

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 6 feet (to a maximum of 18 feet, if cost effective) of the hot or inlet piping and a minimum of 6 feet of outlet piping 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 Housing: 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 \(a, b, c, f, g, h, i, j, k, 1, m, n\) Baseload - Water Heating - Installation and 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.

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.

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

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

Trained Weatherization Staff: A subgrantee staff person who has successfully completed appropriate training to perform a task in the weatherization program.

CFM⁵⁰: 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: A space or area 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, *manufactured home* 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.).

Friable: Material that can be crumbled, pulverized, or reduced to powder by the pressure of an ordinary human hand.

H

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

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

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.

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 building envelope* that is used on a regular basis for sleeping, eating, bathing etc.

M

Manufactured Housing: Commonly known as *manufactured 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 particles (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, and 3 stories in height
- Large Multifamily: 25+ units, and 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: 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.

Qualified Plumbing Technician: An individual or company that is specifically involved in the installation and/or servicing of residential plumbing 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 *Trained Weatherization Staff*.

SIR (Savings to Investment ratio): A ratio of economic performance as calculated by NEAT/MHEA and MULTEA 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 space or 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 200 ppm as measured in the flue gases or 70 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.

Nebraska Weatherization Assistance Program Standard Work Specifications

Single Family Housing Standard Work Specifications

2 Health & 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 hazards



Unsafe

Recognize potential risks



Safe

Wear appropriate hand protection



GOOD:

Wear nitrile gloves when handling mastic



Unsafe

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



When working with high-pressure spray foam, use a Supplied Air Respirator



All P-100s should be fitted to the individual worker



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 will be consulted

Objective(s):

Avoid electrical shock and arc flash hazards



Unsafe

Inspect house for unsafe electrical situations



Best Practice

Attics and *crawl spaces* should be inspected closely for electrical safety before work begins

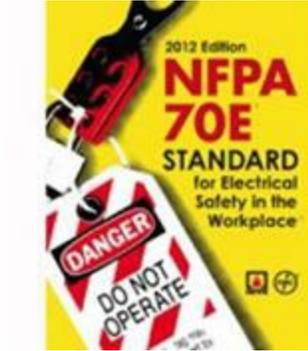


Use GFCIs and three-wire extension cords for all power tools

Electrical wiring should not be located near a water source



Use fiberglass ladders in place of metal



Follow NFPA 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 35 ppm!!



Best Practice

Install carbon monoxide alarms

Tools:

1. CO meter

- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

2.0100.1f - Personal Protective Equipment

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

Workers should be aware of work required and dress appropriately



After

Ensure workers have proper protective equipment for work environment



Bad Practice

This worker has donned some PPE, but is not fully protected.



Best Practice

The worker has donned proper PPE, and is fully protected.



Select the proper PPE according to the task to be performed. More volatile substances require more protection.

Tools:

1. Safety Glasses or Goggles
2. Disposable Coverall
3. Gloves

4. Shoe Covers
5. Ear Plugs (situation-dependent)

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



Unsafe

Inspect confined spaces for safety concerns and hazards before work begins



After

Locate all access and egress points of confined spaces before entering



Visual Inspection

Ensure proper personal protective equipment is worn and that workers are aware of ingress and egress points



Best Practice

Perform visual inspection of confined spaces before beginning work



In confined spaces, use a ventilator



Check for frayed or worn electrical wires



Check GHS labels and Safety Data Sheets for all materials to minimize hazards



Do NOT use hazardous materials in confined spaces - particularly those carrying these GHS warnings

Tools:

1. Flashlight
2. Ventilator

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

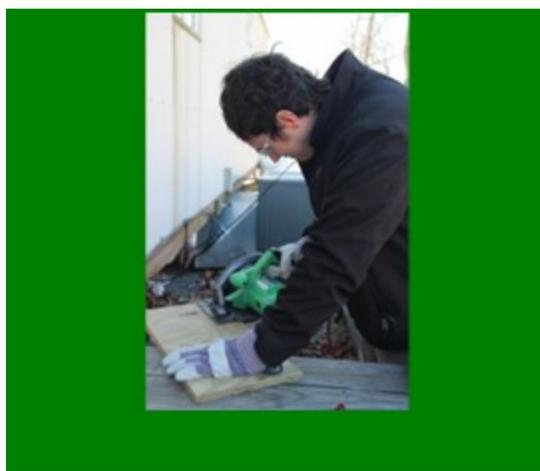
Objective(s):

Prevent power tool injuries



Before

Worker is using a circular



After

Worker is cutting off of a

saw with no eye or ear protection, and is not properly supporting the material to be cut.

stable surface, with appropriate eye and ear protection.



Inspect power and extension cords closely for damage. Follow manufacturer's instructions for repair or replacement.



Generator has been moved off the trailer to ensure no buildup of harmful exhaust gases.



Make sure tools are GFCI-protected or double insulated

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,

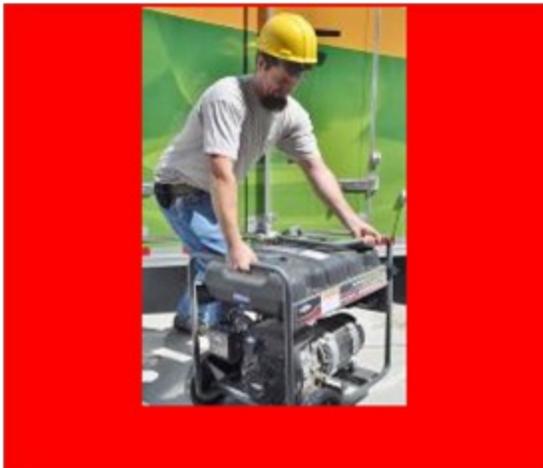
additional padding)

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

Visit [OSHA - Safety and Health Topics - Ergonomics](#) for additional guidance.

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



Before

Using tools for other than their intended purpose is dangerous



After

Use tools in a manner consistent with their intended purpose

Use hand tools only in a manner consistent with their intended purpose. Doing otherwise can cause serious injuries, damage to the tools, damage to materials and equipment. Besides being unsafe, the practice represents poor workmanship and leads to low quality results.

2.0100.1I - 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



Unsafe

Fire hazards like this should be removed from the work area with the permission and/or assistance of the homeowner.



After

After potentially dangerous items have been removed, set combustion appliances to off or pilot to minimize risk of fire.



Remove items in close proximity to flue pipes with homeowner permission and/or assistance.



Turn wall mounted heaters off.



Sometimes it may even be necessary to turn the fuel supply off to service an appliance.



When sealing around *heat sources* like flue pipes, code approved fire-rated materials should always be used.

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 will 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 subgrantee believes that asbestos is present:
 - The subgrantee **must** 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



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

2.0100.1r – *Crawl space safety*

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

The source of all contaminants (e.g., sewage, dead animals, needles) will be corrected, repaired, or removed before performing inspections that require complete access to the crawlspace

If appropriate, the contaminant will be neutralized and/or a protective barrier will be installed in the area

Objective(s):

Ensure work safety

Prevent worker exposure to hazards

2.0101 Air Sealing

2.0101.1 Air Sealing Worker Safety

2.0101.1a - Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be in accordance with SWS Global Worker Safety

Complete safety action plan based on hazard; plan will be in place for each job site

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0101.1b - Moisture precautions for *crawl spaces and basements*

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Exposed earth will be covered with a continuous, durable, and sealed class I *vapor retarder* that is suitable for ground contact exposure to normal service traffic

Causes of air dew points greater than 55°F will be identified and eliminated in *crawl spaces* connected to *conditioned spaces*

Seasonal dehumidification (e.g., dehumidified or *conditioned* with air conditioner supply) will be recommended where humidity sources, including outdoor air incursion, cannot be eliminated

Undesigned penetrations between the *crawl space* or *basement* and the outdoors will be sealed living space will be sealed

Holes between the *crawl space* or *basement* and the living space will be sealed

Open sumps and intentional slab or *vapor barrier* penetrations will be sealed or capped to control moisture and radon levels

Objective(s):

Ensure durability of repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards

Reduce potential for occupant exposure to radon and other soil gases

2.0101.1c – Moisture precautions: living space

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Moisture sources in the building will be identified and reduced or removed

Where local ventilation will be installed, (e.g., baths, kitchens), exhaust units will be vented to the outdoors in accordance with ASHRAE 62.2

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

Unvented gas or propane cooking stoves will be tested for carbon monoxide (CO) per BPI Standard and corrected as required before air sealing work begins

If replacing air conditioning system, new system will be sized to optimize dehumidification

Properly sized dehumidifier will be installed to satisfy latent and sensible loads, when necessary

ANSI / ACCA 2 Manual J-2011 (Residential Load Calculation) will be used to size replacement AC and heat pumps

Objective(s):

Ensure durability of building components and repairs

Reduce potential for occupant exposure to mold and other moisture-related hazards

Reduce potential occupant exposure to CO

2.0101.1d – Moisture precautions for exterior water

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Before air sealing and insulating building components, exterior water management will be addressed

Before insulating *basement* or *crawl space* walls near wet areas, surface water pooling near the foundation will be addressed by repairing, modifying, or replacing gutters and downspouts

Grading and subsurface drainage at critical locations (e.g., localized drain and grading beneath valleys) will be in accordance with EPA Indoor airPLUS Construction

Specifications Section 1.1

Objective(s):

Reduce potential for occupant exposure to mold and other moisture-related hazards

- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case-by-case basis by the Nebraska Energy Office prior to any work being implemented.

2.0102 Insulation

2.0102.1 Insulation Worker Safety

2.0102.1a - Worker Safety

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be followed in accordance with SWS [2.0100 Global Worker Safety](#)

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0102.1b - Asbestos-containing materials (ACM)

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

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 pressured 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



Do not disturb vermiculite by vacuuming, dusting, or sweeping



Do not disturb vermiculite by drilling, sanding, scraping, sawing, etc.



Before

Material identified as vermiculite may contain asbestos



After

If asbestos is suspected, call an EPA- accredited professional

- The cost associated with testing vermiculite is an eligible expenditure in the Nebraska Weatherization Assistance Program, however subgrantees are limited to a maximum cost of \$150 for vermiculite testing.
- The costs associated with asbestos encapsulation, remediation or removal are not eligible expenditures in the *Nebraska >Weatherization Assistance Program*.

2.0102.1c - Materials

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

Objective(s):

Eliminate hazards associated with incorrect, defective, or improperly used or installed materials



Best Practice

Ensure workers wear appropriate masks or respirators for the material with which they are working



Check SDS for materials to be used during retrofit to determine what PPE is



Wear respirator or mask appropriate to the materials being used

necessary

2.0102.1d - 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



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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

2.0103 Heating and Cooling Equipment

2.0103.1 Combustion Worker Safety

2.0103.1a - Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be followed in accordance with SWS [2.0100 Global Worker Safety](#)

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0103.1b - 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

STOP WORK if CO levels measure above 35 ppm!!



After

Install carbon monoxide alarm if none are found.

Tools:

1. CO meter

2.0103.1c - 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

2.0103.2 Heating and Cooling Worker Safety

2.0103.2a - Worker safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be followed in accordance with SWS [2.0100 Global Worker Safety](#)

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0103.2b - 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



Safe

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.com for recycling options.

2.0103.2c - Asbestos

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Suspected asbestos hazards will be identified in furnaces (e.g., gaskets), wood stoves, zonal heating devices, electrical wiring insulation, boilers, and pipe insulation and corrected in accordance with EPA guidance

Workers will take precautionary measures to avoid exposure

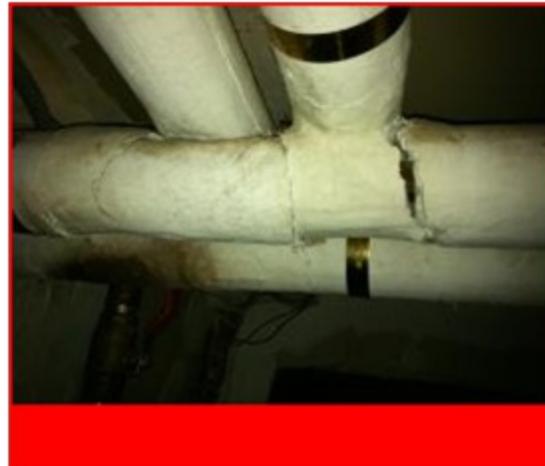
Objective(s):

Protect workers and occupants from asbestos exposure



Unsafe

Suspicious pipe insulation may contain asbestos



Unsafe

Have an AHERA-certified professional test all areas with suspected asbestos. Remediate in accordance with EPA rules.



When asbestos is suspected, call in EPA-accredited professionals.

- The costs associated with the testing (excluding vermiculite), encapsulation, remediation and removal of Asbestos materials are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0103.2d - Personal Protective Equipment (PPE)

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Workers will wear personal protective equipment (PPE) as needed to protect themselves against exposure to hazards (e.g., pests, sewage, flooded duct work, mold, chemicals, scat, viruses)

Long sleeves and long pants should be worn as additional

protection from liquid refrigerants and other hazardous materials

Objective(s):

Protect worker from exposure to hazards

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



Wear work gloves when working with metal ducts



Assess the site and situation to determine proper PPE to

minimize risks

2.0103.2e – Combustible gas detection

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Worker will check for presence of combustible gas leaks before work begins

Leaks will be repaired before work is performed

Objective(s):

Protect worker and occupant from exposure to hazards



Unsafe

Fuel leaks need to be repaired



Safe

Repairs need to be tested and verified to no longer leak

Measures

Measure 12 Repair - Gas Leak in Crawlspace (flagged)

Comment

#	Material / Labor	Description /Comment	Units
10	Unspecified	Misc Material	Each



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

Tools:

1. Combustion gas detector
2. Testing solution

Materials:

1. Noncorrosive leak detection fluid

Paraphrased from IRC: 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 *pipng system* will be repaired or replaced and retested.

2.0103.2f – Carbon Monoxide

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Workers will check for presence of ambient CO before and during work.

CO issues will be addressed before work is performed or continued

Objective(s):

Protect worker and occupant from exposure to hazards



Unsafe

STOP WORK if CO levels are higher than 35 ppm!!



Best Practice

Install carbon monoxide alarms



Test for CO in entire home, particularly around combustion appliances



If CO issues are found, clean and tune appliances to remediate issues



All workers should wear personal ambient CO monitors and halt work if levels exceed 35 ppm

Tools:

1. CO meter

- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.
- The costs associated with cleaning and tuning appliances are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0103.2g – Sealant

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Pipes will be sealed by a certified professional with an approved fastening process and sealant in accordance with manufacturer specifications (International Fuel Gas Code)

Gas lines will be leak free when tested with an electronic combustible gas leak detector and verified with bubble solution

OR

Gas lines will be leak free when tested by a standing pressure test that meets the approval of the local code

Objective(s):

Install gas lines with no leaks

2.0103.2h – Safety Devices

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

A secondary LP safety detector system (valve, exhaust fan, alarm light) will be installed by a certified professional for propane piping installed below grade

When installing new equipment, a shut off valve will be installed by a certified professional at each gas appliance (ANSI Z21.15)

Objective(s):

Detect accumulation of dangerous levels of propane in below-

grade areas

Isolate appliances from the rest of the system for emergencies, removal, or repairs

- The costs associated with the installation of secondary LP safety detector systems are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0104 Ventilation Equipment

2.0104.1 Ventilation Worker Safety

2.0104.1a - Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be followed in accordance with SWS [2.0100 Global Worker Safety](#)

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0105 Baseload

2.0105.1 Baseload Worker Safety

2.0105.1a - Worker Safety

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be followed in accordance with SWS [2.0100 Global Worker Safety](#)

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0106 Material Safety

2.0106.1 Material Selection, Labeling, and Material Safety Data Sheets (MSDSs)

2.0106.1a - 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

2.0106.1b - 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

2.0106.1c - 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

2.0107 Basements and Crawl Spaces

2.0107.1 Basements and Crawl Spaces Worker Safety

2.0107.1a - Worker Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Worker safety specifications will be followed in accordance with SWS [2.0100 Global Worker Safety](#)

Objective(s):

Prevent injury

Minimize exposure to health and safety hazards

2.0107.2 Crawl Spaces - Pre-Work Qualifications

2.0107.2a - Fuel Leaks

Desired Outcome:

Site properly prepared for upgrade

Specification(s):

Fuel leaks will be repaired and inspected in accordance with

the 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, subgrantees are expected to use good judgment in dealing with the

situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

- **Paraphrased from IRC:** 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.

Measures

Measure 12 Repair - Gas Leak in Crawlspace (flagged)

Comment

Material / Labor	Description / Comment	Units
Specified	Misc Material	Each



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

2.0107.2b - 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, subgrantees are expected to use good judgment in dealing with the situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.2c - 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

- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is

independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case-by-case basis by the Nebraska Energy Office **prior** to any work being implemented.

- In the case of extensive mold concerns, subgrantees are expected to use good judgment in dealing with the situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.2d - 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 IRC

Objective(s):

Prepare site for upgrade

- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term

stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case-by-case basis by the Nebraska Energy Office **prior** to any work being implemented.

- When extensive plumbing and water leaks are discovered, subgrantees are expected to use good judgment in dealing with the situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.2e - 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 IRC

Objective(s):

Prepare site for upgrade

- Pest removal is allowed only where infestation would prevent weatherization. Subgrantees are limited to a

maximum cost of \$300 for pest removal, although approval to exceed this limitation will be reviewed on a case-by-case basis by the Nebraska Energy Office **prior** to any work being implemented.

- If extensive pest issues are discovered, subgrantees are expected to use good judgment in dealing with the situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.2f - 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 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, subgrantees are expected to use good judgment in dealing with the situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.2g - 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

2.0107.3 *Crawl Spaces* - Debris removal

2.0107.3a - 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, subgrantees are expected to use good judgment in dealing with the situation. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.3b - 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*.
- Subgrantees are expected to use good judgment in dealing with these difficult situations. The client **must** 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 **must** 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 subgrantee **must** clearly indicate in the client file why the dwelling was given "deferral" status.

2.0107.4 Negative Pressure Contamination Control

2.0107.4a - 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 greater than 10% Lower Explosion Limit (LEL), ambient CO levels that exceed 70 ppm) will be communicated clearly and immediately to the customer, the home shall be evacuated, and appropriate personnel (e.g. HVAC technician, utility, emergency services) shall be contacted

Significant problems (e.g., gas leak less than 10% LEL, ambient CO levels that exceed 35 ppm but less than 70 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested

Examine appliance for signs of damage, misuse, improper repairs, and lack of maintenance

Objective(s):

Ensure system does not have potentially fatal problems



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):

For oil systems, the presence and operability of it (that draft regulator) will be verified and tested

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

Determine whether 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 disconnected pipes



Inspect ventilation systems for damage



Inspect ventilation systems for inadequate slope



Inspect for missing draft diverter

2.0201.1d - Base pressure test

Desired Outcome:

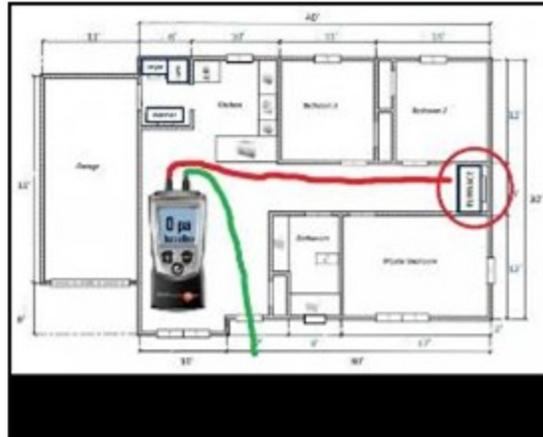
Accurate information about appliance safe operation is gathered

Specification(s):

Baseline pressure for naturally drafting vented appliances 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

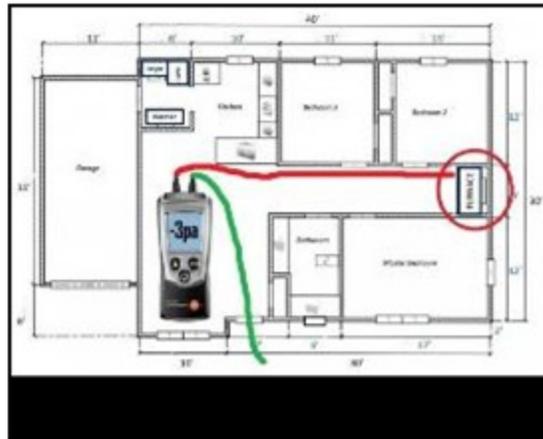
Specification(s):

CAZ depressurization testing will be administered for all equipment equipped with a draft hood

Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof; the test will be done to determine the largest negative pressure per BPI Standard 1200

Objective(s):

Determine worst-case depressurization in combustion zone due to mechanical system fans



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



6

Turn on interior exhaust fans, including any clothes dryers



7

Check interior doors for pressure differential either using smoke pencil or hand

Is the air handler on?



8

Manometer reading should not be more negative than -3pa



9

If reading is within allowable limit, all is well

2.0201.2 Combustion Safety -

Make-up Air

2.0201.2a - Outside combustion make-up air

Note:

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

Desired Outcome:

Build-up of dangerous combustion byproducts in the living space prevented

Specification(s):

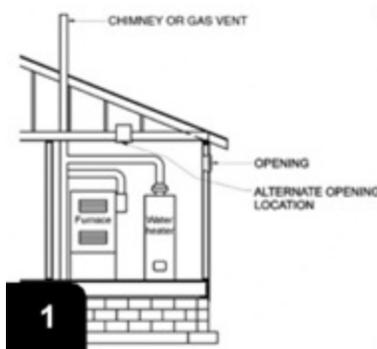
Where applicable, combustion air will be provided from the outside and installed in accordance with the IRC for the type of appliance installed

Objective(s):

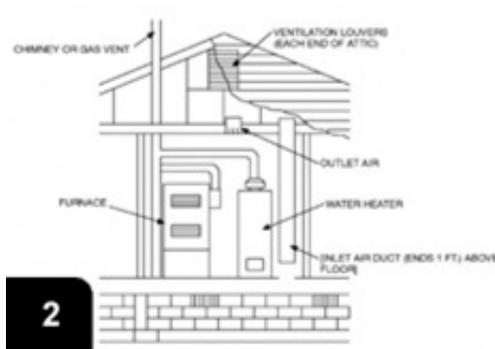
Prevent combustion byproducts from entering the house

- **Image 1:** For homes with one permanent opening, see IRC G2407.6.2 (304.6.2): a minimum free area of 1 in 2 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 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in 2 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 IRC G2407.6.1 (304.6.1): a minimum free area of 1 in 2 per 2,000 Btu/h (1,100 mm²/kW) of total

input rating of all appliances



min free area of 1 sqin per 3,000 Btu/h (734 mm²/kW) of total input rating



min free area of 1 sqin per 4,000 Btu/h (550 mm²/kW) of total input rating



min free area of 1 sqin per 2,000 Btu/h (1100 mm²/kW) of total input rating

2.0201.2b - New appliances

Note:

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

Desired Outcome:

Build-up of dangerous combustion byproducts in the living space prevented

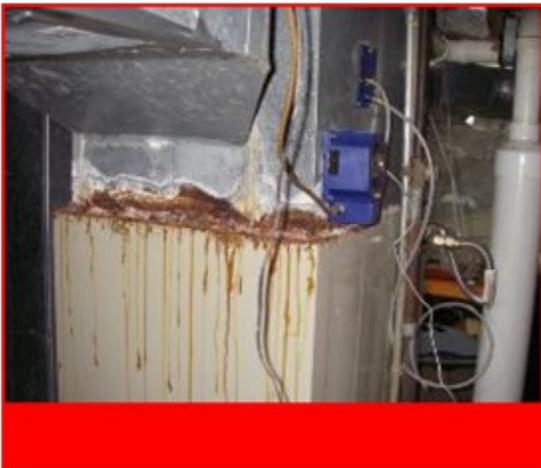
Specification(s):

If replacing appliances, a sealed-combustion, direct-vent appliance will be installed, if possible. New appliances will be installed in accordance with manufacturer specifications, the IRC and additional applicable codes

Objective(s):

Prevent combustion byproducts from entering the house

- Always perform combustion safety testing on newly installed equipment to ensure it is performing properly.



Before

Damaged combustion appliances beyond repair should be replaced



After

Sealed-combustion, direct-vent appliances should replace unsafe appliances

Tools:

1. Digital manometer and air line tubing
2. Personal carbon monoxide detector
3. Combustion analyzer
4. Combustible gas leak detector



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

Note:

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

Desired Outcome:

Build-up 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

Installation will be accomplished by a licensed electrician when required by local code

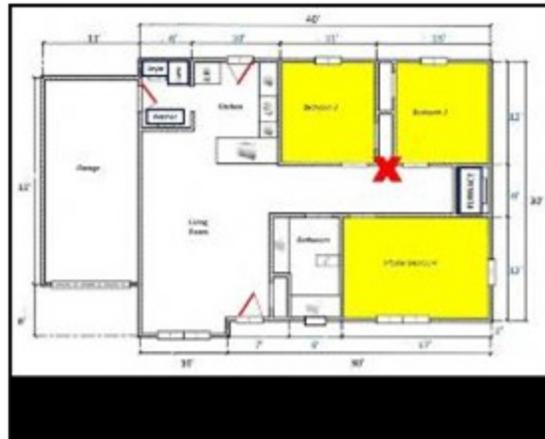
Objective(s):

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:

Materials:

1. Drill

1. CO alarm

2. Fasteners

- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.
- **Paraphrased from IRC:** An approved CO alarm will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within which fuel fired appliances are installed and in dwelling units that have attached garages. CO detectors will comply with UL 2075. Single-station CO alarms will comply with UL 2034 and will be installed in accordance with this code and the manufacturer's installation instructions.
- Full compliance with ASHRAE 62.2 and NFPA 720 is required.

2.0201.2d - Gas ovens - Approved Variance

Note:

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

Desired Outcome:

Build-up 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 225 ppm as measured

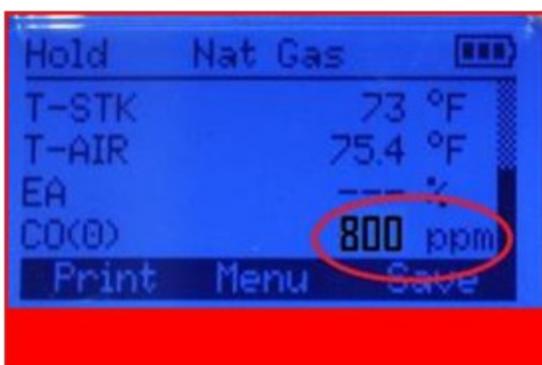
If the measured CO in undiluted flue gasses in the oven vent at steady state exceeds 225 ppm as measured, the problem will be communicated clearly and immediately to the client

The home will be appropriately ventilated and appropriate solutions will be suggested.

The subgrantee must clearly indicate to the client, in writing, and in the client file why the dwelling was given "deferral" status and the condition that must be corrected before weatherization services are provided.

Objective(s):

Ensure clean burn of gas ovens



Unsafe

If air-free CO reading exceeds 225 ppm, order a clean and tune



Best Practice

Test gas oven for carbon monoxide using a combustion gas analyzer

Tools:

1. Combustion analyzer with probe

- Maintenance, replacement, repair, tuning and/or cleaning of gas ranges or ovens are not eligible expenditures through the NeWAP.

2.0201.2e - Gas range burners**Note:**

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

Desired Outcome:

Build-up of dangerous combustion byproducts in the living space prevented

Specification(s):

Specify clean and tune if the flame has any discoloration, flame impingement, 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



1

Yellow, uncontrolled flames indicate the need for a clean and tune



2

Gas ranges should be cleaned and tuned if improper operation is evident



3

Blue, even flames indicate burners are working properly

- The costs associated with tuning and cleaning ranges and ovens are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

2.0201.2f - Solid fuel burning appliances

Note:

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

Desired Outcome:

Build-up 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

- 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



Before

Unvented space heaters should be removed with the occupants' permission



After

Unvented space heaters can be replaced with properly vented space heaters



Secure permission to remove unvented space heaters from occupants



Ensure new combustion appliances are vented properly

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



Unsafe

Unvented space heaters in homes are hazardous to occupants



Best Practice

Clearly communicate the hazards to the occupant in order to inform their decision to remove the appliance



Unvented space heaters significantly increase the risk of house fires



Unvented combustion gases cause a hazard to all occupants



Unvented space heaters can create moisture issues in homes, leading to black mold

- *Manufactured homes* primarily heated by naturally drafting combustion *heating systems* that are not specifically manufactured for use in *manufactured housing* **must not** be weatherized until the *heating system* has been replaced with a *heating system* designed for use in *manufactured housing*.

2.0203 Vented Gas Appliances

2.0203.1 Combustion Air for Natural Draft Appliances

2.0203.1a - Required combustion air

Desired Outcome:

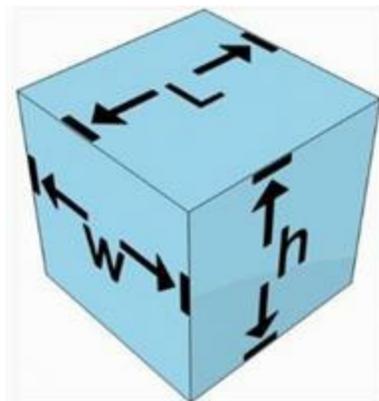
Sufficient air provided in the *Combustion Appliance Zone* (CAZ)

Specification(s):

The required volume of indoor air will be determined in accordance with 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), IRC Section G2407.5.2 will be used

Objective(s):

Determine if existing conditions meet the combustion air calculation



Best Practice

G2407.5.1 (304.5.1) Standard method. The minimum required volume shall be 50 cubic feet per 1,000 *Btu/h* (4.8 m³/kW).

G2407.5.2 (304.5.2) Known air-infiltration-rate method. Where the air *infiltration* rate of a structure is known, the minimum required volume shall be determined as follows: For purposes of this calculation, an *infiltration* rate greater than 0.60 ACH shall not be used in Equations 24-1.

For *appliances* other than fan-assisted, calculate volume using Equation 24-1.

*Required Volume (natural draft) ≥ ((21ft³/ACHn) * (Input (other) / 1,000BTU/hr))*

Input (other) = All appliances other than fan-assisted (input in Btu/h).

ACHn = Air change per hour under natural conditions

Standard:

100,000 BTUH Furnace Input 100,000 x .05 = 5,000 ft³

or 100,000/1000 = 100

100 x 50 = 5,000 ft³

Known *infiltration* rate method (assuming ACHn is .50 in this example):

$((21\text{ft}^3/.50)*(100,000/ 1,000\text{BTU/hr})) = 4,200$
ft³



Measure the CAZ width



Measure the CAZ length



Measure the CAZ height

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 IRC G2407 and authority having jurisdiction when necessary to solve spillage problems

Objective(s):

Ensure adequate combustion air for operation of the appliance



Before

Combustion appliances in a confined space



After

Additional combustion air supplied from high / low vents

Tools:

1. Drywall saw
2. Drill
3. Tin snips
4. Tape measure
5. Wire cutters

Materials:

1. Metal ducts
2. 1/4" galvanized hardware cloth mesh
3. Galvanized straps or L-brackets to secure high/low vents
4. Screws
5. Louvered grilles (optional)
6. Louvered doors (optional)

Combustion appliances require 50 cubic feet of volume for every 1,000 Btuh input. If this is not available, provide makeup air in accordance with the IRC G.2407 or local code.

When high/low vents are used, use two metal ducts each having 1 in² of cross-sectional area for every 4,000 Btuh input. Extend each into the attic above the insulation level, and use 1/4" galvanized hardware cloth mesh on top to screen out insects and vermin. Terminate one vent within 12 inches of the ceiling, and one vent within 12 inches of the floor. The vents may be concentric (one inside the other) to save space, so long as the difference between the area of the larger and smaller vents is equal to or greater than the 1 in²/4,000 Btuh requirement.

If using a single large opening in the ceiling, make the opening total 1 in² per 3,000 Btuh input.

If high/low vents extend horizontally through a CAZ wall, use vents with 1 in² of area per 2,000 Btuh of input.

Louvered grilles or doors may be used to connect the CAZ to larger sections of the home to achieve the required volume, but be aware that using this approach has higher potential for creating a carbon monoxide pathway into the home than does creating a sealed CAZ with high/low vents.



Select vent sizes based on the total input Btus in the



Cut hole in ceiling and mount high/low vents to

CAZ. Concentric vents are shown

framing



Fasten 1/4" galvanized hardware cloth over high / low vent openings



Complete installation by adding supports and fasteners as required for stability and durability



Terminate the low vent within 12 inches of the floor. This one is mounted inside a section of larger diameter metal duct

2.0203.1c - Spillage testing

Desired Outcome:

Sufficient air provided in the *Combustion Appliance Zone* (CAZ)

Specification(s):

If spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate

If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate

Objective(s):

Detect excessive spillage of combustion gases

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 spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate

If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate

Objective(s):

Detect excessive spillage of combustion gases



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. Stopwatch or timer

2.0203.2b - Flue gas removal (chimney liner) - Approved Variance

Desired Outcome:

Flue gasses successfully removed from the house

Specification(s):

A chimney liner will be installed in accordance with the IRC or applicable NFPA standard

In the case of excessive room pressures and/or chimney conditions, a power vent may be installed on the water heater as an alternative to installing a chimney liner

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 2 minutes during pressure testing, specify measures to mitigate

Objective(s):

Ensure appliance is not spilling longer than 2 minutes with a warm vent



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



1

Retest for spillage. If spillage remains, more repair is needed.



2

Repipe the flue to eliminate the oversized chimney



3

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 IRC G2407.5.1 and authority having jurisdiction

Exception: Existing appliances that have passed combustion safety testing per BPI 1200 are deemed to have sufficient combustion air

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 IRC G2407 or other authority having jurisdiction

Objective(s):

Ensure adequate combustion air for operation of the appliance

2.03 Safety Devices

2.0301 Combustion Safety Devices

2.0301.1 Smoke Alarm

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 manufacturer specifications

Objective(s):

Ensure proper installation



Best Practice

All homes should have UL-217 rated smoke alarms



Ceiling mounted smoke alarms can be battery-operated



Wall mounted smoke alarms **must** be mounted within 12 inches of the ceiling

- **Paraphrased from IRC:** 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.
- The costs associated with hard-wiring smoke detectors is not an eligible expenditure in the *Nebraska Weatherization Assistance Program*.

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

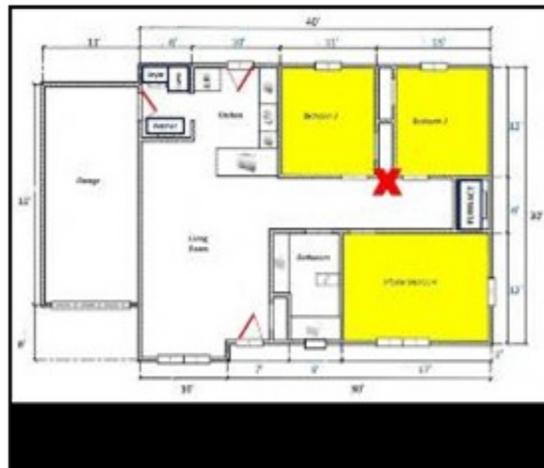
Objective(s):

Ensure proper installation



Best Practice

All homes should have a carbon monoxide detector installed, whether hardwired or battery operated



Best Practice

Alarms should be mounted near sleeping areas—such as the one marked in red



After

Alarms should be mounted in sleeping areas – such as the one marked in red



1

Mount alarm to wall close to bedrooms



2

Plug alarm into outlet. In addition, cord can be stapled into place

Tools:

1. Hammer

Materials:

1. Nails

- **Paraphrased from IRC:** An approved CO alarm will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within which fuel-fired appliances are installed and in dwelling units that have attached garages. CO detectors will comply with UL 2075. Single-station CO alarms will comply with UL 2034 and will be installed in accordance with this code and the manufacturer's installation instructions.
- Full compliance with ASHRAE 62.2 and NFPA 720 is required.
- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

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 battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.
- Full compliance with ASHRAE 62.2 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 **must** 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

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

Any *vapor retarder* shall not encasulate wood building materials or spray foam

Holes between the *crawl space* 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 62.2-2016

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 **must** 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



Best Practice

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 6 mil or thicker).
- From IRC definition of *vapor retarders*:
 - Class I: ≤ 0.1 perm (called impermeable),
 - Class II: 0.1 to 1.0 perm (called semi-impermeable), and
 - 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 inches and is securely fastened

Tools:

1. Stapler
2. Utility knife
3. Drill

Materials:

1. Ballast
2. Plastic sheeting (at least 6 mil)
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

- The joints **must** be sealed with appropriate sealants.

2.0403.1e - Fastening

Desired Outcome:

Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor

Specification(s):

When ground moisture barrier is installed on sloping ground, may be exposed to wind, or accessed for routine maintenance or storage it will be fastened to ground with durable fasteners or ballast(s).

Objective(s):

Prevent movement of the ground moisture barrier



Before



After

Fastening of moisture barrier is required and **must** last at least 10 years

Moisture barrier needs to be held in place with more permanent fasteners

Ground moisture barrier should extend up the wall at least 12" and be held in place

Ballast or fasteners should be used to hold barrier in place securely

Tools:

1. Stapler
2. Drill

Materials:

1. Plastic sheeting (at least 6 mil)
2. Furring strips
3. Fasteners

- The ground moisture barrier **must** extend a minimum of 12 inches up the foundation wall and all support barriers.



1

Seams can be taped to prevent water leakage



2

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 **must** extend a minimum of 12 inches 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 6 mil, able to withstand puncture and last 10 yrs

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*, the SWS call for materials with a *perm rating* of <0.5 (which translates to 6 mil or thicker).
- From IRC definition of *vapor retarders*:
 - Class I: ≤ 0.1 perm (called impermeable),
 - Class II: 0.1 to 1.0 perm (called semi-impermeable), and
 - 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 inches and is securely fastened

Tools:

1. Stapler
2. Utility knife
3. Drill

Materials:

1. Ballast
2. Plastic sheeting (at least 6 mil)
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

- The Nebraska WAP Standard states: The ground moisture barrier must extend a minimum of 12 inches up the foundation wall and all support barriers and be sealed with appropriate sealants

2.0403.2e - Fastening

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

When ground moisture barrier is installed on sloping ground, or accessed for routine maintenance or storage it will be fastened to the ground with durable fasteners or ballast(s)

Objective(s):

Prevent movement and uplift of the air barrier and ground moisture barrier

See [2.0403.1e - Fastening](#) for **Before** and **After** photos along with **Tools** and **Materials**.

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



After

Ground moisture barriers in unvented spaces should be

moisture penetration of floor

sealed

Tools:

1. Utility knife



Tape wall seams and press to ensure airtight bonding of adhesive

Materials:

1. Moisture-resistant adhesive tape



Tape (overlapped) floor seams to prevent movement and water leakage

- The joints *must* be sealed with appropriate sealants.

2.06 Electrical

2.0601 Knob and Tube Wiring

2.0601.1 Knob and Tube Wiring

2.0601.1a - Knob and tube identification

Note:

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

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

Note:

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

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:

1. 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 - Approved Variance

Note:

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

Desired Outcome:

Live unsafe wiring identified and brought to local codes

Specification(s):

Proper clearance will be maintained around live knob and tube as required by the National Electrical Code (NEC) or authority having jurisdiction

When required, a dam that does not cover the top will be created to separate insulation from the wire path

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 minimum 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, and
- . In 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 subgrantee 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 installation details at [4.1001.2 Knob and Tube Wiring](#).

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.

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

Tools:

1. Drill
2. Tape measure
3. Non-contact wire tester



After

Dams should be installed to hold back loose fill insulation

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

Note:

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

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

With modern wiring in place and old k&t disabled, insulation can begin



4

Exposed knob and tube should be replaced with modern wiring

2.0602 Electric Hazards

2.0602.1 Static Electric Shock

2.0602.1a - Rigid fill tube

Desired Outcome:

Prevention of static electric shock to the insulation installer when using rigid tubing

Specification(s):

Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded

Objective(s):

Prevent injury to the installer



Best Practice

Rigid fill tubes should be low-conductivity and be grounded

Tools:

1. Wrench

Materials:

1. Couplers
2. Schedule 40 PVC fill tube

3. Grounding wire
4. Grounding rod



1
Select rigid fill tubes that are low conductivity – Schedule 40 PVC fill tube



2
Attach grounding wire to fill tubes to minimize shock risk



3
Attach grounding wire to rod with coupler



4
Blow insulation

2.0602.1b - Metal coupler grounding

Desired Outcome:

Prevention of static electric shock to the insulation installer

when using rigid tubing

Specification(s):

For an additional level of protection, the metal coupler on the hose will be connected to the grounding wire

Grounding wire will be connected to the grounding rod

Grounding rod will be driven into the ground a minimum of 8' when possible; grounding wire will be connected in compliance with local code and authority having jurisdiction

Objective(s):

Divert static discharge of electricity to ground instead of installer



Unsafe

Ungrounded fill tubes can build up static electricity during insulation blowing

Tools:



Best Practice

Fill tubes should be grounded to prevent electric shock to workers

Materials:

1. Sledgehammer
2. Wrench

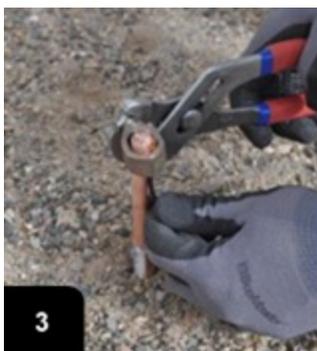


Copper grounding rod should be at least 8' long

1. Grounding rod, at least 8 inches
2. Grounding wire
3. Metal coupler
4. Grounding coupler



Grounding rod should be driven into the ground so that nearly all of rod is underground



Attach grounding wire to rod with coupler



Attach grounding wire to fill tube



Blow in insulation with peace of mind that workers will not be electrocuted

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 the IRC

Access to mechanical equipment located in the *crawl space* will be in accordance with 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 IRC N1102.2.4 and 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



Best Practice

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

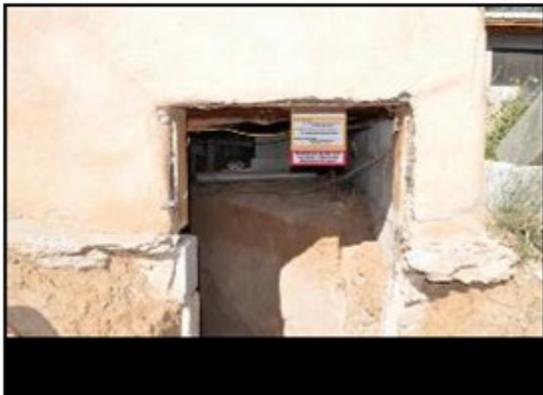
case there are questions or needs for repairs

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*

Tools:

1. Printer
2. Staple gun

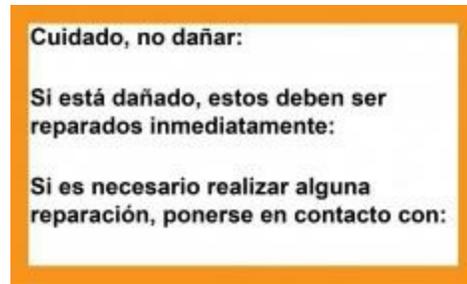


Best Practice

Be sure sign includes relevant information to aid occupant in repairs

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 safety 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

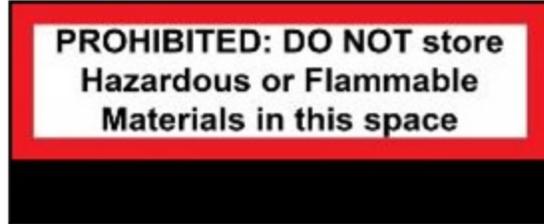


Best Practice

Mount sign where anyone entering the *crawl space* can see it

Tools:

1. Staple gun
2. Printer

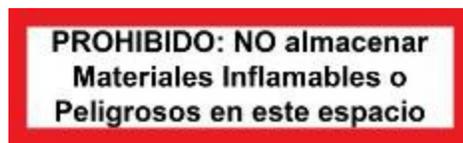


Best Practice

Alert those entering the *crawl space* never to store hazardous materials

Materials:

1. Paper
2. Laminant
3. Staples



Hacer la señal en español también

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 & Safety 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 & Safety 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 and Maintenance agreement - client education

Desired Outcome:

Occupants provided recourse for failures in materials, workmanship, and serviceability and informed of potential hazards

Specification(s):

Provide occupants with manufacturers' warranties on installed equipment and inform of installer maintenance agreement options

Share information on company related annual inspections and maintenance agreements as well as manufacturer related warranty details

Objective(s):

Ensure occupants are aware of warranty and maintenance agreement options

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

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 **must** 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 **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** 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 **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.
- A maximum of \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** be checked at the end of each measure to determine its cost effectiveness.
- Sealing and repair materials **must** 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
3. Metal snips

Materials:

1. High-temperature caulking
2. 26-gauge steel sheeting

- See [3.1402.1c](#) for Clearance Requirements.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat sources*.
- A maximum of \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** be checked at the end of each measure to determine its cost effectiveness.
- Sealing and repair materials **must** 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

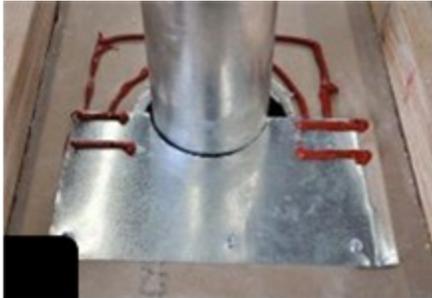
Apply first ring of caulking to



4

Apply second ring of

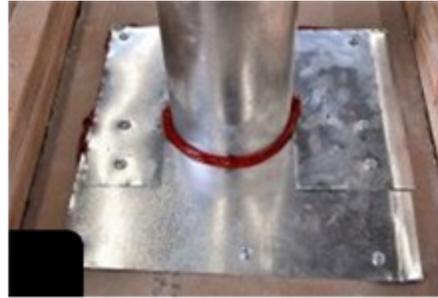
match shape of opening



5

Fasten rigid material (26-gauge steel) and apply additional caulking

caulking to size and shape of rigid material



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

Tools:



After

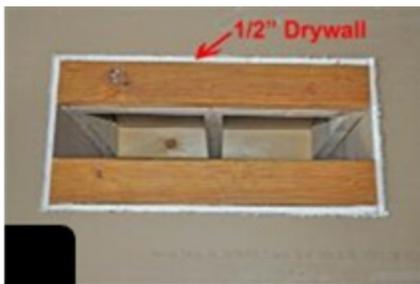
The air barrier is be maintained by capping chases with rigid material

Materials:

1. Drill/screwdriver
2. Caulk gun

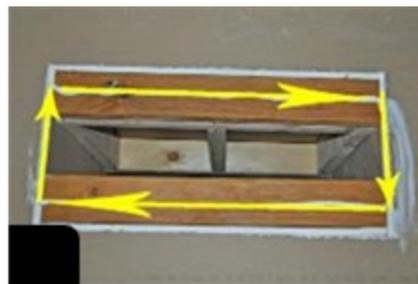
1. Drywall or other code approved rigid board material
2. Caulk
3. Sheet metal
4. OSB or plywood

- A maximum of \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** be checked at the end of each measure to determine its cost effectiveness.



1

Clear area of debris and insulation in preparation for work



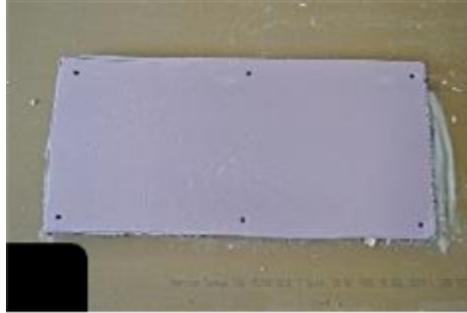
2

Apply sealant all the way around opening



3

Fasten rigid material appropriately, such as with screws



4

Trim rigid material, such as drywall, to size and place over sealant

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 IRC

Objective(s):

Prevent a fire hazard



Before

Paneled drop soffits typically are more combustibile than plain drywall

Tools:

1. Drywall saw
2. Tape measure
3. Caulk gun
4. Drill



After

When sealing on attic side, drywall or other code approved rigid board materials are viable

Materials:

1. Drywall or other code approved rigid board material
2. Fire-block sealant
3. Fasteners

- A maximum of \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** 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

3.1001.2d - Support

Desired Outcome:

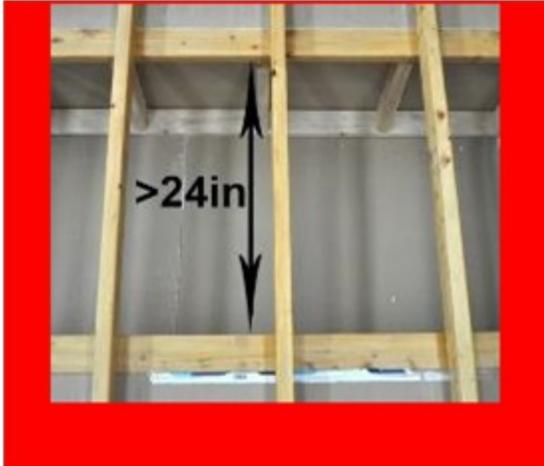
Chase capped to prevent air leakage and moisture movement between the attic and *conditioned space*

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 \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** 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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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

Tools:



After

Whatever option chosen, test for visible air movement with smoke pencil

Materials:

1. Utility knife
2. Saw
3. Insulation machine
4. Caulk gun
5. Spray foam gun

1. Drywall or other code approved rigid board material
2. Spray foam
3. Caulk
4. Fasteners
5. *Dense packable* insulation
6. 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: Cap with drywall and seal exposed joints

3.1001.3c - Support

Desired Outcome:

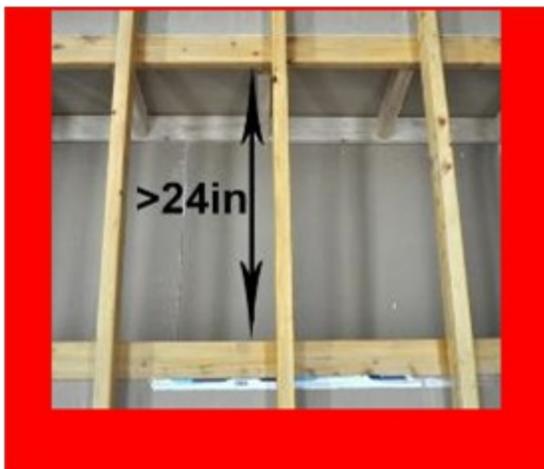
Continuous air barrier prevents air leakage and moisture movement between the attic and *conditioned space*

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

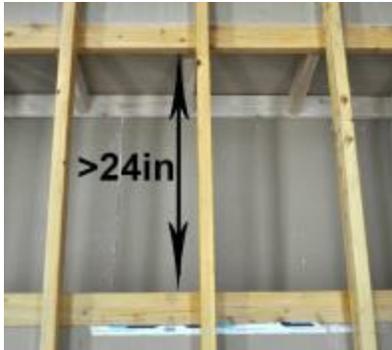
Support should prevent cap from sagging or moving

Tools:

Materials:

1. Saw
2. Drill
3. Tape measure

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:

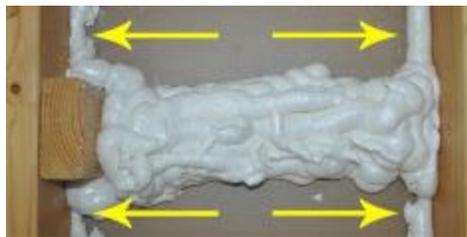
1. Spray foam gun
2. Caulk gun

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:

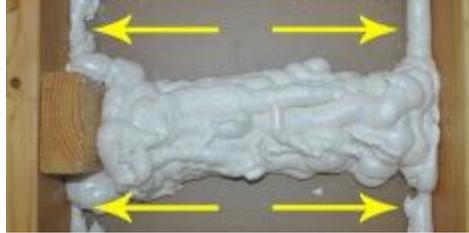
1. Spray foam gun
2. Caulk gun

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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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

- **Limited** water damage repairs that can be addressed by

weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.

- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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 **must** 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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although

approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.

- Where severe Mold and Moistures cannot be addressed, deferral is required.

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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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*

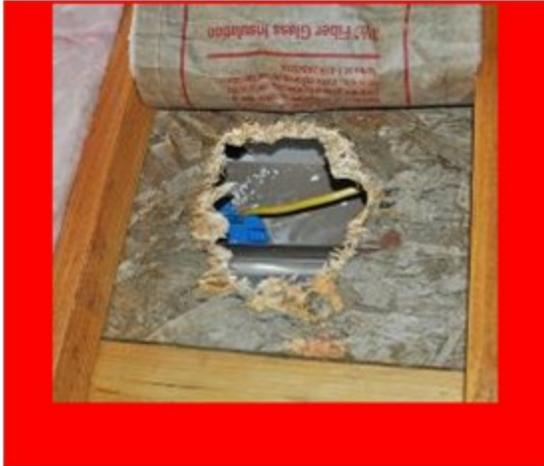
Or

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

Tools:

1. Utility knife
2. Saw
3. Drill
4. Insulation machine
5. Caulk gun
6. Spray foam gun
7. Tape measure



After

Rigid material sealed in place creates an air barrier

Materials:

1. Caulk sealant
2. Drywall or other code approved rigid board material
3. Spray foam
4. Fasteners
5. *Dense packable* insulation
6. Wrapped fiberglass batts



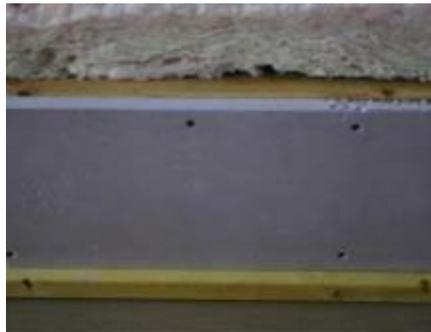
Prepare work area by removing existing insulation and debris



Option 1, Step 1: Run a bead of sealant around damage in old ceiling



Option 1, Step 2: Cover openings with code approved rigid board material or drywall



Option 2: Seal with rigid material along face of stud cavities



Option 3: *Dense pack* cavities through fastened



Option 4: Bridge cavities at new ceiling level with

wood plate

wrapped batts and SPF



Whatever option chosen,
test with chemical smoke to
verify no leakage

3.1003.1c - Support

Desired Outcome:

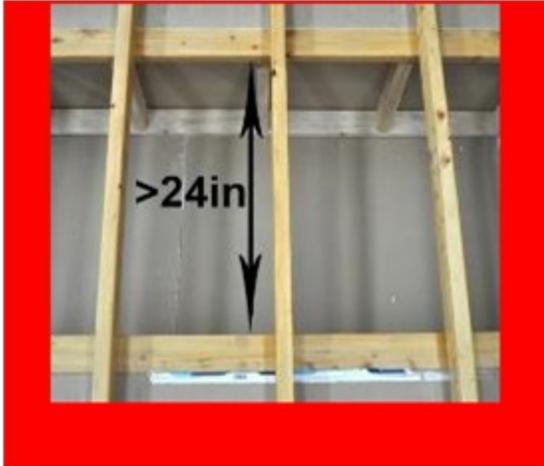
Continuous air barrier prevents air leakage and moisture movement between the attic and *conditioned space*

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



Ensure new bracing is secure by using screws to fasten to joist



Bracing can be screwed to drywall before capping chase



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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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:

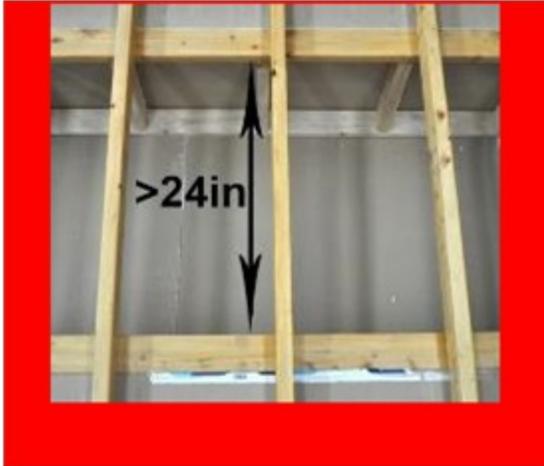
Continuous air barrier prevents air leakage and moisture movement between the attic and *conditioned space*

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

Tools:

1. Caulk gun
2. Spray foam gun



After

No gaps should remain after sealant is applied

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 all 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

Unsealed drop soffits over tubs and closets can be a point of leakage



After

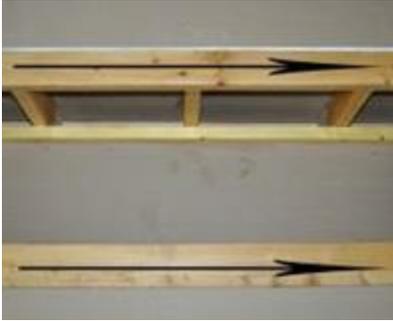
Capped soffits minimize leakage to and from *unconditioned spaces*

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. Drywall or other code approved rigid board material
2. Plywood
3. Caulk
4. Spray foam
5. *Dense packable* insulation
6. Fasteners
7. Wrapped fiberglass batts



Option 1, Step 1: Apply sealant to top-plates or other relevant surfaces



Option 1, Step 2: Cover face of stud bay with code approved rigid board material or drywall



Option 1, Step 3: Secure the rigid material with screws



Option 2: Cover face of stud bay with code approved rigid board material, such as 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:

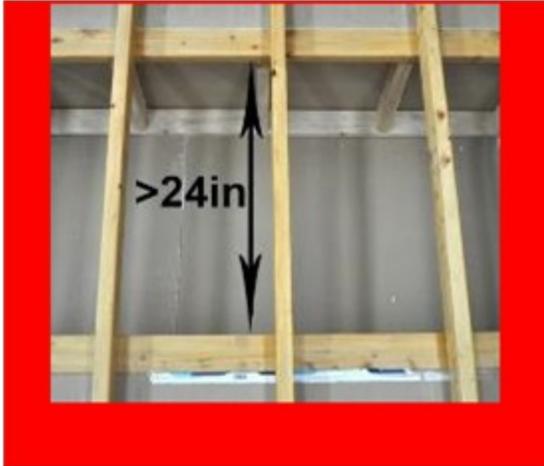
Continuous air barrier prevents air leakage and moisture movement between the attic and *conditioned space*

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

Uninsulated soffits can cause leakage to and from *unconditioned spaces*



After

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

Tools:

1. Caulk gun
2. Spray foam gun



After

No gaps should remain after sealant is applied along adjacent framing

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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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:

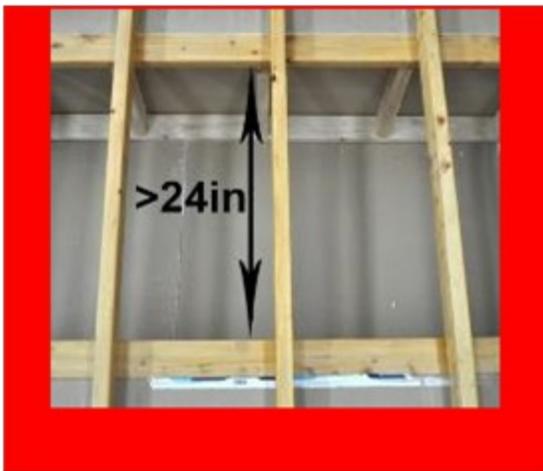
Continuous air barrier prevents air leakage and moisture movement between the attic and *conditioned space*

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



After

No gaps should remain after

capped and sealed to prevent leakage

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 applied along all joists and framing before the cap was set



2

Additional sealant should fill in all remaining gaps after the 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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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

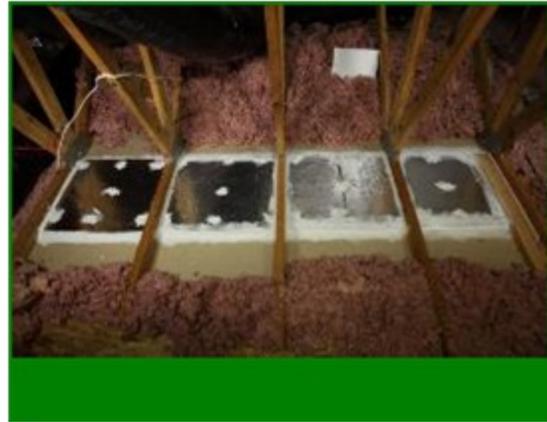


Before

Accessible drop soffits should be sealed to prevent heat gain/loss

Tools:

1. Measuring tape
2. Utility knife
3. Caulk gun
4. Spray foam gun
5. Saw



After

Completely sealed drop soffits and chases minimize heat transfer

Materials:

1. Caulk
2. Spray foam
3. Lumber
4. Drywall or other code approved rigid board material

6. Drill

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

Fasten cap with screws to set sealant and create air barrier



5

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. Drywall
2. Plywood
3. Lumber
4. Fasteners
5. Caulk
6. Spray foam
7. *Dense packable* insulation
8. 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



Option 3: Stud bay will faced with rigid material,

spray foam

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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a

case by case basis by the Nebraska Energy Office prior to any work being implemented.

- Where severe Mold and Moistures cannot be addressed, deferral is required.

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

- **Limited** water damage repairs that can be addressed by weatherization workers are allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Subgrantees are limited to a maximum cost of \$300 to implement these **limited** repairs, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office **prior** to any work being implemented.
- **Minor** source control work (i.e. correction of moisture and mold creating conditions) is allowed when necessary in order to weatherize the home and to ensure the long-term stability and durability of the measures. Source control is independent of latent damage and related repairs. Subgrantees are limited to a maximum cost of \$300 to implement this **minor** source control work, although approval to exceed this limitation will be reviewed on a case by case basis by the Nebraska Energy Office prior to any work being implemented.
- Where severe Mold and Moistures cannot be addressed, deferral is required.

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

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

Tools:

1. Saw
2. Drill
3. Pry bar
4. Sander
5. Caulk gun



After

Once repaired, this window is less leaky and better supported

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

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

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

3.1201.2b - Operable windows

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

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

- The new door **must** have an NFRC (National Fenestration Rating Council) tested U-factor of 0.17 or lower.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys **must** be provided to the client.
- Any safety lock installed on the existing door **must** be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing **must** match the existing in design and dimension, as closely as possible.
- The cavities around the door frame **must** be insulated or

sealed with non-expanding foam sealant.

- All door casings **must** be caulked.
- Doors **must** conform to the thickness of the existing jamb.
- Solid core doors **must** have 3 hinges.
- If trimming the bottom of the door is required; the door **must** be trimmed at a 5 degree angle.
- 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.
- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.



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

- The new door **must** have an NFRC (National Fenestration Rating Council) tested U-factor of 0.17 or lower.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys **must** be provided to the client.
- Any safety lock installed on the existing door **must** be

removed and reinstalled on the new door.

- The existing casing may be reinstalled. If new casing is needed, the casing **must** match the existing in design and dimension, as closely as possible.
- The cavities around the door frame **must** be insulated or sealed with non-expanding foam sealant.
- All door casings **must** be caulked.
- Doors **must** conform to the thickness of the existing jamb.
- Solid core doors **must** have 3 hinges.
- If trimming the bottom of the door is required; the door **must** be trimmed at a 5 degree angle.
- 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.
- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.



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

- The new door **must** have an NFRC (National Fenestration Rating Council) tested U-factor of 0.17 or lower.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys **must** be provided to the client.
- Any safety lock installed on the existing door **must** be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing **must** match the existing in design and dimension, as closely as possible.

- The cavities around the door frame **must** be insulated or sealed with non-expanding foam sealant.
- All door casings **must** be caulked.
- Doors **must** conform to the thickness of the existing jamb.
- Solid core doors **must** have 3 hinges.
- If trimming the bottom of the door is required; the door **must** be trimmed at a 5 degree angle.
- 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.
- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.



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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

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 - Hand Protection](#).
- 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.
- Replacement window glass **must be** tempered when

required by state and local code jurisdictions.

- Window glass **must** be secured with glazing points and glazing compound, if necessary and **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 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.
- 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 **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 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.



1

Always wear heavy work gloves when working with glass



2

Cut through caulk bead and glazing to ease removal



3

With points and glass removed, measure opening for replacement pane



4

Remove old putty and glazing to expose metal points holding glass in place



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

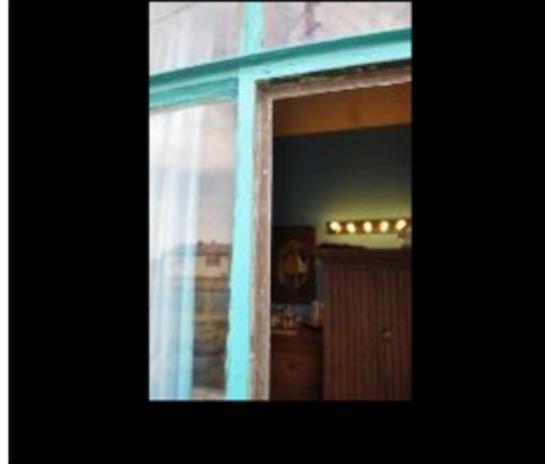
Objective(s):

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 **must not** be less than "B" grade single strength.
- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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.
- 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 **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 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.



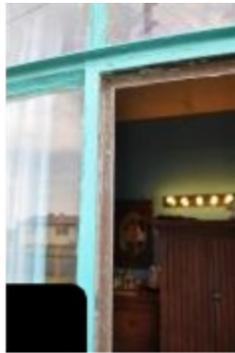
1

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
3. Paint brush

Materials:

1. Primer
2. Window glazing
3. Push points
4. Shims
5. Replacement glass
6. Tape

- Always wear heavy work gloves when working with glass. See also [2.0100.1b - Hand Protection](#).
- Replacement window glass **must not** be less than "B" grade single strength.
- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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.

- 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 **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 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.



1

Always wear heavy work



2

With broken glass removed,

gloves when working with glass



3

Cut replacement glass 1/8" smaller than measured opening

measure 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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

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 - Hand Protection](#).
- Replacement window glass **must not** be less than "B" grade single strength.
- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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.



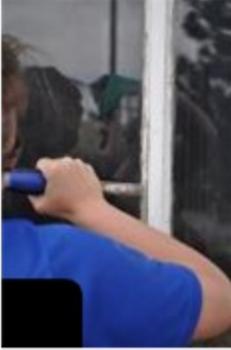
1

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

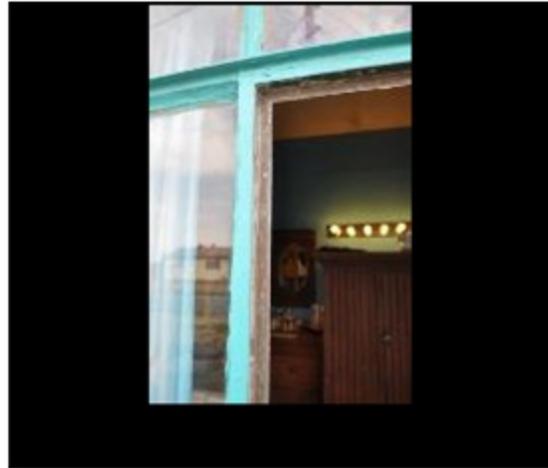
Objective(s):

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 **must not** be less than "B" grade single strength.

- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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.



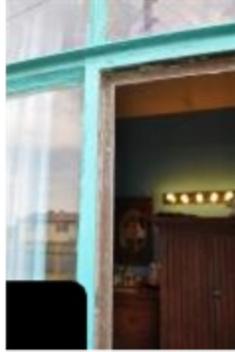
1

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 - Hand Protection](#).
- Replacement window glass **must not** be less than "B" grade single strength.

- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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.



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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

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 **must** 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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

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

Tools:

1. Pry bar
2. Utility knife
3. Drill



In Progress

Window is removed to allow for replacement with double pane unit

Materials:

1. Window and door flashing



1

Single pane window needs



2

Cut through caulk at stops

to be replaced with double pane



3

Remove stops while attempting to keep damage to rough opening to minimum

to break seal



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):

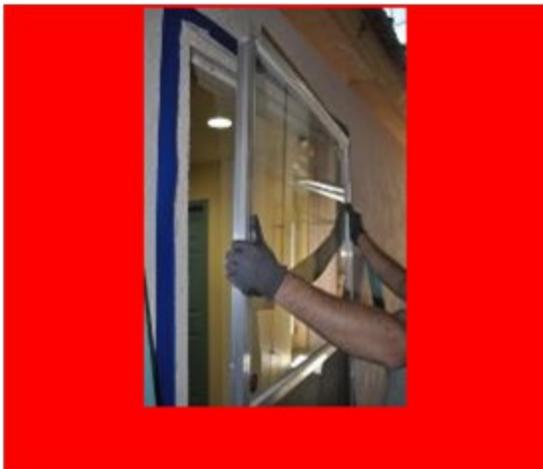
Replacement windows will be installed in accordance with manufacturer specifications and will be integrated with flashing

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

Materials:

1. Fasteners
2. Flashing

3. Drill
4. Hammer
5. Saw

3. Low-expansion spray foam
4. Backer rod
5. Primed trim

- New primary replacement windows **must** 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

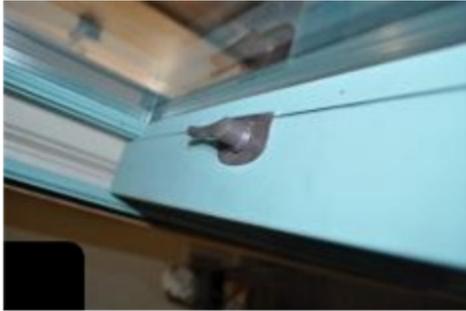


3



4

Fasten window flange securely around exterior of entire window



5

Check that sash locks align properly, indicating window is plumb



7

Prime and replace interior trim and, if needed, sill

With window secured in place, check for proper function



6

Fill interior gap with compressible foam or appropriate sealant



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

Visually inspect to verify no gaps remain



4

Apply appropriate caulking to ensure backing/infill does not move

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:

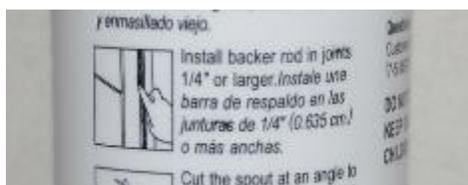
1. Caulk
2. Spray foam



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

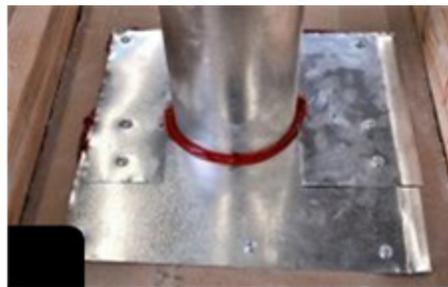


4

Apply second ring of caulking to size and shape of rigid material



5



6

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 - 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 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.

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

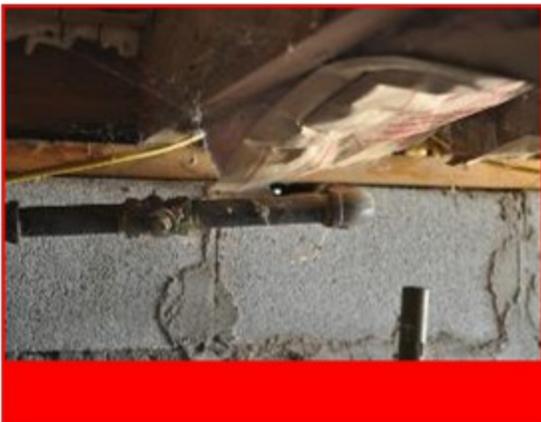
Specification(s):

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

Materials:

1. Caulk
2. Sprayfoam

3. Metal snips
4. Drill

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 1/4 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

Tools:

1. Caulk gun
2. Sprayfoam gun
3. Metal snips
4. Drill



After

Choose the backing and infill strategy that works best for the hole size

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 - 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
- A minimum expected service life of 10 years will be ensured
- ~~Re-venting exterior weep holes with wicking rope~~

Objective(s):

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

Decrease probability of rot

3.1402.4b - 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

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 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**, **must** 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 **must** have a *pressure treated*, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.
- Manufactured insulating skirting, indicated as cost-effective in the **Energy Audit**, may be used.
- It **must** have a minimum of R-8 insulation.
- Accesses **must** be constructed of $\frac{3}{4}$ 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.
- Foam or felt tape skirting access weather-strips are not eligible for reimbursement under the NeWAP.
- *Manufactured home* insulating skirting **must** 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, **must** 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 **must** have a *pressure treated*, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.
- It **must** have a minimum of R-8 insulation.
- Accesses **must** be constructed of $\frac{3}{4}$ 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.
- Foam or felt tape skirting access weather-strips are not eligible for reimbursement under the NeWAP.
- *Manufactured home* insulating skirting, indicated as cost-effective in the Energy Audit, may be used.
- *Manufactured home* insulating skirting **must** 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, **must** 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 **must** have a *pressure treated*, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.
- It **must** have a minimum of R-8 insulation.
- Accesses **must** be constructed of $\frac{3}{4}$ 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.
- Foam or felt tape skirting access weather-strips are not eligible for reimbursement under the NeWAP.
- *Manufactured home* insulating skirting, indicated as cost-effective in the Energy Audit, may be used.
- *Manufactured home* insulating skirting **must** 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



After

Penetrations between the garage and house can leak hazardous fumes

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 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 **must** be sealed using non-toxic and water-resistant mastic.
- Mesh tape **must** be used when openings and tears are over 1/16 of an inch.
- Appropriate manufacturer recommended 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 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:

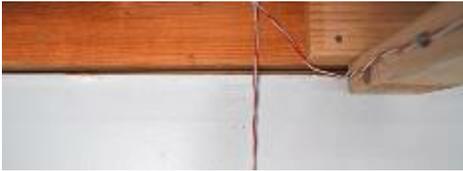
1. Sprayfoam
2. Fire-block caulk



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

Materials:

1. Weather-stripping (Q-lan)
2. Door sweep
3. Caulk
4. Fasteners

5. Saw
6. Tape measure
7. Drill
8. Planer

- An NFRC (National Fenestration Rating Council) tested U-factor of 0.17 or lower.
- Existing locksets may be reinstalled on the new door.
- If a new lockset is installed, 2 keys **must** be provided to the client.
- Any safety lock installed on the existing door **must** be removed and reinstalled on the new door.
- The existing casing may be reinstalled. If new casing is needed, the casing **must** match the existing in design and dimension, as closely as possible.
- The cavities around the door frame **must** be insulated or sealed with non-expanding foam sealant.
- Door lights with uninsulated glass **must not** exceed 1 square foot.
- Door lights with *insulated glass* **must not** exceed 2 square feet.
- All door casings **must** be caulked.
- Doors **must** conform to the thickness of the existing jamb.
- Solid core doors **must** have 3 hinges.
- If trimming the bottom of the door is required; the door **must** be trimmed at a 5 degree angle.
- 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.

- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.



1

Remove door for access to work space and to install sweep



2

Measure for weather-stripping around door



3

Install weather-stripping into rabbit around door



4

Corners of weather-stripping should be snug and secure



5

Adjust threshold to minimize contaminant and water *infiltration*



6

Caulk along threshold to minimize water and contaminant *infiltration*



7

Cut door sweep to width of the door



8

Ensure door sweep fits tightly against bottom of door and fasten in place



9

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



Remove stops, taking care not to damage them

Materials:

1. Brads
2. Caulk
3. Glazing
4. New glass cut to size of rough opening



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

Carbon monoxide alarms should be installed throughout the house



Best Practice

Occupants should be alerted to CO alarm locations and maintenance

- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

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 IRC

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 gypsum

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 IRC 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 1/4" 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 1/2" 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



Metal wire should be at least 12 gauge and galvanized

wide

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 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 1/4" will be sealed using fiberglass mesh and mastic

Mastic alone will be acceptable for holes less than 1/4" that

are more than 10 feet from air handler

Seams, cracks, joints, holes, and penetrations between 1/4" and 3/4" 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 feet 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 1/4" and 1/2" 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 1/2" 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):

Seams, cracks, joints, holes, and penetrations less than 1/4" will be sealed using fiber-embedded mastic

Seams, cracks, joints, holes, and penetrations between 1/4" and 3/4" will be sealed in two stages:

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

Seams, cracks, joints, holes, and penetrations larger than 3/4" will be repaired using rigid duct material

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

Objective(s):

Eliminate air leakage into or out of ducts and plenums

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

Reinforce seal

Support fiberglass mesh and mastic during curing



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 **must** be sealed using non-toxic and water-resistant mastic.
- Mesh tape **must** be used when openings and tears are over 1/16 of an inch.
- Appropriate manufacturer recommended 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 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 IRC

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

Sufficient insulation will be applied to all joints and around all penetrations to the *conditioned space* through walls, floors, and ceilings

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

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

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

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

The foam plastic will be protected with an ignition barrier

Objective(s):

Insulate and seal all exposed ductwork in *unconditioned spaces*

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

Provide adequate fire protection for exposed SPF

3.1602.4 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 IRC

Objective(s):

Prevent air leakage

Prevent a fire hazard



Before

Gaps around duct boots



After

Use a mesh in mastic

allow for leakage to and from the attic

system to seal duct boot to interior surface

Tools:

1. Utility knife
2. Spray bottle
3. Putty knife

Materials:

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



1

Unnecessary holes in the air handler cabinet should be sealed



2

Removable foil tape should be used to seal



3

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:

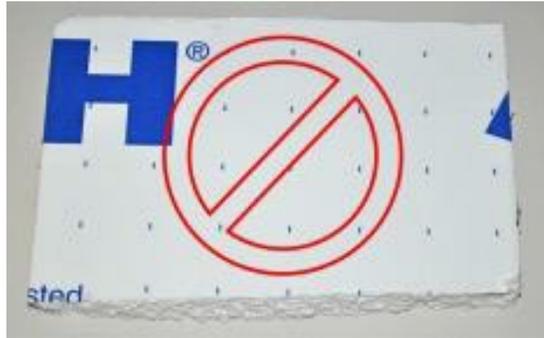
1. Tape measure
2. Utility knife

Materials:

1. Drywall
2. Fire-resistant caulk

- 3. Drill
- 4. Caulk gun

- 3. Fasteners



Do NOT use EPS in air returns due to proximity to combustion appliances

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 IRC

Objective(s):

Select permanent sealant

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



Best Practice

Sealants, like mesh and mastic, meet IRC, ASTM, and UL specs

Tools:

1. Caulk gun
2. Utility knife
3. Taping knife



Best Practice

Caulk sealants will be continuous

Materials:

1. Fiberglass mesh
2. Siliconized caulk
3. Mastic

Paraphrased from IRC: 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

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

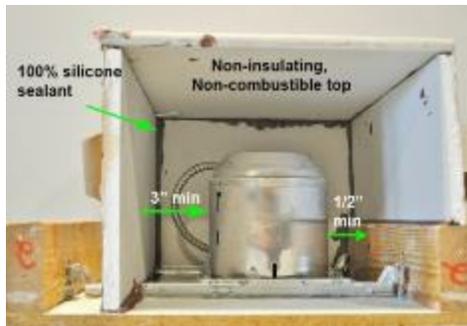
Sealed box around non-IC light should be taller than surrounding insulation

Tools:

1. Utility knife
2. Tape measure

Materials:

1. 5/8" fire-rated drywall
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 0.56 or less

The top of the enclosure will be left free of insulation

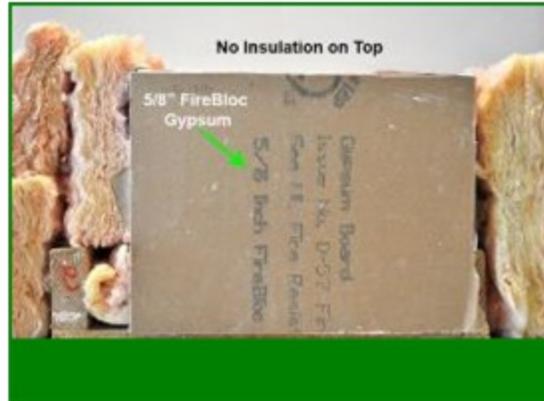
Objective(s):

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 **must** be kept a minimum of 6 inches 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

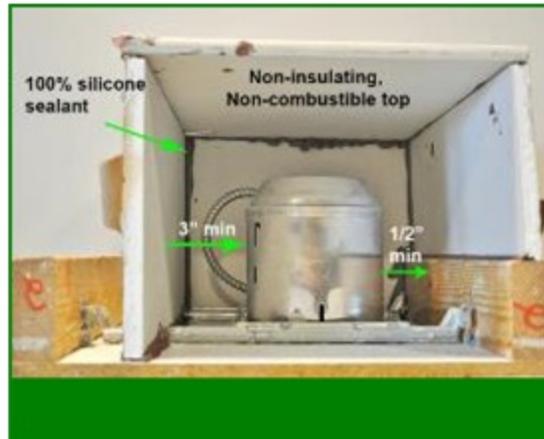
Objective(s):

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

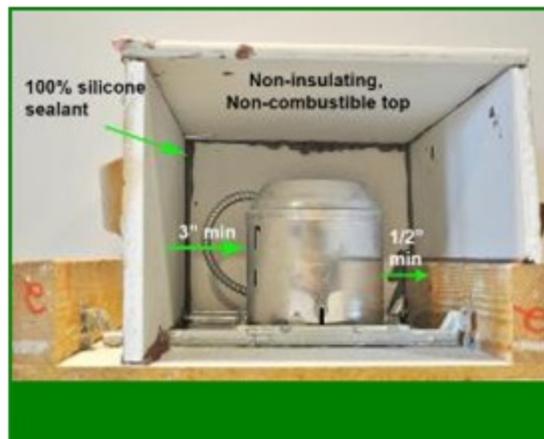


Before

Non-IC recessed light fixtures produce excess heat and can be a fire risk

Tools:

1. Caulk gun
2. Spray foam gun



After

Entire box should be sealed, but none should come in contact with light

Materials:

1. Fire-rated silicone caulk
2. UL-181 mastic

3. Putty knife

3. Spray foam

4.1001.2 Knob and Tube Wiring

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 - Approved Variance

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

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 minimum 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, and

- . In 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 subgrantee 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 [Health & Safety 2.0601.1c - Isolation and protection](#) 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.

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



If electrician determines wiring is Safe and keeps it active, isolate wires



Warning of knob & tube should be posted at all entrances to related spaces

To isolate, dams higher than intended insulation depth should be installed



If knob & tube can be replaced, all existent k&t should be disabled



Many electricians will remove exposed wires to prevent reactivation



Modern wiring should replace all knob & tube



Warning signs should encourage the use of certified electrician for repairs



Some jurisdictions require warning signs in Spanish as well

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.

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):

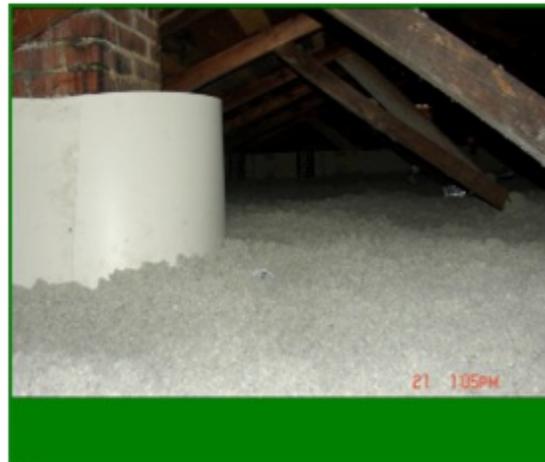
Prevent air leakage

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



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

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

4.1001.3b - Required clearance

Desired Outcome:

Combustible materials kept away from combustion sources

Specification(s):

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

Objective(s):

Ensure dam material does not bend, move, or sag

Prevent a fire hazard



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 **must** be kept a minimum of 6 inches 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:

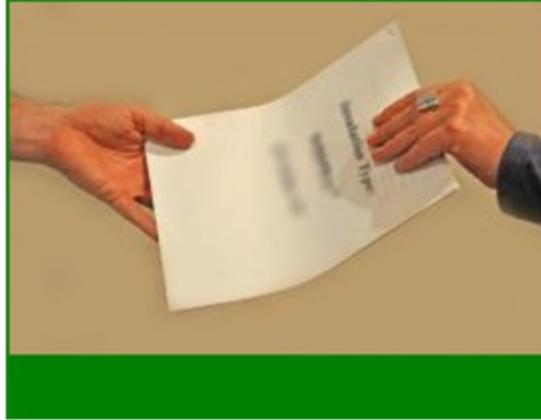
Combustible materials kept away from combustion sources

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

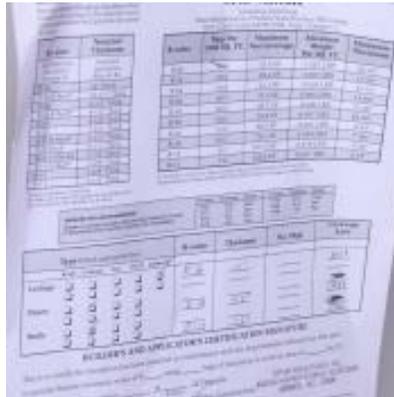


Best Practice

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

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

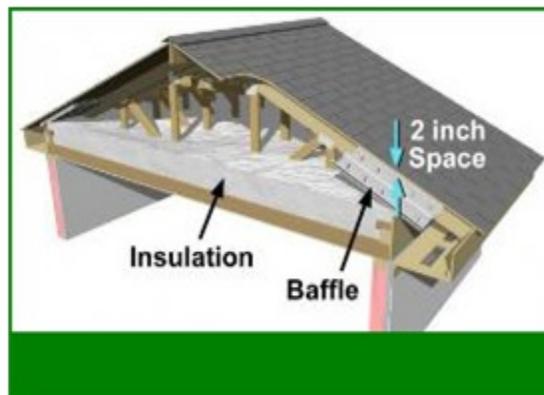
If soffit venting or eave venting is present, baffles will be installed to maintain clearance between the roof deck and baffle in accordance with manufacturer specifications

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

Insulation should not block vented eaves



Allow a standard two inch gap for air flow through eave

After

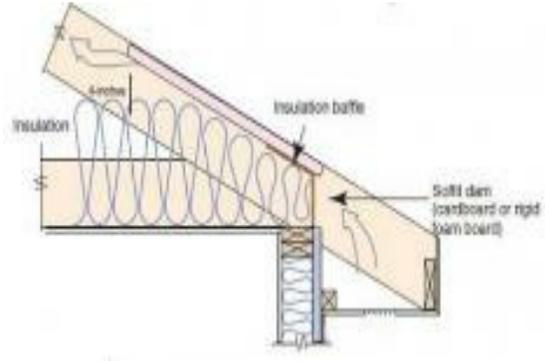
Baffles installed in vented attics to allow air flow past insulation



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 eaves

Tools:

Materials:

1. Stapler

1. Baffles

2. Staples

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 non-woven polypropylene netting (webbing) baffles of the same height as the insulation every 6' across slope to prevent the loose fill insulation from sliding downward, or *dense pack* cellulose above webbing stapled to the bottom (underside) of the rafters

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

Roof cavities will be insulated with loose fill according to manufacturer specifications without gaps, voids,

compressions, misalignments, or wind intrusions

Insulation will be installed to prescribed R-value

Objective(s):

Ensure appropriate material and application

Insulate to prescribed R-value

4.1003.1d - 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 at 50 pascals of pressure difference using chemical smoke, IR scans, or other approved verification method

Objective(s):

Ensure complete and consistent coverage throughout ceiling plane

Eliminate voids and settling

Minimize framing cavity air flows

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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



After

Vents in the space below the

have venting installed



Unvented flat roofs should have venting installed

roof help maintain proper air flow



Vents in the space below the roof help maintain proper air flow



Mushroom capped vents in the roof are equally important to air flow

Tools:

1. Saw
2. Grinder

Materials:

1. Metal lath
2. Stucco

3. Metal snips
4. Drill

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



In Progress

Attic will be *dense packed* to

insulated with old rug – not adequate.

R-value specified on Work Order.

Tools:

1. Insulation machine

Materials:

1. Loose fillable or *dense packable* insulation

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 **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, and
 - the R-value.

- This information **must** be included in the subgrantee 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 **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, and
 - the R-value.

- This information **must** be included in the subgrantee 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 **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, and
 - the R-value.
- This information **must** be included in the subgrantee client file.

4.1003.7 Ignition and Thermal

Barriers – Spray Urethane Foam

4.1003.7a - Identify fire safety requirements

Desired Outcome:

Meeting building code requirements for fire protection of spray polyurethane foam

Specification(s):

Meet or exceed local fire safety requirements for installation of SPF foam

Consult local codes to ensure installation complies with fire safety requirements

If local code requirements are unclear, consult local code officials for clarification

Objective(s):

Ensure SPF installed in attic meets fire safety requirements

4.1003.7b - Installation of ignition barrier

Desired Outcome:

Meeting building code requirements for fire protection of spray polyurethane foam

Specification(s):

If attic is to be used for service of utilities, foam will be separated from the attic space using a suitable ignition

barrier covering or coating

Check manufacturer specifications and/or local codes for appropriate ignition barrier coatings/materials

Objective(s):

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

4.1003.7c - Installation of thermal barrier

Desired Outcome:

Meeting building code requirements for fire protection of spray polyurethane foam

Specification(s):

If attic is to be used for storage or occupancy, spray foam will be separated from attic space using thermal barrier material (e.g., ½" gypsum wall board)

Consult manufacturer specifications and local codes for approved ignition/thermal barrier, materials, or coatings

Objective(s):

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

4.1003.7d - Occupant education

Desired Outcome:

Meeting building code requirements for fire protection of spray polyurethane foam

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

4.1004 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 manufacturers 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

Materials:

1. Drywall or other code approved rigid board material
2. Caulk
3. Spray foam

6. Stapler

4. Fasteners

5. Staples

- New and existing *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*.
- If batt insulation is used to seal the base of the *knee walls*, the batt **must** be sealed in an enclosed *vapor barrier*.
- Materials used **must** form an airtight seal.



1

Knee walls missing top plates need one created from rigid material



2

Top plate holds *dense pack* insulation in cavity



3



4

New top plate should be sealed to surrounding joists and studs



5

Cut to size and attempt to install in line with air barrier above

Bottom plates also need to be installed. Measure for size



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

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

- New and existing *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*.
- If batt insulation is used to seal the base of the *knee walls*, the batt **must** be sealed in an enclosed *vapor barrier*.
- Materials used **must** form an airtight seal.



1

Attach furring strips to create pockets for *dense pack* insulation



2

Insulation should meet manufacturer specifications for density.

4.1004.2 Preparation for Batt Insulation

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

When *knee wall* floor and walls are being insulated, the floor joist running under the knee wall will be air sealed

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

- New and existing *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*.
- If batt insulation is used to seal the base of the *knee walls*, the batt **must** be sealed in an enclosed *vapor barrier*.
- Materials used **must** form an airtight seal.



Before

Top plate is missing from



After

New top plate is sealed to

knee wall

adjacent framing



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 code approved rigid board material 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

Tools:

1. Spray foam gun
2. Caulk gun
3. Tape measure
4. Utility knife
5. Drill
6. Saw

Materials:

1. Code approved rigid board material
2. Lumber
3. Caulk
4. Spray foam
5. Fasteners

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

- New and existing *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*.
- If batt insulation is used to seal the base of the *knee walls*, the batt **must** be sealed in an enclosed *vapor barrier*.
- Materials used **must** form an airtight seal.



Before

Knee wall with batts improperly installed and missing from stud bays



After

Properly fit insulation filling full volume of stud bay



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

Tools:

1. Utility knife
2. Tape measure

Materials:

1. Fiberglass batts

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

Materials:

1. Drywall

2. Tape measure
3. Drill

2. House wrap

- New and existing *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*.
- If batt insulation is used to seal the base of the *knee walls*, the batt **must** be sealed in an enclosed *vapor barrier*.
- Materials used **must** form an airtight seal.



1

Fiberglass batts in attic *knee walls* can be held in place by house wrap



2

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

- New and existing *Knee wall* insulation **must** be secured in place with staples, twine, wire, hex netting or wire expanders and **must** 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 **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, and
- the R-value.
- This information ***must*** be included in the subgrantee 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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 **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, and
- the R-value.
- This information **must** be included in the subgrantee 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

Tools:

1. Hammer
2. Pry bar



After

Flag electrical junctions to make future maintenance and repairs easier

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 **must** be repaired prior to insulating the attic.
- Sealing and repair materials **must** 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-value



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:

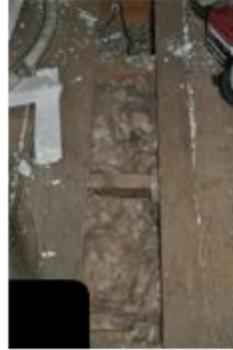
1. Fiberglass batts

- 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

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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. Caulk
5. 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 **must** be repaired prior to insulating the attic.
- Sealing and repair materials **must** 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

When missing, bottom plates **must** be installed under *knee walls*



After

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. Drywall or other code approved rigid board material
3. Plywood
4. Fasteners
5. Caulk sealant



Measure floor cavity for new bottom plate



Cut code approved rigid board material 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 minimum unsettled depth and the maximum coverage per bag to reach a consistent depth for desired R-value indicated on the manufacturer's coverage chart

Objective(s):

Reduce heating and air conditioning costs

Improve comfort

Minimize noise



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 **must** be stapled near the attic access of each *accessible attic*.
- Cellulose insulation should be installed over existing batt insulation.
- Enclosed ceilings **must** 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 **must** 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:

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:

- 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.

- **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.

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee client file.

4.1005.2e - Occupant education

Desired Outcome:

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

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

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 **must** be repaired prior to insulating the attic.
- Sealing and repair materials **must** 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):

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

Insulation will be installed to prescribed R-value

Objective(s):

Insulate to prescribed R-value

- 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, and
- the R-value.
- This information **must** be included in the subgrantee 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 - Onsite documentation

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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 **must** be repaired prior to insulating the attic.
- Sealing and repair materials **must** 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

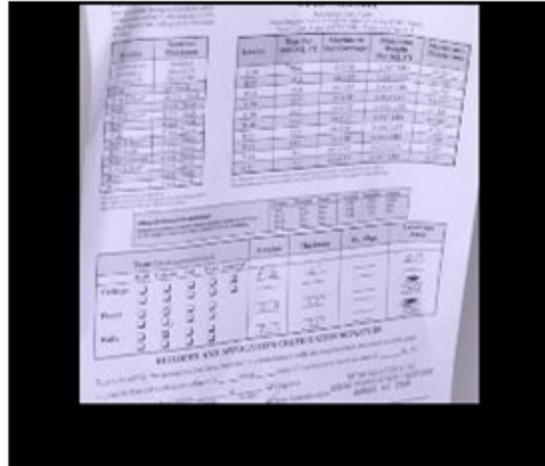
Ensure ability to match bags required for total area completed

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

- **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.
- 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, and
- the R-value.
- This information **must** be included in the subgrantee client file.

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*

Tools:

1. Drywall saw
2. Utility knife
3. Tape measure
4. Straight edge



Snap chalk lines to keep access cuts clean and easy



After

Rigid material forms an air barrier located under the bonus room stem wall

Materials:

1. Drywall or other code approved rigid board material



Cut through garage ceiling to access joist cavities below

to repair



The rigid block should be placed in line with the stem wall above

bonus room



Measure joist cavity depth



Measure joist cavity width



Cut code approved rigid board 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):

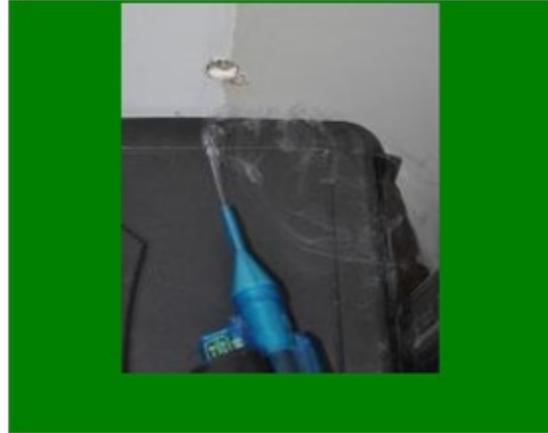
Eliminate voids and settling

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



1

Blow insulation into cavities to density appropriate for chosen material



2

Close cavities with access panel cut out at the beginning



3

Cut small test holes in cavities to verify specified density has been met



4

Set up blower door and depressurize bonus room to -50pa wrt outside



5

With blower door running, chemical smoke should not draw into test holes



6

Tape and spackle access panel and test holes to repair garage ceiling

Tools:

1. Insulation machine
2. Drill
3. Smoke pencil
4. Blower door

Materials:

1. Cellulose insulation
2. *Dense packable* insulation
3. Spackle
4. Seam tape

5. Small hole saw bit

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:

- Coverage area
- Thickness
- 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



A copy of the posted documentation may be provided to the client



Information should include insulation type, R-value, coverage area, etc.

- **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.

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee client file.

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 or to a maximum density structurally allowable
- Loose fiberglass material will be installed and will be

specifically approved for air flow resistance to a minimum density per the manufacturer's recommendations

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

Insulation will be verified to prevent visible air movement 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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee client file.

4.1005.6d - Occupant education

Desired Outcome:

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

Specification(s):

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

Objective(s):

Provide occupant with documentation of installation

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):

Spray foam should never be installed over light fixtures

regardless of if fixture is rated for IC or not. Nor between a heat-generating appliance and a dam, unless material is rated for contact with heat-generating sources

Objective(s):

Prevent a fire hazard

4.1005.7d - 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 **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, and
- the R-value.
- This information **must** be included in the subgrantee client file.

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

4.1006 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. Code approved rigid board material
4. Pre-fabricated stairwell cover

- Pull-down ladder hatch **must** be shielded/dammed with 1-inch common lumber or $\frac{3}{4}$ inch plywood with a hinged $\frac{3}{4}$ 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 - Onsite documentation

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. Code approved rigid board material
2. Lumber
3. Weather-stripping
4. Fasteners

- All *accessible attics* over 100 square feet **must** have an access.
- New attic accesses **must** 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 **must** 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 **must** be framed and boxed with 1 inch common lumber or $\frac{3}{4}$ 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 **must** be reframed to provide an acceptable opening and be boxed with 1 inch thick common lumber or $\frac{3}{4}$ inch plywood at a height to accommodate the insulation and access.
- Attic access hatch cover **must** be constructed of $\frac{3}{4}$ inch plywood or particle board.
- The attic access **must** be finished to match the ceiling where installed as closely as possible.
- New *knee wall* attic access covers or doors **must** be minimum $\frac{3}{4}$ inch plywood and attached with a minimum of

2 hinges and 2 latching mechanisms.

- New *knee wall* attic accesses **must** be finished to match the wall as closely as possible.
- Foam or felt tape attic access weather-strips are not eligible for reimbursement under the NeWAP.



1

Create hatch cover that matches R-value of surrounding insulation



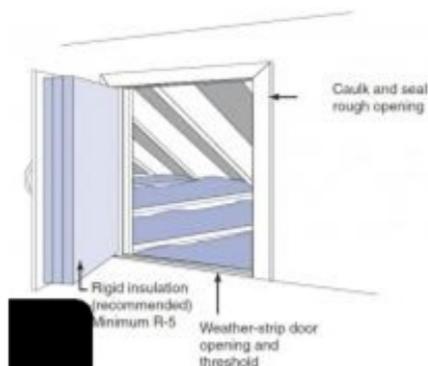
2

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 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 **must** 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 **must** be caulked with clear caulking or caulking that is a color complementary to the surface to which it is applied.
- New *knee wall* attic access covers or doors **must** be minimum $\frac{3}{4}$ inch plywood and attached with a minimum of 2 hinges and 2 latching mechanisms.
- Foam or felt tape attic access weather-strips are not eligible for reimbursement under the NeWAP.



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. Code approved rigid board material
2. Adhesive

- Attic access hatch cover **must** be constructed of $\frac{3}{4}$ inch plywood or particle board.
- New *knee wall* attic access covers or doors **must** be minimum $\frac{3}{4}$ 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 complete attachment of insulation



5



6

Affix insulation board to "cold-side" of hatch with adhesive, ensuring insulation board is tight and square to hatch

Repeat adhesive and insulation board layers to reach maximum R-value without making hatch excessively heavy or awkward



7

All insulation board 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 - Onsite documentation

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

- 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.

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 **must** be installed prior to insulating.
- Venting **must not** be installed on metal roofs.
- Attics with metal roofs that cannot be vented **must 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 **must** 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 roofing nails.
- Roof vents **must** be centered within 2 feet of the ridge or peak of the roof.
- 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.
- 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

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 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 **must** 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 roofing nails.
- Roof vents **must** be centered within 2 feet of the ridge or peak of the roof.
- 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.
- 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



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 **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.
- 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.



1

Open walls to be insulated and drywalled 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-value



Before

Open walls should be insulated



After

Well-insulated rooms are significantly more comfortable in all seasons

Tools:

1. Insulation machine

Materials:

1. Loose fillable insulation

2. Staple gun

2. Netting

3. Staples

4. Fiberglass batts

- Open wall cavities **must** be covered and insulated with batt, blown or *spray-applied insulation*.
- 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.
- 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 covering is drywall, the drywall **must** be taped and receive one coat of joint compound.
- If the covering of an open wall cavity is drywall, the drywall **must** be taped and receive one coat of joint compound.
- If the covering of an open wall cavity is plywood, chipboard or hardboard the joints **must** be caulked.
- 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.
- If plywood, chipboard or hardboard is installed, the joints **must** be caulked.
- If paneling is installed, the paneling **must** be a minimum 3/16 inch and the joints **must** 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

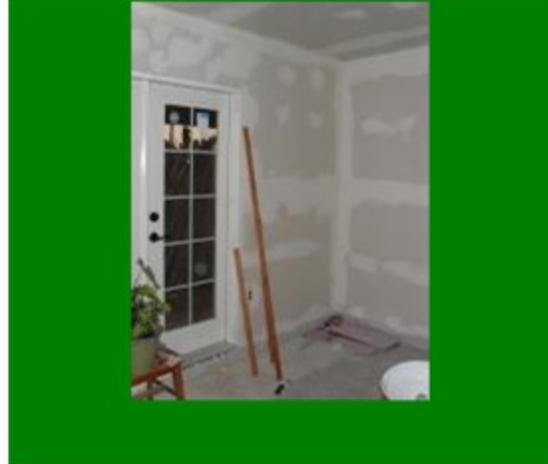
Objective(s):

Install insulation correctly



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 - Onsite documentation

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

- 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, and
- the R-value.
- This information **must** be included in the subgrantee 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

See Sections [2.0809 Electrical](#) and [4.1001 General Practice](#)

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* - Approved Variance

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

- All holes and penetrations will be plugged and/or sealed

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

Objective(s):

Eliminate voids and settling

Minimize framing cavity air flows

- Siding **must** be removed or drilled and all enclosed wall cavities **must** 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 **must** be repaired prior to insulating.
- 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.
- Removed siding **must** be reinstalled using the original fastening system whenever possible.
- The seam tabs on slate siding **must** be reinstalled.
- 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.
- Entry holes in stucco or masonry siding **must** be sealed with mortar or a material specifically manufactured to repair stucco or masonry.

- Sealing materials **must** 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 **must** be painted to match the existing siding color.
- Interior entry holes in drywall or plaster **must** be plugged and taped or sealed with one coat of a material specifically manufactured to repair drywall or plaster.

Testing:

Core sampling will be completed on a minimum of 5% of all frame homes billed each month in which insulation is installed in an enclosed cavity.

- Testing **must** be completed by the subgrantee, with verification testing completed by state QCI Monitors, for proper weight and density by taking a minimum of 3 core samples.
- The core samples must:
 1. be taken in random locations,
 2. 1 core sample **must** be taken within 3 feet of the top of the wall, and
 3. the results **must** be recorded on the inspection form and retained in the client's files.
- The remaining 95% of homes will have the *dense packed* enclosed wall insulation evaluated using either infrared scans (when a 25° interior-exterior temperature difference is achievable) or with a wire probe.
 - The results will be recorded on the inspection forms and retained in the client file.

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 **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.
- Removed siding **must** be reinstalled using the original fastening system whenever possible.
- The seam tabs on slate siding **must** be reinstalled.
- 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.
- Entry holes in stucco or masonry siding **must** be sealed with mortar or a material specifically manufactured to repair stucco or masonry.
- Sealing materials **must** 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 **must** be painted to match the existing siding color.
 - Interior entry holes in drywall or plaster **must** be plugged and taped or sealed with a material specifically manufactured to repair drywall or plaster.
 - Interior entry holes **must** 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



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

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

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

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 - Approved Variance

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 plugged and taped or sealed with an appropriate material and made ready for paint

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

Tools:

1. Taping knife
2. Caulk gun
3. Drill
4. Paint brush



After

When repair is finished, it shouldn't be obvious any work was done

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 **must** 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

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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

Tools:

1. Caulk gun

After

Sealed penetrations maintain the air barrier

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 - High temperature application](#).



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

4.1301.1b - 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

Measure #		Floor Ins. R-11		Components F1			
Comment		Estimated					
#	Material / Labor	Description / Quantity	Units	Qty	Unit Cost	Total	Q
1	Insulation	Floor Insulation - Kraft-faced Batts - R-11	Sqft	1180	\$0.22	\$220.00	<input type="checkbox"/>
2	Labor	Floor Insulation - Kraft-faced Batts - R-11	Sqft	1180	\$0.35	\$413.00	<input type="checkbox"/>
3	Miscellaneous Bt	Floor Insulation - Kraft-faced Batts - R-11	Each	1	\$100.00	\$100.00	<input type="checkbox"/>

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 subfloor



Before

Fiberglass batts should not be hanging away from subfloor



After

"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

- 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, and
 - the R-value.
- This information **must** be included in the subgrantee 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

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 - High temperature application](#).

- See [4.1301.1a - Sealing](#) for appropriately caulking gaps.

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

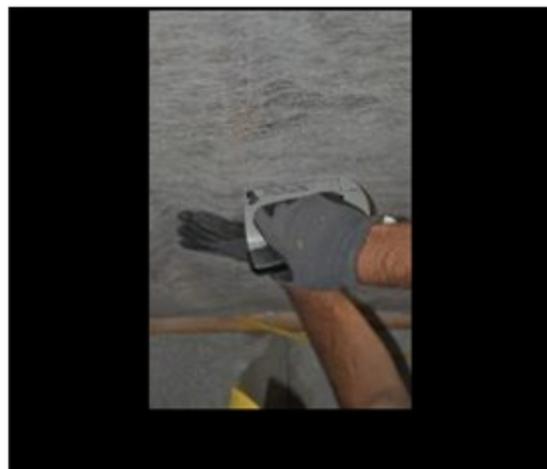
Objective(s):

Secure insulation



Bad Practice

Uninsulated floors above



In Progress

Netting is secured to joists

unconditioned spaces are an energy drain

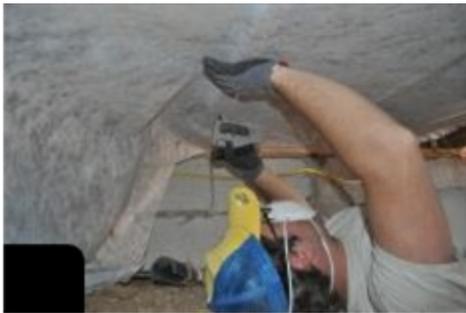
and sills to create cavities for insulation

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



4

Keep netting taut while stapling to prevent wrinkles and leakage

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		Component: F1					
Measure 7	Floor Ins. R-30						
Comment							
#	Material / Labor	Description / Comment	Units	Qty	Unit Cost	Total	Q
1	Insulation	Floor Insulation - Net & Fill - R-30	SqFt	1100	\$0.58	\$638.00	<input type="checkbox"/>
		Floor Insulation - Net & Fill - R-30	SqFt	1100	\$0.35	\$415.00	<input type="checkbox"/>
		Floor Insulation - Net & Fill - R-30	Each	1	\$100.00	\$100.00	<input type="checkbox"/>

1

Order and install insulation based on specifications in



2

Always wear proper PPE when blowing in insulation

work order



3

Cut holes in each individual cavity to insert insulation machine nozzle



4

Ensure that hole is large enough for nozzle without allowing for outflow



5

Consult manufacturer specs on insulation packaging for proper installation



6

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

- 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, and

- the R-value.
- This information **must** be included in the subgrantee 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. 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 - High temperature application](#).
- See [4.1301.1a - Sealing](#) for appropriately caulking gaps.

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



After

Uninsulated floors over *unconditioned spaces* are an energy drain

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

Measure 7		Floor Ins. R-19	Components F1				
		Comment	Estimated				
#	Material / Labor	Description / Comment	Units	Qty	Unit Cost	Total	Q1
1	Insulation	Floor Insulation - Loose-Fill + Rigid Barrier - R-19	SqFt	1180	\$0.37	\$436.60	<input type="checkbox"/>
		Floor Insulation - Loose-Fill + Rigid Barrier - R-19	SqFt	1180	\$0.35	\$413.00	<input type="checkbox"/>
		Insulation Machine	Each	1	\$100.00	\$100.00	<input type="checkbox"/>

2

Purchase and install loose fill to R-value specified on Work Order





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

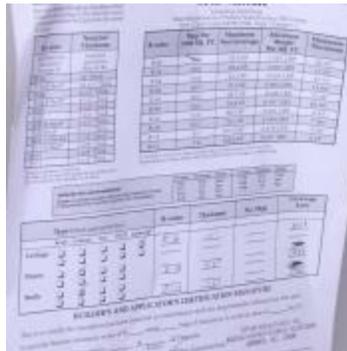
Ensure ability to match bags required for total area completed

Comply with 16 CFR 460.17

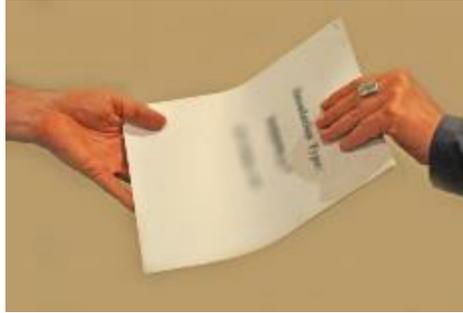
- The insulation specifications **must** include:
 - the insulation brand name,
 - thermal resistance chart,
 - certification that the insulation conforms to federal specifications,
 - the name of the company or agency that installed the insulation,
 - the date the insulation was installed, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 - High temperature application](#).
- See [4.1301.1a - Sealing](#) for appropriately caulking gaps.

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
3. Drill

Materials:

1. Rigid material – drywall, XPS, plywood
2. Fasteners

- 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

Materials:

1. *Dense packable* insulation



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

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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

- 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, and
 - the R-value.
- This information **must** be included in the subgrantee 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

- *Exposed floors*, except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.
- Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See [3.1402.1c - High temperature application](#).
- See [4.1301.1a - Sealing](#) for appropriately caulking gaps.

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

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. Drill

Materials:

1. Kraft-faced fiberglass batts to work order specifications
2. Rigid barrier – drywall, plywood, XPS
3. Fasteners

- *Exposed floors*, except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.



Order and install insulation as called for in Work Order

Measures

Measure 8: Floor Ins. R-11		Components F1					
Comment		Estimated					
#	Material / Labor	Description / Comment	Units	Qty	Unit Cost	Total	Q
1	Insulation	Floor Insulation - Kraft-Faced Batts - R-11	SqFt	1150	\$0.22	\$250.00	<input type="checkbox"/>
2	Labor	Floor Insulation - Kraft-Faced Batts - R-11	SqFt	1150	\$0.35	\$410.00	<input type="checkbox"/>
3	Miscellaneous Ss	Floor Insulation - Kraft-Faced Batts - R-11	Each	1	\$100.00	\$100.00	<input type="checkbox"/>

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 subfloor



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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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

Tools:

1. Utility knife
2. Saw
3. Drill
4. Tape measure
5. Caulk gun



After

Rigid barrier allows for air sealing and protects batt insulation

Materials:

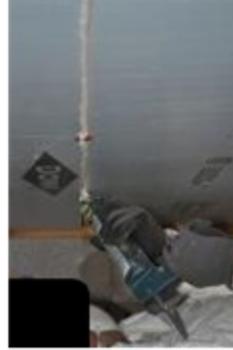
1. Rigid material - drywall, XPS, plywood
2. Caulk
3. Fasteners

- *Exposed floors*, except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 - High](#)

temperature application.

- *Exposed floors*, except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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

4.1301.7b - 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

Tools:

1. Utility knife
2. Saw
3. Drill
4. Tape measure
5. Caulk gun



After

Rigid barriers allow for air sealing while creating cavities for insulation

Materials:

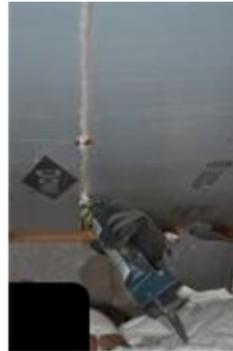
1. Rigid material - drywall, XPS, plywood
2. Fasteners
3. Caulk

- *Exposed floors, except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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:

Materials:

1. Insulation machine
2. Caulk gun

1. Loose fill insulation
2. Caulk

- *Exposed floors, except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.*



1

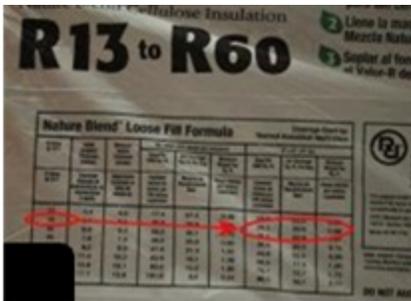
Always wear proper PPE when working with insulation

Measures

Measure 7 Floor Ins. R-19		Components F1					
Comment							
#	Material / Labor	Description / Comment	Units	Estimated		Q1	
				Qty	Unit Cost		Total
1	Insulation	Floor Insulation - Loose-Fill + Rigid Barrier - R-19	SqFt	1480	\$0.37	\$436.00	<input type="checkbox"/>
		Floor Insulation - Loose-Fill + Rigid Barrier - R-19	SqFt	1480	\$0.35	\$443.00	<input type="checkbox"/>
		Floor Insulation - Loose-Fill + Rigid Barrier - R-19	Each	1	\$100.00	\$100.00	<input type="checkbox"/>

2

Purchase and install insulation to R-value specified on Work Order



3

Check manufacturer specs



4

Drill hole in rigid barrier

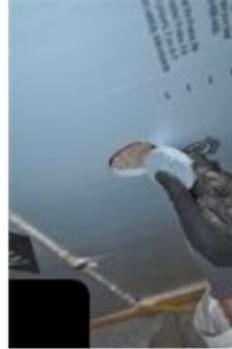
to ensure proper installation and density

slightly larger than insulation hose



5

Fill cavities formed by rigid barrier with loose fill insulation



6

Once cavities have been filled to specified R-value, prepare plug



7

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

- 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, and

- the R-value.
- This information **must** be included in the subgrantee 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 - High temperature application](#).
- *Exposed floors* except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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

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
5. Caulk gun

Materials:

1. Rigid material - drywall, XPS, plywood
2. Fasteners
3. Caulk

- Nebraska WAP requires: *Exposed floors* except over garages, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** 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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.

Measures		Measure 7 Floor Ins. R-19		Components F1			
		Comment		Estimate			
#	Material / Labor	Description / Comment	Units	Qty	Unit Cost	Total	Qty
1	Insulation	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	\$0.37	\$436.60	<input type="checkbox"/>
2	Labor	Floor Insulation - Dense-pack + Rigid Barrier - R-19	SqFt	1180	\$0.35	\$413.00	<input type="checkbox"/>
	Net Gt	Floor Insulation - Dense-pack + Rigid Barrier - R-19	Each	1	\$100.00	\$100.00	<input type="checkbox"/>



1

Make sure to wear proper PPE when working with insulation

2

Purchase and install insulation as per Work Order

NOMINAL BAG COVERAGE CHART FOR CLOSED-CRITY APPLICATION

Thickness	Grade	Installed Density	Minimum Weight per Cubic Foot	Number of Bags per 1000 Cu. Ft.	Minimum Coverage per Bag
1.5"	INSUL	8.0	8.0	125	8.0
1.5"	INSUL	11.0	11.0	91	11.0
1.5"	Insulated Gypsum	11.0	11.0	91	11.0
1.5"	INSUL	14.0	14.0	71	14.0
1.5"	INSUL	17.0	17.0	59	17.0
1.5"	Insulated Gypsum	17.0	17.0	59	17.0
2.0"	INSUL	8.0	8.0	156	8.0
2.0"	INSUL	11.0	11.0	114	11.0
2.0"	Insulated Gypsum	11.0	11.0	114	11.0
2.0"	INSUL	14.0	14.0	91	14.0
2.0"	INSUL	17.0	17.0	76	17.0
2.0"	Insulated Gypsum	17.0	17.0	76	17.0

Insulation should be installed over a smooth surface and does not account for the space taken up by roof ducts, pipes, conduits, cables, etc. For the maximum density in a given structure, please coverage for the overall actual required volume only.



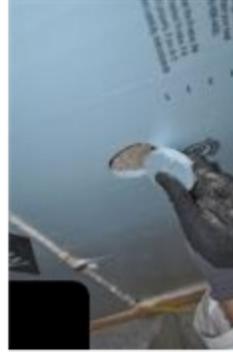
3

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

- 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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.
- *Exposed floors* over garages, **must** be insulated with batt or blown insulation. Fire code drywall **must** be installed on open floor cavities over garages. 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.

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, **must** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.
- *Exposed floors* over garages, **must** be insulated with batt or blown insulation. Fire code drywall **must** be installed on open floor cavities over garages. 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.

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, **must*** be insulated with batt or blown insulation and covered with exterior grade plywood or tar impregnated fiberboard and the seams **must** be caulked.
- *Exposed floors over garages, **must*** be insulated with batt or blown insulation. Fire code drywall **must** be installed on open floor cavities over garages. 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.

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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 except as stipulated by classification [4.1402.1c](#)

When applied to second story floor or above, SPF will be continuous from subfloor surface, over band/rim joist, and in contact with top plate below

Objective(s):

Insulate and seal floors

- Sill box insulation **must** 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, unless the space is a habitable space and then cover it with drywall or another thermal barrier

Local codes will be confirmed and followed for fire protection Requirements

Objective(s):

Provide necessary fire protection for 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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee 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 or vinyl faced fiberglass batt insulation, installed tightly to the wood and sealed at all edges. 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 ***must*** 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 **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, and
 - the R-value.
 - This information **must** be included in the subgrantee client file.

4.1402 Basements and Crawl

Space Walls

4.1402.1 Closed *Crawl Spaces* - Wall Insulation

4.1402.1a - Insulation selection

Desired Outcome:

Insulate closed *crawl spaces* to achieve best thermal performance possible

Specification(s):

A fire-rated insulation (25 or less flame spread or Class I or Class A) will be used with a minimum life expectancy of 10 years

Objective(s):

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

- Insulation **must** be a minimum R-10.
- *Crawl space* walls **must** be insulated with foam board or *spray-applied insulation*.
- If faced batt insulation is installed, the *vapor barrier must* be to the warm side and the insulation **must** 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 **must** be a minimum R-10.
- *Crawl space* wall **must** be insulated with foam board or *spray-applied insulation*.
- The insulation **must** fill the sill box and extend down the foundation wall.
- To ensure there are no gaps in the wall insulation, 24 inch wide *batts* **must** be used in areas of 16 inch floor joist spacing and 16 inch *batts* **must** be used in areas of 24 inch joist spacing.

4.1402.1c - Termite inspection gap

Desired Outcome:

Closed *crawl spaces* insulated to achieve best thermal performance possible

Specification(s):

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

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 better than or equal to 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 ***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, and
- the R-value.
- This information **must** be included in the subgrantee 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 **must** 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



Before

Basement shows no sign of ground water penetration, but needs insulation

Tools:

1. Utility knife
2. Tape measure
3. Drill
4. Taping knife



After

Insulation and drywall create an air barrier

Materials:

1. Code approved rigid insulation board
2. Kraft-faced fiberglass batts
3. Drywall
4. Spackle
5. Seam tape
6. Fasteners



Rigid insulation board is a non-absorbent insulation option



The drywall still provides an air barrier to keep moisture build up on wall



OR Kraft-faced fiberglass batts can be used with paper toward living space



Both kraft-face and drywall create air barrier, but batts are absorbent

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 semi-impermeable 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. Tape measure
3. Drill
4. Taping knife

Materials:

1. Code approved rigid insulation board
2. Drywall
3. Kraft-faced fiberglass batts
4. Spackle
5. Seam tape
6. Fasteners



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



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 (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



1

Prepare work area by assessing any safety concerns



2

Wrap joint with fiberglass mesh tape



3

Apply UL 181 mastic to seal joint

Tools:

1. Putty knife

Materials:

1. Mesh tape
2. Mastic

- Tears and joints **must** be sealed using non-toxic and water-resistant mastic.
- Mesh tape **must** be used when openings and tears are

over 1/16 of an inch.

- Appropriate manufacturer recommended sealing tape may be used only when the installation of mastic is not feasible.
- The insulation **must** have a *vapor barrier*.

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 **must** be insulated with a minimum R-8 insulation secured with cord, wire, plastic or nylon bands.
- The insulation **must** have a *vapor barrier* installed to the exterior and the joints **must** be sealed with butyl tape, caulking or mastic.
- Fiberglass duct liner **must 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 manufacturer approved tape to preserve *vapor barrier*

Tools:

1. Utility knife

Materials:

1. Tape
2. R-8 duct insulation with *vapor barrier*

- Tears and joints **must** be sealed using non-toxic and water-resistant mastic.
- Mesh tape **must** be used when openings and tears are over 1/16 of an inch.
- Appropriate manufacturer recommended sealing tape may be used only when the installation of mastic is not feasible.

- The insulation ***must*** 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

5 Heating and Cooling

5.30 Forced Air

5.3001 Design

5.3001.1 Load Calculation and Equipment Selection

5.3001.1a - Load calculation - Approved Variance

Desired Outcome:

Equipment sized properly and operates efficiently

Specification(s):

Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J (Residential Load Calculation) and manufacturer specifications

As a NeWAP option, the NEAT/MHEA Recommended Measures report may also be used for equipment selection

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 **must** be a minimum 14-SEER (Seasonal Energy Efficiency Factor) and use environmentally friendly Freon.
- Replacement heat pumps **must** be a minimum 14-SEER and 8.2-HSPF (Heating Seasonal Performance Factor) and use environmentally friendly Freon.
 1. 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 **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 Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of

Certified Product Performance.

- Heat exchangers in all replacement *heating plants* **must** 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 **must** use the existing ductwork.
- New ductwork may be installed to properly balance the system.
- New flexible ductwork **must** 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 **must** be realigned or reattached using sheet metal screws.
- Missing or damaged ductwork and floor registers **must** 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 **must** 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

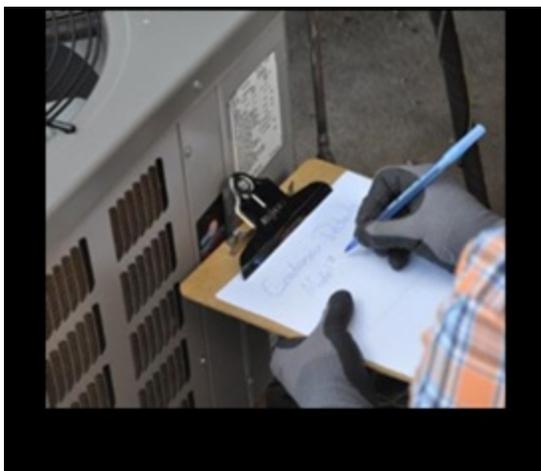
Specification(s):

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



In Progress

Complete a visual inspection



In Progress

Record model information

of all heating and cooling equipment

about heating and cooling equipment to ensure proper maintenance

5.3003.2 Combustion Analysis of Oil-Fired Appliances

5.3003.2a - Oil system: filter

Note:

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

If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC* Quality Installation Specification will be followed

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

Specification(s):

Filter will be present, clean, and leak free

Objective(s):

Ensure oil filter is present and functional

5.3003.2b - Nozzle size

Note:

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

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC Quality Installation Specification* will be followed

Specification(s):

Nozzle size, angle, and spray pattern will be correct for design input and within equipment firing rate of the *heating system* manufacturer

Position of nozzle and electrodes will be in accordance with manufacturer specifications

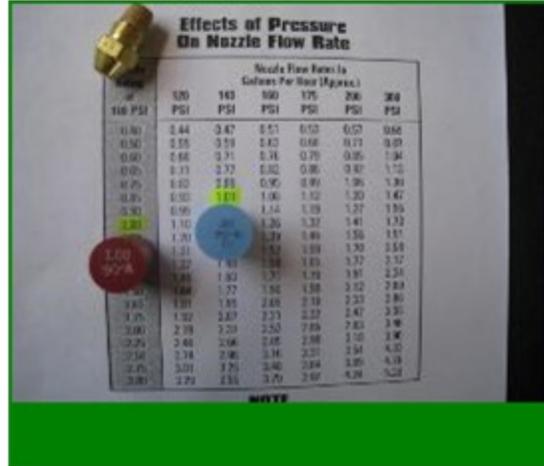
Objective(s):

Ensure equipment is outfitted with the correct nozzle per manufacturer guidelines



Before

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*.

5.3003.2c - Fuel pressure

Note:

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

If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC Quality Installation Specification* will be followed

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

Specification(s):

Measurement will be verified in accordance with manufacturer specifications

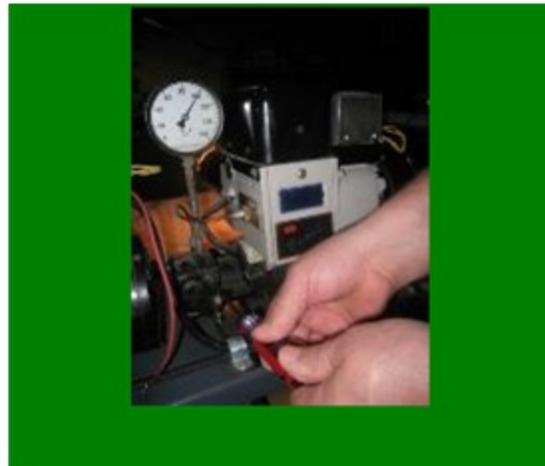
Objective(s):

Ensure correct oil pump pressure for nozzle installed and at OEM's specified values per ACCA



Before

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.

5.3003.2d - Place appliance in operation

Note:

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

If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC* Quality Installation Specification will be followed

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

Specification(s):

Heating equipment will be placed in operation in accordance with applicable standards and manufacturer specifications when available

Objective(s):

Prepare equipment for combustion analysis tests

5.3003.2e - Smoke test

Note:

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

If new installation or replacement is necessary, *ANSI / ACCA*

5 QI HVAC Quality Installation Specification will be followed

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

Specification(s):

Smoke test will be conducted before any combustion testing is completed

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):

Determine whether equipment is operating within acceptable range according to smoke test and call for action if needed



Best Practice

Smoke tests determine if oil-fired appliances burn cleanly by testing soot

Tools:

1. Smoke testing pump

Best Practice

Verify oil-fired furnaces and water heaters are operating safely

Materials:

1. Filter paper

- This work to be completed by a *Qualified Heating Technician*.



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

5.3003.2f - Steady state efficiency (SSE)

Note:

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

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

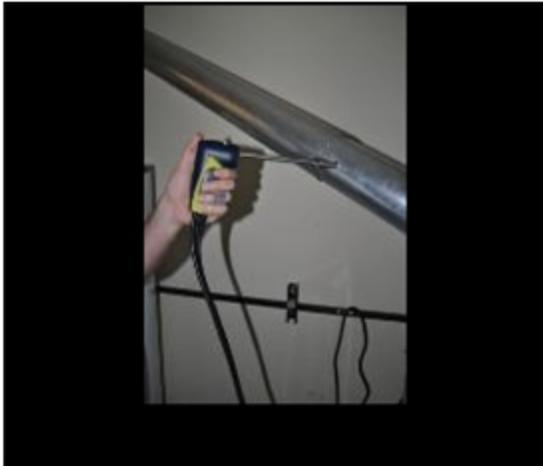
If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC* Quality Installation Specification will be followed

Specification(s):

Measurement will be verified in accordance with manufacturer specifications

Objective(s):

Determine whether steady state efficiency is within manufacturer range



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*.

5.3003.2g - Net stack temperature

Note:

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

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

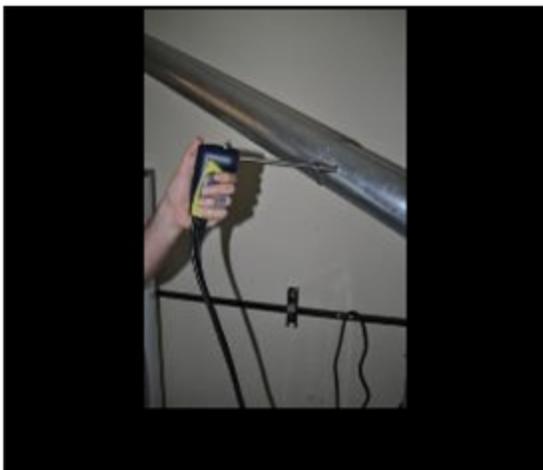
If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC* Quality Installation Specification will be followed

Specification(s):

Net stack temperature will be measured and verified in accordance with manufacturer specifications

Objective(s):

Determine whether net stack temperature is within manufacturer's recommended range



In Progress

Verify oil-fired appliances



After

T-stack minus T-air equals

are not burning hotter than
manufacturer specs

net stack temperature.
Check against specs

Tools:

1. Combustion analyzer with probe

- $T = \text{temperature}$. $T_{\text{stack}} - T_{\text{air}} = \Delta T$ or Net Stack Temperature.
- This work to be completed by a *Qualified Heating Technician*.

5.3003.2h - Carbon dioxide (CO₂) and oxygen (O₂)

Note:

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

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

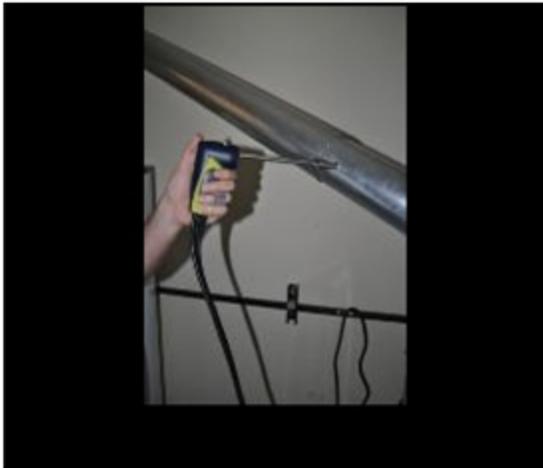
If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC Quality Installation Specification* will be followed

Specification(s):

Measurement will be verified in accordance with manufacturer specifications

Objective(s):

Verify combustion performance of equipment is within manufacturer recommended range based on CO₂ and O₂ readings



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.

5.3003.2i - Excess combustion air

Note:

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

Desired Outcome:

Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

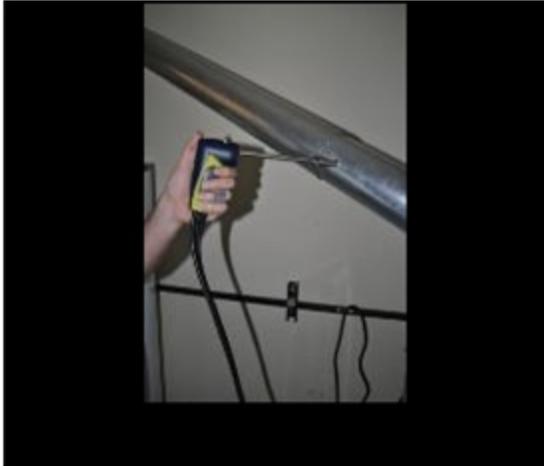
If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC* Quality Installation Specification will be followed

Specification(s):

Excess combustion air will be calculated and shown to be in accordance with manufacturer specifications

Objective(s):

Verify combustion performance of equipment is within manufacturer recommended range based on excess combustion air readings



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*.

5.3003.2j - CO in flue gas

Note:

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

If new installation or replacement is necessary, *ANSI / ACCA*

5 QI HVAC Quality Installation Specification will be followed

Desired Outcome:

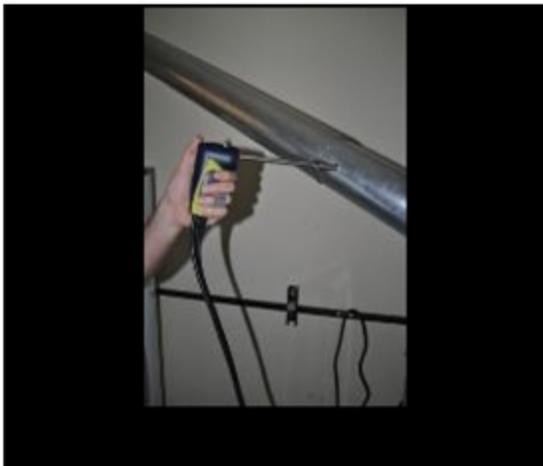
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

Specification(s):

Measure CO and recommend actions to ensure that CO in the undiluted flue gas will be less than 400 ppm air-free

Objective(s):

Ensure CO in undiluted flue gas is less than 400 ppm air-free



In Progress

Test oil-fired appliances for CO in the flue gases to verify safe levels



After

CO should measure less than 200 ppm



CO should measure less than 200 ppm



AiR-free CO, or CO(0), should be less than 400 ppm

Tools:

1. Combustion analyzer with probe
2. Drill

- This work to be completed by a *Qualified Heating Technician*.

5.3003.2k - Testing/inspection holes

Note:

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

If new installation or replacement is necessary, *ANSI / ACCA 5 QI HVAC* Quality Installation Specification will be followed

Desired Outcome:

Analysis on critical components and operations completed in

accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable

Specification(s):

All testing and inspection holes will be sealed with approved materials

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable

5.3003.3 Evaluating Air Flow

5.3003.3a - Total air flow

Note:

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

Desired Outcome:

Air flow is properly tested

Specification(s):

Total system air flow will be measured by one of the following methods:

- Temperature rise
- Flow plate
- Fan depressurization device (e.g., Duct Blaster[®], DucTester[®])

Objective(s):

Ensure equipment:

- operates as designed
- operates efficiently
- provides comfort
- operates safely
- is durable

5.3003.3b - External static pressure

Note:

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

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
- operates efficiently
- provides comfort
- operates safely
- is durable

5.3003.3c - Pressure

Note:

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

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
- operates efficiently
- provides comfort
- operates safely
- is durable



Before

Pressure drop across the coil should be less than or equal to manufacturer recommendations, generally less than .3" w.c.

Tools:

1. Manometer
2. Static pressure probes
3. 1/4" hoses



Drill holes being careful not to damage the evaporator coil.



Hook gauges up to measure pressure before and pressure after the coil.



Static pressure probe should be inserted with the tip pointing into the air stream.



Probe placed before the coil.



Probe placed after the coil.



Measure resulting pressure drop of the dry evaporator coil.

5.3003.3d - Filter inspection

Note:

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

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
- operates efficiently
- provides comfort
- operates safely
- is durable

5.3003.3e - Balancing room flow: new ductwork

Note:

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

Desired Outcome:

Air flow is properly tested

Specification(s):

Proper air flow delivery to each room will be ensured by one of the following:

- Measuring air flow at each register

OR

- Measuring heat rise, room pressures, and interviewing resident's to ensure their comfort

Objective(s):

Ensure equipment:

- operates as designed
- operates efficiently
- provides comfort
- operates safely
- is durable

5.3003.3f - Supply and return temperature measurements

Note:

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

Desired Outcome:

Air flow is properly tested

Specification(s):

Supply and return wet bulb (wet bulb temperature is measured for cooling systems only) and dry bulb temperatures will be recorded

Objective(s):

Ensure equipment:

- operates as designed
- operates efficiently
- provides comfort
- operates safely
- is durable

5.3003.3g - Return web bulb and dry bulb

Note:

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

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
- operates efficiently
- provides comfort
- operates safely
- is durable

5.3003.3h - Temperature rise: gas and oil

furnaces only

Note:

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

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
- operates efficiently
- provides comfort
- operates safely
- 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
- 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
- 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
- operates efficiently
- 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
- operates efficiently
- 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

Note:

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

Desired Outcome:

Refrigerant lines properly installed

Specification(s):

All suction or vapor refrigerant lines will be insulated to a minimum of R-4

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

Objective(s):

Ensure refrigerant lines do not gain excessive heat or cause condensation to occur inside the *building envelope*



Best Practice

Refrigerant line set should be insulated to an R-4 to maintain performance

5.3003.5b - Ultraviolet (UV) protection of insulation

Desired Outcome:

Refrigerant lines properly installed

Specification(s):

If exposed to sunlight, refrigerant line insulation will be protected from UV degradation in accordance with

manufacturer specifications, IRC or local code

Objective(s):

Install insulation so it does not degrade



Bad Practice

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



Best Practice

Line set insulation is protected with integrated UV protection. Tapes and other sealants may be required.

5.3003.5c - 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 drainline
- 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

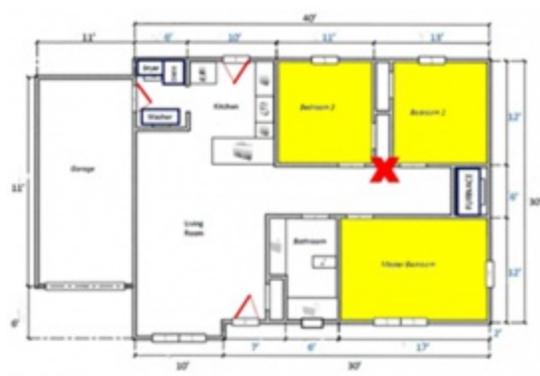
Objective(s):

Occupant will be made aware of operation of CO alarm



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 battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

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:

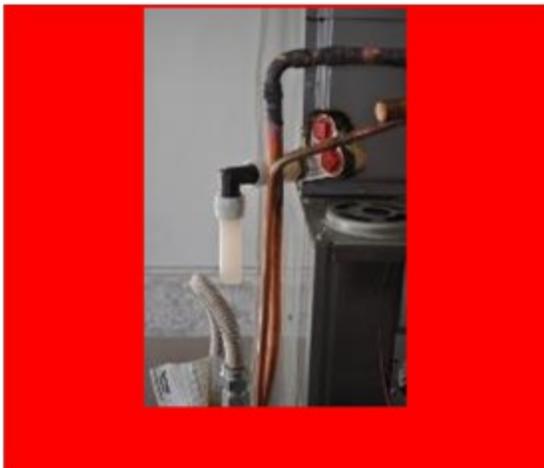
Equipment and condensate drain operate as designed

Specification(s):

Connections in condensate drain system will be watertight

Objective(s):

Ensure condensate drain connections do not leak



Bad Practice



In Progress

HVAC equipment needs condensate drainage to prevent water damage

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 drainlines will be insulated with a minimum 1" of insulation with a *vapor retarder* when there is potential for condensation or freezing on the drainline

Objective(s):

Ensure condensate drain connections do not leak



Before

Once drainage pipes cross into *unconditioned space*, they can freeze

Tools:

1. Tape measure
2. Utility knife



After

Pipes in *unconditioned spaces* should be insulated with 1" pipe insulation

Materials:

1. 1" thick pipe insulation
2. Zip ties

5.3003.10c - Overflow protection: upflow

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 upflow

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 drainlines

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 drainline

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 - Gas pressure - Approved Variance

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

Use certified professionals, in accordance with fuel type and manufacturers specifications, to measure gas pressure on the recommendation of trained weatherization technicians who have pressure concerns based on a visual inspection of the size of flame, clocking of the meter and/or experiencing high or low temperature splits when an appliance is initially tested.

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

Natural gas should have a manifold pressure of 3.5" w.c.

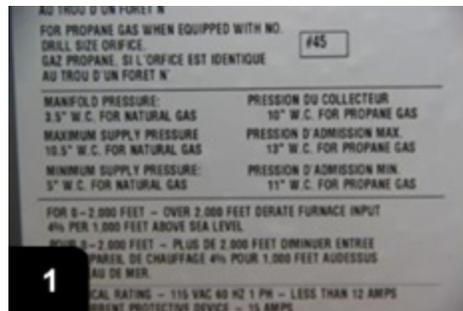


Best Practice

Propane should have a manifold pressure of 10" w.c.

Tools:

1. Gas pressure gauge



See the manufacturer specifications for desired manifold pressure.

5.3003.14b – 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



Before

Appliance is set to OFF at the electrical disconnect, and will not fire.



After

Appliance is set to ON at the disconnect, and can now fire.

Ensure appliance is fired in accordance with manufacturer specifications.



Propane - Ensure gas valve is open at the tank and there is fuel in the tank.



Natural Gas - Ensure the valve on the meter is on.



Ensure gas valve is open at the appliance.



Turn appliance to heat, and raise the temperature 15 degrees above ambient conditions.

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



Best Practice

Carbon dioxide and oxygen levels should be measured in undiluted flue gas

Tools:

1. Combustion analyzer with probe

Oxygen levels should usually fall between 7 - 9%. CO₂ should be between 6.5 - 8%.

5.3003.14d - Carbon monoxide (CO) in flue gas

Desired Outcome:

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

Specification(s):

CO in the undiluted flue gas will be less than 400 ppm air-free

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

CO levels should be less than 400 ppm to ensure safe operation

5.3003.14e - Testing/inspection holes

Desired Outcome:

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

Specification(s):

All testing and inspection holes will be sealed with manufacturer approved materials

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Before

The testing hole was left unsealed.



After

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

Materials:

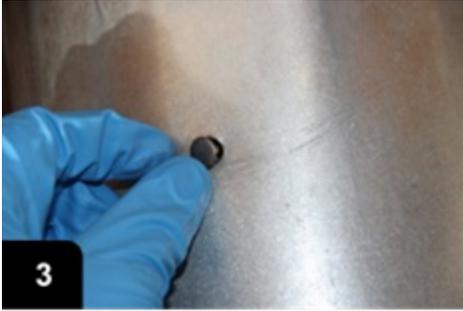
1. High temperature sealant
2. Stainless steel plug or cap
3. Stainless 5/16" bolt



Apply high temperature sealant to the bolt, so that both holes will be sealed.



Screw the bolt into place, ensuring a proper seal on both pipes.



If sealing each wall individually, insert the plug into each hole.



Apply high temperature sealant to the perimeter of the plug.

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 (Residential Load Calculation) and manufacturer specifications

Objective(s):

Enable proper sizing of the heating appliance

- Replacement *heating plants* **must** 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 **must** have a minimum AFUE of 85 percent.
- Efficiency ratings for boilers **must** be listed in the most current edition of the Air Conditioning, Heating, and Refrigeration Institute (AHRI) Directory of Certified Product Performance.

Heat exchangers in all replacement *heating plants* **must** 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 (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 **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.

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 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 1200 or other approved standard

If combustion is not in compliance with the referenced standard, diagnostics and adjustments will be referred to a qualified technician 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

- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. 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 & safety

Desired Outcome:

Thorough maintenance improves safety, efficiency, and performance

Specification(s):

Combustion safety testing will be performed in accordance with the Health & 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 **must** 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.
- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. Detectors, located one per sleeping level and one adjacent to a combustion appliance, are eligible for reimbursement.

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

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 **must** be vented to the exterior.
- Horizontal runs and elbows should be avoided.
- If the exhaust vent 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.

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

Tools:

1. Utility knife



After

R-8 insulation with a *vapor barrier* should be securely wrapped around ducts

Materials:

1. R-8 insulation with *vapor*

2. Metal snips

barrier

2. Nylon twine

3. Wire

- See also ASHRAE 62.2.
- 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 feet 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.



BAD:

Make sure supports DO NOT compress insulation or duct



Flex ducts should have support straps at least every 4 feet

	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

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 **must** be fastened at all connections with sheet metal screws or rivets.

6.6002.1e - Duct Materials

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Flexible materials will be UL 181 listed or Air Diffusion Council approved

The metal gauge of rigid kitchen and exhaust gauges shall meet code requirements or authority having jurisdiction

- Flexible metal duct for exhaust ventilation is limited to 6 foot or less
- Flexible plastic ducting is not allowed

Objective(s):

Effectively move the required volume of air

Preserve the integrity of the duct system

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 **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.



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



4

Hole should be no more than

size (in this case, 4"), mark
to cut hole

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 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 **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.



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 feet 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 **must** 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 generated

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 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 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 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



Before

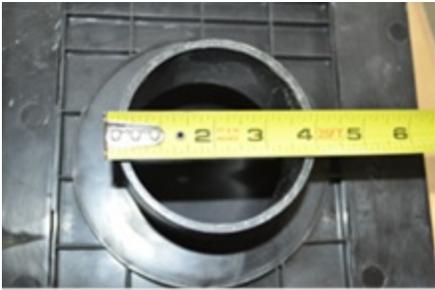
Determine size to cut hole by measuring fan assembly and ducting

After

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:

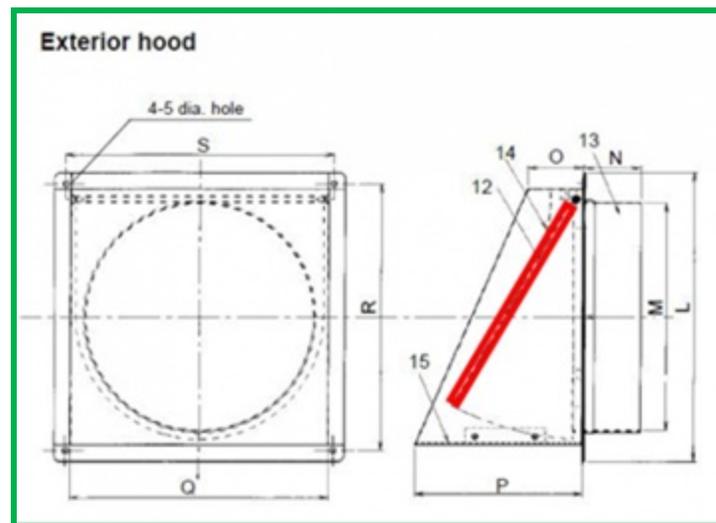
Through the wall fans installed to specification

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):

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



Before

Installing new ventilation can cause imbalances within the house

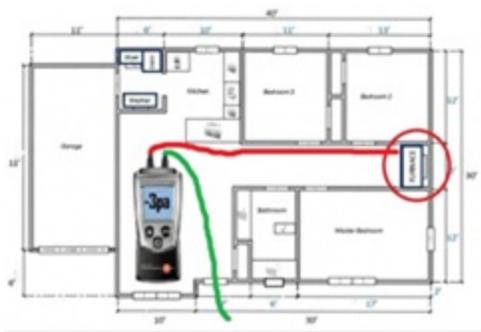


After

Test that depressurization limit is not being exceeded by new ventilation

Tools:

1. Manometer



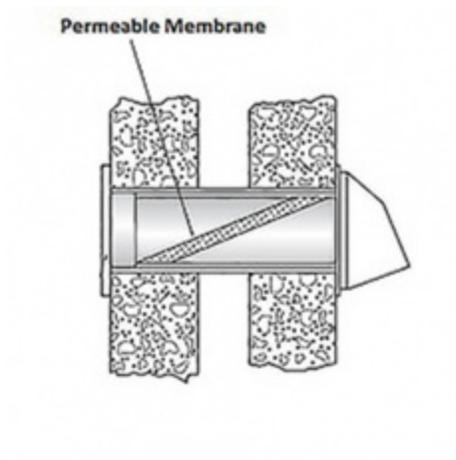
1

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

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 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 **must** be vented to the exterior of the home.
- Dryer vent pipe **must 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.
- Dryer vent ductwork **must** be smooth surfaced and whenever possible and **must 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 **must not** be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.



Before

Dryer is vented outside, but with wrong material



After

Dryer is vented outdoors, with correct material. Run is as short and straight as possible ensuring maximum flow.

Tools:

1. Metal snips
2. Drill

Materials:

1. Metal flex duct
2. Dryer vent kit
3. Hose clamps



Disconnect existing vent pipe from termination. If hose clamp is installed, save



Disconnect existing vent pipe from dryer.

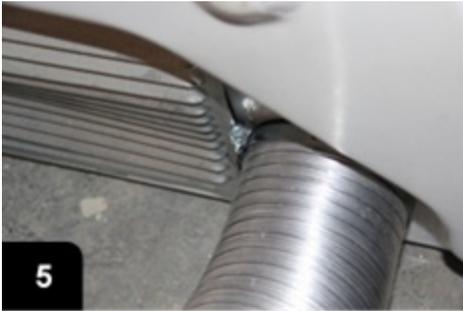
for reuse.



Attach approved vent material to termination vent. Termination vent may need to be trimmed.



Trim metal vent to ensure the run is as short and straight as possible.



Connect vent pipe to dryer.



Dryer vents to outdoors, and exhaust damper is functional.





For vent runs >35 feet, a booster fan is required.

Duct runs outside of *conditioned space* **must** be insulated and properly supported.

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
- Existing unvented clothes dryers **must** be vented to the exterior of the home.
- Dryer vent pipe **must** be metal and the termination cap **must** be dampered and attached with rust proof fasteners.

6.6005.1c - Make-up air

Desired Outcome:

Dryer air exhausted efficiently and safely

Specification(s):

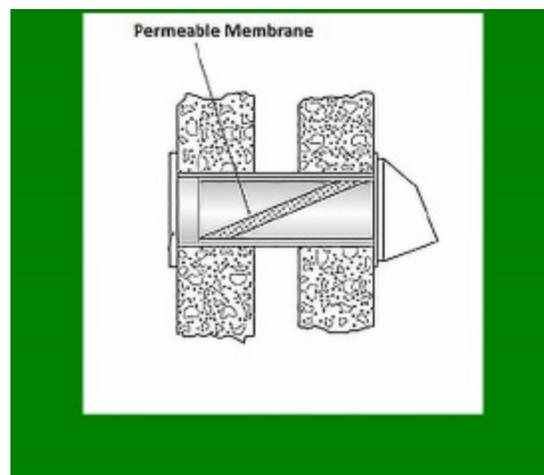
If natural draft combustion appliances are present and if worst-case *CAZ* and/or other performance based testing is conducted and indicates a need for make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction

If natural draft combustion appliances are present and if no performance based testing is conducted, make-up air will be provided prescriptively 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



Before

Appliance exhaust, such as that for a dryer, can cause depressurization

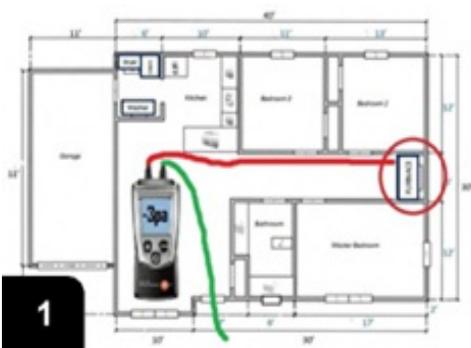


After

Test to verify combustion appliances are within depressurization limits

Tools:

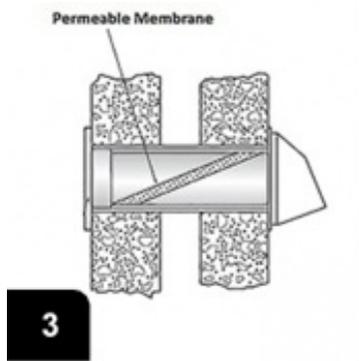
1. Manometer



Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions



If depressurization limit is exceeded, mitigate to eliminate safety risk



Install make-up air, such as a passive inlet vent, or other pressure relief



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 IRC in the absence of such regulations or where those regulations are not as stringent as the 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*





Before

Recirculating fans over ranges do not actually remove contaminants



After

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 listed material

Objective(s):

Preserve integrity of *building envelope*

Effectively move air from range to outside



Before

Exhaust duct should be smooth-walled and in as short a run as possible

Tools:

1. Drill



After

Daylight visible through dampered kitchen exhaust proves outside access

Materials:

1. Round metal ducting

2. Putty knife
3. Tape measure
4. Metal snips
5. Saw

2. Mastic
3. Fiberglass mesh tape
4. Fasteners

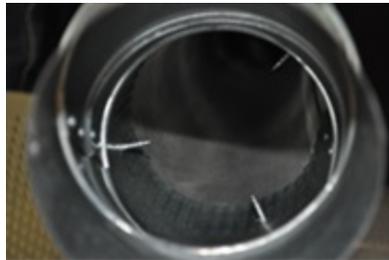
- See also [6.6002.1d - Duct Connections](#).
- Note: Only smooth-wall metal duct will be used, except for down-draft exhaust systems where
- PVC is acceptable as well. Flex duct is NOT acceptable for kitchen fan exhaust application.

Existing kitchen exhaust fans **must** be vented to the exterior.
Horizontal runs and elbows should be avoided.



2

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 mastic

6.6005.2d - Termination fitting

Desired Outcome:

Kitchen range fan installed to specification

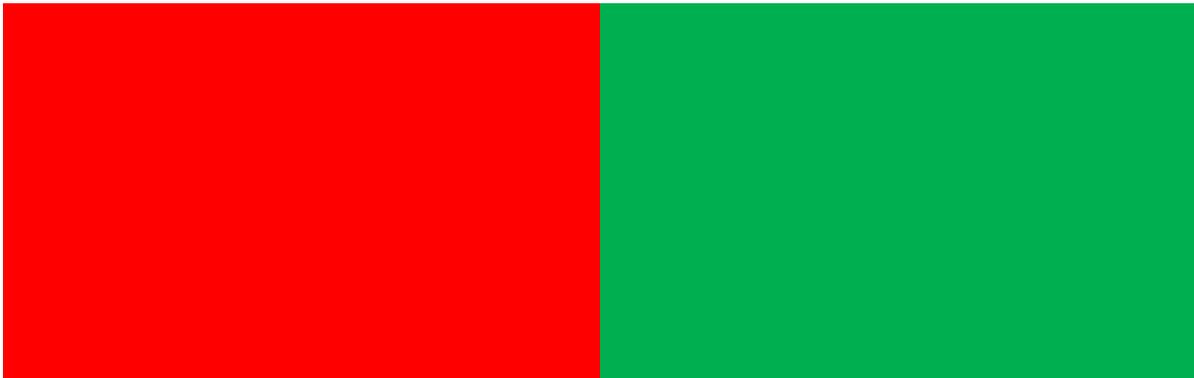
Specification(s):

Termination fitting will be installed including a *backdraft damper*, as described in termination fitting detail

Objective(s):

Ensure safe operation of combustion appliances

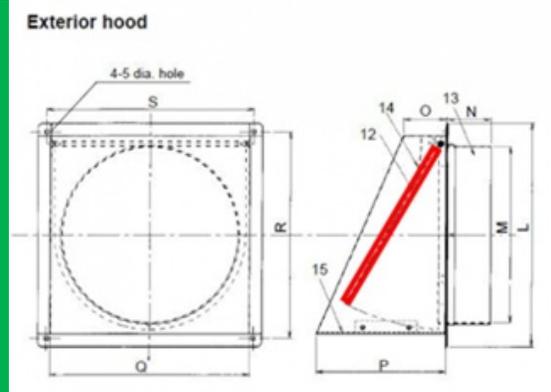
Ensure occupant health and safety





Before

Kitchen fans should exhaust to the exterior, not just recirculate air



After

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):

If natural draft combustion appliances are present and if worst-case *CAZ* and/or other performance based testing is conducted and indicates a need for make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction

If natural draft combustion appliances are present and if no performance based testing is conducted, make-up air will be provided prescriptively in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction.

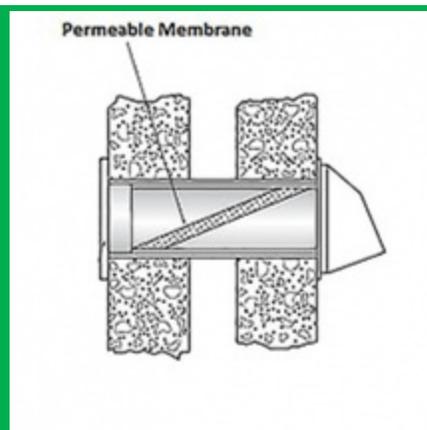
Objective(s):

Ensure safe operation of combustion appliances

Ensure occupant health and safety



Before



After

If kitchen exhaust is venting at more than 200 *CFM*, provide make-up air

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





Before

Kitchen exhaust fans can cause combustion appliances to depressurize

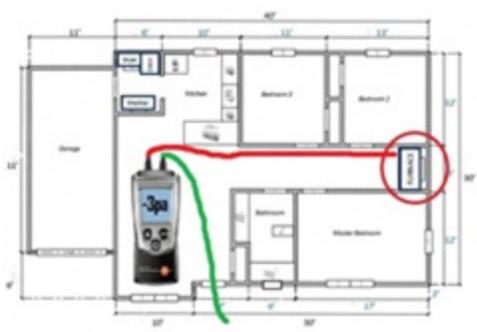


After

Test that combustion appliances are operating within depressurization limit

Tools:

1. Manometer



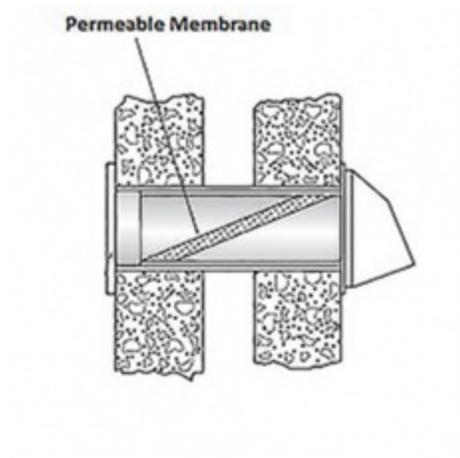
1



2

Run depressurization testing on house to ensure new ventilation isn't causing unsafe conditions

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 ft 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 feet 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 feet 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 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 feet 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* (CAZ)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

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 IRC

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

6.6201.2 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 $> \pm 3\text{pa}$, 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 $> +/- 3\text{pa}$ 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 **must** 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 current ASHRAE standard

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 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

7 Baseload

7.80 Plug Load

7.8001 Refrigerators

7.8001.1 Refrigerator Replacement

7.8001.1a – Selection

Desired Outcome:

A more efficient appliance installed

Specification(s):

Appliance shall be ENERGY STAR[®] qualified or at least as energy efficient

Appliance will fit in the available space without blocking access to light switches, cabinets, etc.

Appliance will carry a minimum one-year warranty that will provide a replacement appliance if repeated issues relating to health, safety, or performance occur

Objective(s):

Energy efficient appliance installed

7.8001.1b – Installation

Desired Outcome:

A more efficient appliance installed

Specification(s):

Appliance will be installed in accordance with manufacturer specifications and local codes

>Any penetrations to the exterior of the home created by the installation of the appliance will be sealed

Energy-related appliance controls will be demonstrated to the occupant

Specific information on the 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

Objective(s):

Achieve intended appliance function

Preserve food at low energy use

Educate occupant on how to operate and maintain the appliance

7.8001.1c – Decommissioning

Desired Outcome:

A more efficient appliance installed

Specification(s):

Appliances replaced by new units will be recycled or disposed of in accordance with federal, state, or local regulations

Appliances infested with pests will be enclosed before moving

Objective(s):

Prevent reuse of inefficient equipment and components

Protect the environment

Protect worker safety

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, movable 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



2.5 GPM stamp on a shower head



Shower and faucet aerators with flow rates equal to or less than 2.5 and 2.2 gpm

Tools:

1. Tongue-and-groove pliers

Materials:

1. Joint sealing tape
2. Shower and faucet aerators

Verify that occupant is satisfied with the performance of their shower and faucet aerators. Offer acceptable alternatives that meet the flow requirements.

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



Before

Old, high flow shower nozzle



After

Leak testing a new shower aerator

Tools:

1. Tongue-and-groove pliers
2. Pipe wrench
3. Adjustable wrench

Materials:

1. Joint sealing tape
2. Rags

Interview occupant to document and verify their satisfaction with new shower and faucet aerators. Operate equipment after installation to ensure that it does not leak.



Remove old, high flow shower heads



Replace with 2.5 gpm maximum shower heads



Clean corrosion and old sealant from the threads on the shower nipple using a wire brush



Seal the threads on the shower nipple with two wraps of Teflon tape. Wrap tape clockwise so it won't peel off



Install the new low-flow shower head



Tighten the shower head using an adjustable wrench or tongue-and-groove pliers and a rag to protect the finish.



Turn on the water and check for leaks



Make sure the client is happy with their new low-flow shower head. Document approval with their signature in the file

- The costs associated with water quality evaluation and shower diverter repair or replacement 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



Recycle or dispose of removed shower faucets and sink aerators to prevent their reuse.

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 IRC

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 & 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 **must** be vented to the exterior.
- *Unsafe water heaters* that cannot be repaired **must** 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 **must** be replaced in owner

occupied homes.

- In renter occupied homes, the owner **must** repair or replace the water heater. If replacement is made in accordance to these installation standards the *Nebraska Weatherization Assistance Program* may contribute a maximum of \$150*.
 - These maximum limitations **do not** apply to the addition of power vents to existing, operating units where drafting is negatively impacted by air sealing the home thru the weatherization process.
- Weatherization of the building **must 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 **must** have a minimum efficiency of .59 and new electric water heaters **must** 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 IRC

Objective(s):

Ensure equipment meets the occupant's expectations while providing efficient energy and water use

- New gas water heaters **must** have a minimum efficiency of .59 and new electric water heaters **must** 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

7.8102.2a - 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 are 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 IRC or authority having jurisdiction
- Seal any unused chimney openings and penetrations in accordance with IRC or authority having jurisdiction
- Remove unused oil tank, lines, valves, and associated equipment in accordance with IRC 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 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 **must** be performed by a *Qualified Heating Technician* or *Qualified 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.

7.8102.2e - Expansion tank - Approved Variance

Desired Outcome:

Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Expansion tanks will be installed where required and in accordance with the authority having jurisdiction

Expansion tanks will be installed 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.

Objective(s):

Protect the storage tank from expansion



Bad Practice

Need to eliminate the valves between the storage tank and expansion tank



Best Practice

Expansion tank is installed on the cold water supply side

Appropriate licensing for installer required. Expansion tanks are only required to be installed only when in conjunction with new and replacement water heaters.

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 the IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with the IRC

Objective(s):

Discharge excessive energy (pressure or temperature) from storage tank to safe location



Before | Unsafe

Water heaters should be not capped off at T&P valve

Tools:

1. Pipe wrench
2. Hacksaw



After | Safe

T&P discharge should be piped to a safe and observable location

Materials:

1. PVC
2. Plumber's epoxy

- Missing or damaged temperature and pressure relief valve **must** be replaced.
- Check local jurisdictional codes.
- **Paraphrased from IRC:** 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

7.8102.2g - 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 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 feet of inlet and outlet piping will be insulated in accordance with manufacturer specifications

Combustible pipe insulation **must** maintain a minimum clearance of 6" from gas water heater draft hood and/or single wall metal pipe. Clearance from vent such as "B" vent should be maintained per vent manufacturer's specifications

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 **must not** be insulated or sealed in the area containing the asbestos.
- Insulation **must not** be installed on water heaters if doing so voids the warranty of the unit.
- *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.
- Water heater insulation **must** be secured with tape and bound with a minimum of 2 wire, cord, plastic or nylon bands on the tank.
- Water lines **must** be insulated a minimum of 6 feet of the 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 **must** have the top insulated and the thermostat control access panels accessible or marked and labeled.
- 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 the pipe wrap.
- 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.
- Insulation **must 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 **must not** begin within 3 inches or farther than 4 inches of a flue and/or draft hood.



Before

Uninsulated storage-type water heater



After

Storage-type water heater with additional insulation

Tools:

1. Outward clinching (stitch) stapler
2. Utility knife
3. Scissors
4. Straight edge

Materials:

1. R-11 tank wrap
2. Vinyl tape
3. Staples
4. Rags or terry-cloth towels
5. Foam pipe insulation

Check warning labels on tanks. Not all water heaters may be insulated. Leave the tops of gas water heaters uninsulated, and be sure to keep combustion chamber access panels and combustion air holes uncovered. Cut out around thermostats on electric units. Use staples or zip ties to mechanically fasten insulation in place. Do not rely on tape alone to hold the tank wrap. Maintain proper clearance from gas appliance vents to combustibles.



Clean the entire outside of the water heater



Wrap blanket around tank and mark it where it overlaps. Add two or three inches and cut off using a straightedge and razor



Cut the insulation off at the mark. Peel away the excess insulation, leaving a flap of *vapor barrier*



Pull insulation blanket around the tank



Staple the flap to the blanket with outward clinching staples or use long zip ties to secure the blanket in place



Cut out around drain valve, P&T relief valve, and thermostats. Do not cover combustion access or air supply on gas units



Use remaining insulation for the top of electric water heaters. Tape up seams in the *vapor barrier*. Insulate water lines

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



4

Adjust water heater settings
and insulate as needed

After adjustment and
insulation, retest to verify
temp is under 120 degrees

7.8102.2l - 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 filled
and purged:

- Safety controls
- Combustion safety and efficiency
- Operational controls
- Fuel and water leaks
- Local code requirements

Commissioning will be in compliance with manufacturer
specifications and relevant industry standards

Objective(s):

Ensure safe system function

Keep cost of ownership as low as possible

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 battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. 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 is 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 IRC
- Seal any unused chimney openings and penetrations in accordance with IRC
- Remove unused oil tank, lines, valves, and associated equipment in accordance with IRC

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 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 the IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with the IRC

Objective(s):

Discharge excessive energy (pressure or temperature) from storage tank to safe location

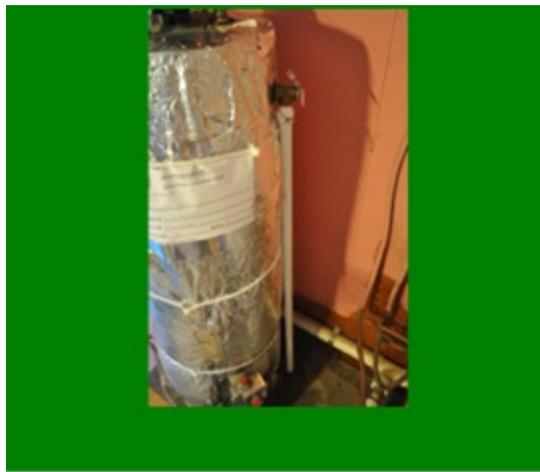


Before | Unsafe

Water heaters should be not capped off at T & P relief valve

Tools:

1. Pipe wrench
2. Hacksaw



After | Safe

T & P discharge should be piped to a safe and observable location

Materials:

1. PVC
2. Plumber's epoxy

Check local jurisdictional codes.

Paraphrased from IRC: 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 inches from floor, pan or waste receptor.



GOOD:

T & P discharge should be piped within 6 inches 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

7.8102.3f - 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 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 is not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8102.3h - Thermal efficiency

Desired Outcome:

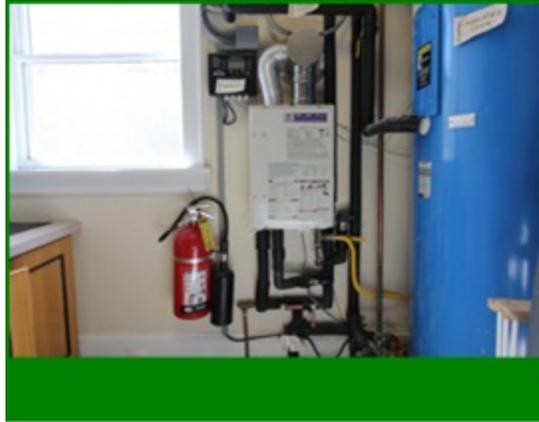
Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Any accessible hot water lines at the appliance will be insulated to meet IRC or local requirements, whichever is greater.

Objective(s):

Reduce line losses



After

Insulate accessible pipes to R-3 or better

Materials:

1. Foam pipe insulation
2. Spray adhesive
3. Zip ties

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 the 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



Before

Best practice is to install on-demand water heaters as direct-vent units



After

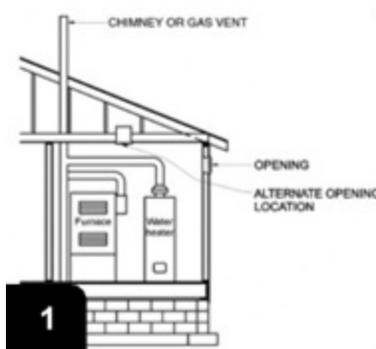
If not installed as direct vent, refer to notes and images on following pages for required combustion air

To determine adequate combustion air: add up the input Btus of all combustion appliances in the space and divide by 20. The result is the minimum required air volume in cubic feet (50 cubic feet per 1,000 input Btus). If the available volume is less than 50 cubic feet per 1,000 input Btus, provide additional combustion air as listed below for each circumstance, in accordance with the IRC G2407.

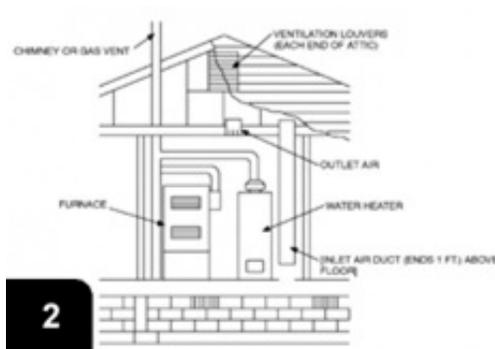
Image 1: For homes with one permanent opening, see IRC G2407.6.2 (304.6.2): a minimum free area of 1 in² per 3,000 Btu/h (734 mm²/kW) of total input rating of all appliances

Image 2: For homes with two permanent vertical duct openings, see 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

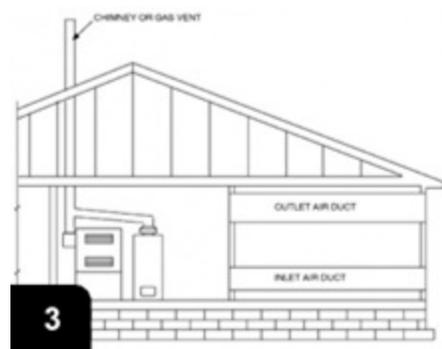
Image 3: For homes with two permanent horizontal duct openings, see IRC G2407.6.1 (304.6.1): a minimum free area of 1 in² per 2,000 Btu/h (1,100 mm²/kW) of total input rating of all appliances



min free area of 1 sqin per 3,000 Btu/h (734 mm²/kW) of total input rating



min free area of 1 sqin per 4,000 Btu/h (550 mm²/kW) of total input rating



min free area of 1 sqin per
2,000 Btu/h (1100 mm²/kW)
of total input rating

- The costs associated with providing additional energy input for the appliance are not an eligible expense in the *Nebraska Weatherization Assistance Program*.

7.8102.3j - Venting of flue gases

Desired Outcome:

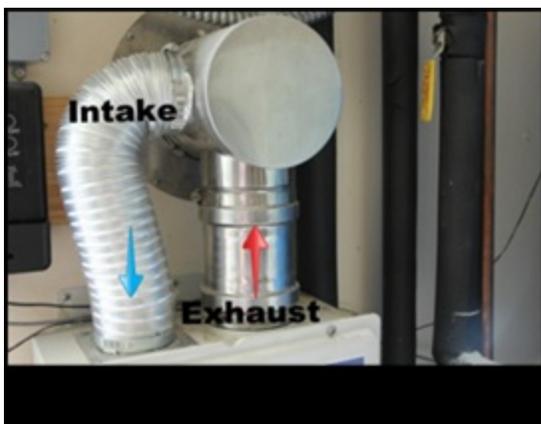
Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership

Specification(s):

Combustion byproducts will be removed in accordance with the IRC, authority having jurisdiction, and manufacturer specifications

Objective(s):

Ensure the safety and durability of the venting system



Safe

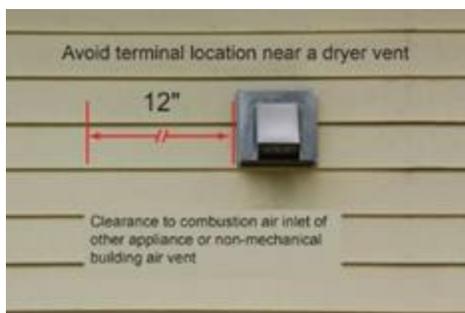
On-demand water heater combustion air intake and exhaust vent, interior view

Safe

On-demand water heater combustion air intake and exhaust vent

Follow manufacturer's venting instructions for on-demand appliances. Local codes may be more stringent than the International Residential Code (IRC), which governs venting of gas appliances.

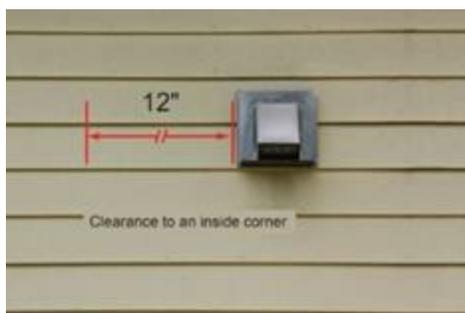
Do not locate vent terminals near dryer vents.



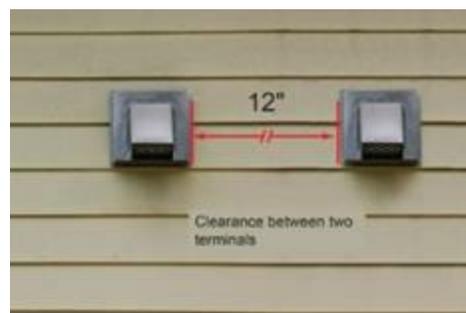
Verify 12 inches between a vent terminal and any non-mechanical building vent or combustion air inlet from another appliance



Check that there is 12 inches between vent terminals and any operable door or window

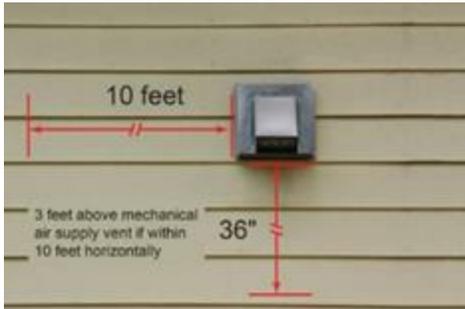


Ensure 12 inches clearance



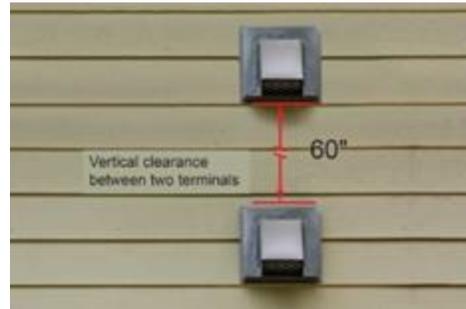
Verify 12 inches between

from the edge of a vent to any inside corner of the building



Verify vent terminals are at least 3 feet higher than any mechanical air inlet closer than 10 feet away horizontally

any two vent terminals



Ensure there is 60 inches between terminals in line vertically



Verify vent terminals are 36" below any eave, soffit, porch, or deck within 24 horizontal inches of center of vent



Ensure that vents are at least 36" above grade, porch, deck, veranda, or snow line

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

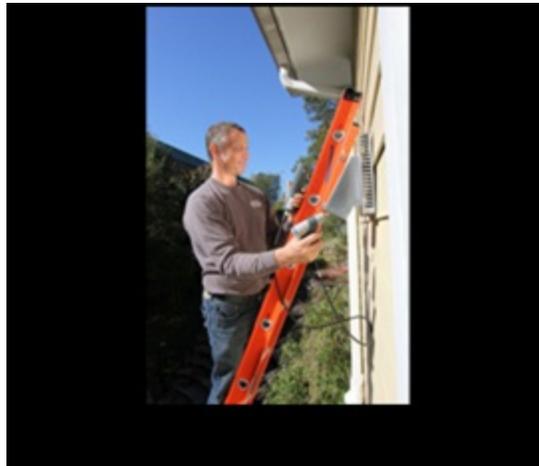
Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T

If combustion is not in compliance with BPI-1100-T, diagnostics and adjustments will be done to manufacturer specifications or local codes

Objective(s):

Confirm that combustion is occurring safely with maximum efficiency



Before

Test flue gases with properly calibrated equipment

Tools:

1. Properly calibrated combustion analyzer

The combustion analyzer shall be calibrated in accordance with the manufacturer's recommendations with available documentation traceable to the individual device.



Verify that calibration date is current on combustion analyzer



Test flue gases for carbon monoxide at outlet of vent



Verify that carbon monoxide levels are within specifications

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 the 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



Unsafe

Hot water temperature over 120°F



Safe

Hot water temperature under 120°F

Tools:

1. Thermometer
2. Cup or bowl

Use a thermometer to measure hot water temperature. 120°F is the recommended setting

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):

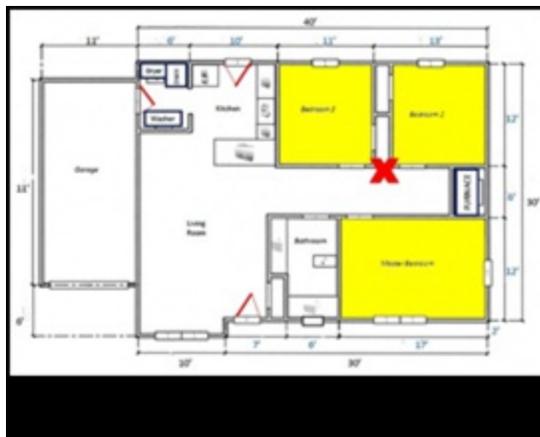
Ensure occupant health and safety



Best Practice

Carbon Monoxide alarms should be installed according to local codes

Tools:



Best Practice

Alarms should be mounted near sleeping areas—such as the one marked in red

Materials:

1. Drill/screwdriver

1. CO alarm

2. Fasteners

- Installation of battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. 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

7.8103.1a - Health & safety

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

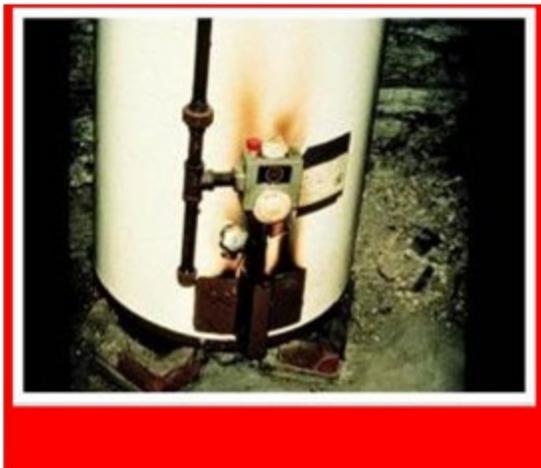
Specification(s):

Combustion safety testing will be performed in accordance with the Health & 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
5. Mirror
6. Stopwatch, timer, or watch with second hand

Materials:

1. CO alarm
2. Fasteners

See also [2.0201.2a for Outside Combustion Air Requirements](#) and [2.0602.2c for Electrical Tool 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 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

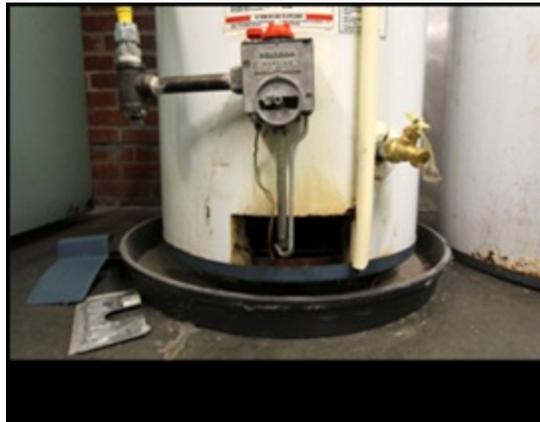
Objective(s):

Determine needed repairs or maintenance



In Progress

Inspect for rust, corrosion, and dust around draft diverter. Verify diverter is centered and fastened. Check T & P valve



In Progress

Inspect for signs of flame rollout, thermostat and gas valve condition, and proper T & P relief valve termination

Tools:

1. Flashlight
2. Inspection mirror



Check draft diverter alignment



Inspect for rust, corrosion, and leaks

7.8103.1c - Thermal efficiency - Approved Variance

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-11, 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 IRC or local requirements, whichever is greater



Best Practice

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

- Water lines that have asbestos pipe wrap **must not** be insulated or sealed in the area containing the asbestos.
- Insulation **must 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 **must not** be installed if the water heater lacks a pressure relief valve.
- *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.

- Water heater insulation **must** be secured with tape and bound with a minimum of 2 wire, cord, plastic or nylon bands on the tank.
- Water lines **must** be insulated a minimum of 6 feet (to a maximum of 18 feet, if cost effective) of the hot or inlet piping and a minimum of 6 feet of outlet piping in all directions from the water heater, using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.
- Water lines **must** be insulated a minimum of 6 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 **must** have the top insulated and the thermostat control access panels accessible or marked and labeled.
- 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 the pipe wrap.
- 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.
- Insulation **must 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 **must 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



Water lines **must** be insulated a minimum of 6 feet (to a maximum of 18 feet, if cost effective) of the

hot or inlet piping and a minimum of 6 feet of outlet piping in all directions from the water heater, using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.

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 the IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with the IRC

Objective(s):

Discharge excessive energy (pressure or temperature) from storage tank to safe location



Before | Unsafe

Water heaters should be not capped off at T & P valve



After | Safe

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 temperature and pressure relief valve **must** be replaced.
- Check local jurisdictional codes.
- **Paraphrased from IRC:** 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 inches 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 battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. 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 & safety

Desired Outcome:

Safe, reliable, and efficient operation of the appliance maintained

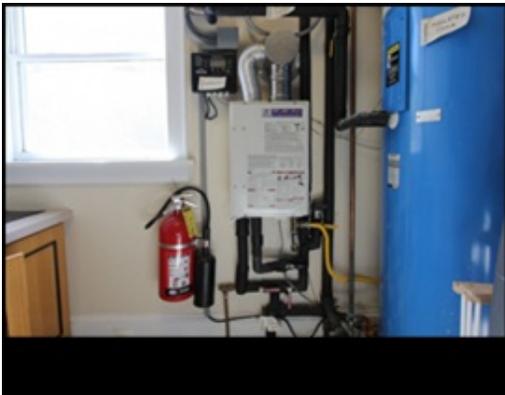
Specification(s):

Combustion safety testing will be performed in accordance with the Health & 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



Safe

On-demand water heater



Best Practice

Check carbon monoxide levels in the appliance vent

Tools:

1. Personal CO monitor
2. Combustion analyzer with probe
3. Manometer

Materials:

1. CO alarm
2. Fasteners

4. Smoke pencil

See also [SWS 2.0201.2a for Outside Combustion Air Requirements](#) and [SWS 2.0602.2c for Electrical Tool Safety](#).

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 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



Check installation and ensure it meets manufacturer's instructions and local codes

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 the IRC and according to manufacturer specifications

Temperature and pressure relief valve discharge tube will be installed in accordance with the 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

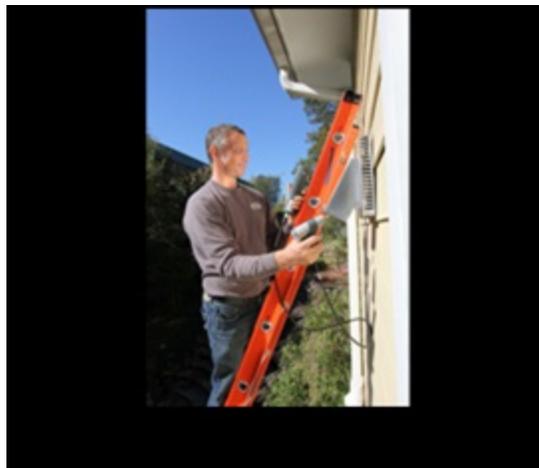
Specification(s):

Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T

If combustion is not in compliance with BPI-1100-T, diagnostics and adjustments will be done to manufacturer specifications or local codes

Objective(s):

Perform combustion testing



Best Practice

Test flue gases at outlet of vent to verify carbon monoxide levels are within

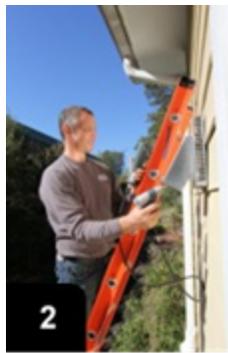
specifications

Tools:

1. Properly calibrated combustion analyzer



Verify that calibration date is current on combustion analyzer



Test flue gases for carbon monoxide at outlet of vent



Verify that carbon monoxide levels are within specifications

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 IRC

If needed, additional combustion air will be provided in accordance with IRC

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



Before

Inspect direct vents for proper connections, rust, corrosion, and clearances



After

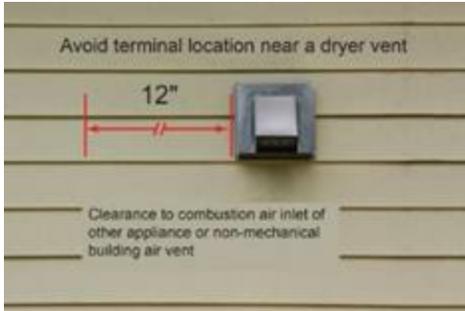
Inspect direct venting for proper connections, rust, corrosion, and clearances

Tools:

1. Flashlight
2. Inspection mirror

Check that all connections are secure, free of rust and corrosion, and that vents are made from the proper material. Verify that sealed combustion units are installed as direct vents, that is, with both combustion air intakes and exhaust gas vents connected.

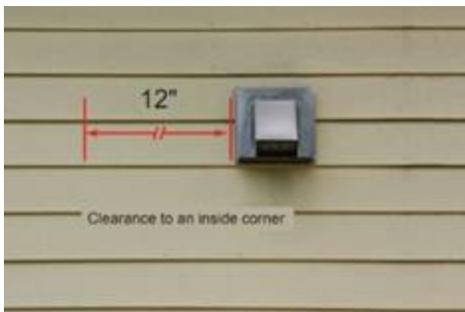
Check that terminal locations are in accordance with the IRC, manufacturer's instructions, and/or local codes.



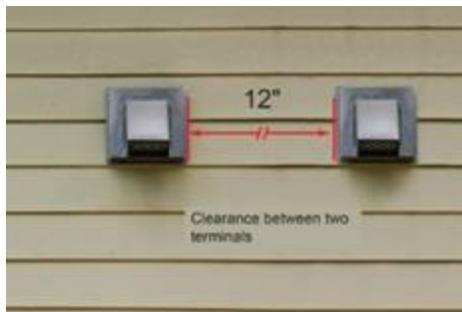
Verify 12 inches between a vent terminal and any non-mechanical building vent or combustion air inlet from another appliance



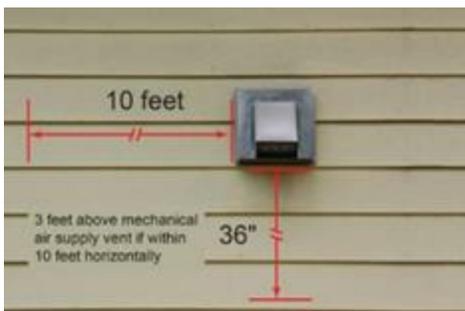
Check that there is 12 inches between vent terminals and any operable door or window



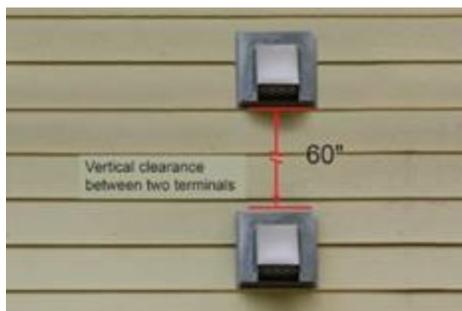
Ensure 12 inches clearance from the edge of a vent to any inside corner of the building



Verify 12 inches between any two vent terminals



Verify vent terminals are least 3 feet higher than any



Ensure there is 60 inches between terminals in line

mechanical air inlet closer than 10 feet away horizontally

vertically



Verify vent terminals are 36" below any eave, soffit, porch, or deck within 24 horizontal inches of center of vent



Ensure that vents are at least 36" above grade, porch, deck, veranda, or snow line

7.8103.2g - Fuel supply

Desired Outcome:

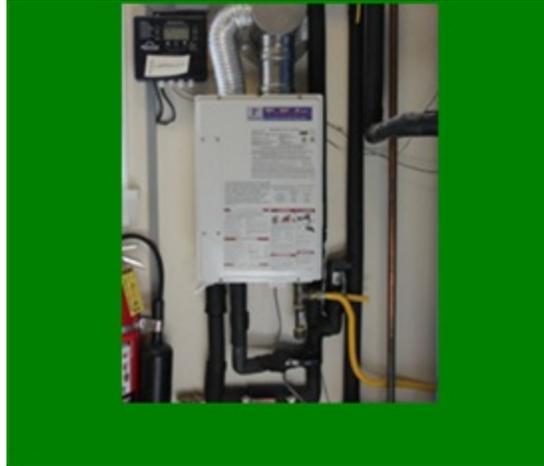
Safe, reliable, and efficient operation of the appliance maintained

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



Best Practice

Inspect fuel supply and verify that sizing and capacity are correct

Tools:

1. Flashlight



Inspect gas lines for corrosion, leaky fittings, worn flex lines, sediment traps and drip legs, and kinked copper



Inspect LP gas tanks for corrosion, proper location, leaky fittings, and kinked or damaged copper

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



Best Practice

Testing water supply pressure

Tools:

1. Water pressure gauge

Check manufacturer's specifications for flow and pressure requirements. System pressure may be easily measured with a pressure gauge attached to a hose bib or faucet. Pipe sizing calculations (to ensure adequate flow rates) are best left to a licensed plumber or mechanical contractor.

- The costs associated with providing additional required volume and/or water pressure are 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

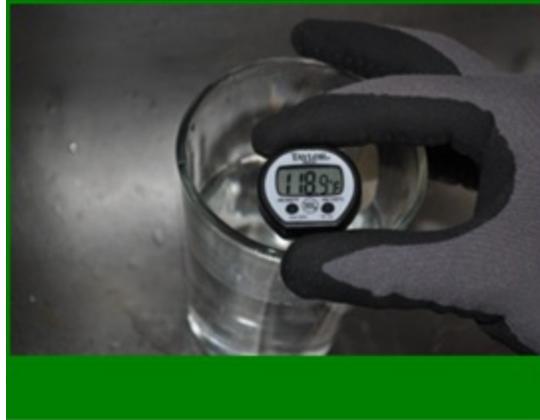
Objective(s):

Ensure safe hot water supply temperature to fixtures



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



Test temperature of hot water at faucets in house



Hot water temperatures should not exceed 120 degrees Fahrenheit



Adjust water heater settings and insulate as needed



After adjustment and insulation, retest to verify temp is under 120 degrees F

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 battery operated or plug-in 110 Volt Carbon Monoxide Detectors, as per manufacturer's instructions, is required on initial inspection of the home. 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

Manufactured Housing Standard Work Specifications

MH 2 Health & Safety

MH 2.01 Safe Work Practices

MH 2.0107 *Basements and Crawl Spaces*

MH 2.0107.5 Pre-work Qualifications (Home Installation)

MH 2.0107.5a - Installation deficiencies

Desired Outcome:

Manufactured home is properly installed

Specification(s):

Any installation deficiencies that may affect worker safety or integrity or installed measures will be repaired before starting work

Objective(s):

Ensure site is safe and ready for upgrade



Unsafe

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



Safe

Approved, properly installed piers, anchors, and tie downs

Tools:

1. Level
2. Cordless driver drill
3. Flashlight

Inspect homes for safety before work. Look for stuck doors and windows, buckled siding, and loose tie-downs as evidence of settling. Inspect piers to ensure that they are solid and level. Check for loose or missing wooden shims and wedges. Inspect anchors and straps for tightness and proper installation per manufacturer's recommendations.



Carefully inspect the foundation piers. Look for loose or missing shims and wedges

- The costs associated with repairing installation deficiencies are not eligible expenditures in the *Nebraska Weatherization Assistance Program*. When these issues are identified the client **must** be advised of the problem and the home **must** be deferred as per the *Nebraska Weatherization Assistance Program's* deferral process.

MH 2.0107.5b - Stabilization

Desired Outcome:

Manufactured home is properly installed

Specification(s):

Home **must** be stabilized in accordance with manufacturer specifications or local authority having jurisdiction

Objective(s):

Ensure the home is secured properly

Prevent injury

Minimize exposure to health and safety hazards



Unsafe

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



Safe

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

- The costs associated with repairing installation deficiencies are not eligible expenditures in the *Nebraska Weatherization Assistance Program*. When these issues are identified the client **must** be advised of the problem and the home **must** be deferred as per the *Nebraska Weatherization Assistance Program's* deferral process.

MH 2.02 Combustion Safety

MH 2.0204 Isolation

MH 2.0204.1 Isolating Combustion Water Heater Closet

MH 2.0204.1a - Work assessment

Desired Outcome:

Isolate combustion water heater closet from *conditioned space*

Specification(s):

Installer pre-work assessment will be conducted to determine:

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

Objective(s):

Ensure combustion appliance is functioning safely

Ensure work space is safe and ready for air sealing

Verify scope of work

- Water heater compartment doors that are beyond repair **must** be replaced. Appropriate photo documentation of the condition of the door **must** be included in the client file.

MH 2.0204.1b - Air seal closet

Desired Outcome:

Isolate combustion water heater closet from *conditioned space*

Specification(s):

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

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

Objective(s):

Prevent combustion gases from entering *living area* and minimize extension of interior pressures caused by exhaust fan, dryers, and interior door closure into the water heater closet

- 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.

MH 2.0204.1c - Materials

Desired Outcome:

Isolate combustion water heater closet from *conditioned space*

Specification(s):

Only noncombustible materials will be used in contact with chimneys, vents, and flues

Objective(s):

Prevent a fire hazard



Best Practice

When sealing around combustion flue penetrations, use appropriate materials

After

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

Tools:

1. Caulk gun
2. Metal snips
3. Drill

Materials:

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

- All openings from the water heater compartment into the *conditioned space* **must** be sealed with metal or 5/8" fire code drywall.

MH 2.0204.1d - Post-work testing/verification

Desired Outcome:

Isolate combustion water heater closet from *conditioned space*

Specification(s):

Blower door assisted zonal pressure diagnostics will be used to verify isolation has been achieved

Objective(s):

Prevent combustion gases from entering *living area*



Before

The reading is closer to 0,



After

The reading is closer to 50,

indicating strong connection
to the inside.

indicating strong connection
to the outside.

Tools:

1. Blower door assembly
2. Manometer
3. 1/4" hose
4. Steel tube or probe
5. Drill

MH 2.04 Moisture

MH 2.0403 *Vapor Barriers*

MH 2.0403.4 Pier and Skirting Foundations - Ground Moisture Barriers

MH 2.0403.4a - Coverage

Desired Outcome:

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

Specification(s):

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

Objective(s):

Reduce ground moisture entering *crawl space*



Before

Manufactured home crawl space with incomplete ground vapor barrier



After

Manufactured home crawl space with complete ground vapor barrier

Tools:

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

Materials:

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

Aim for complete coverage. If access to the entire *crawl space* is impossible, cover all accessible areas. Overlap seams in *vapor barrier* by at least twelve inches, and seal them with waterproof tape and/or polyurethane caulk or adhesive. Wrap and cover support piers at least twelve inches high.



Remove skirting as needed for access to *crawl space*



Measure, cut, and spread *vapor barrier* material after removing debris over 1/2" in size. Notch around obstructions



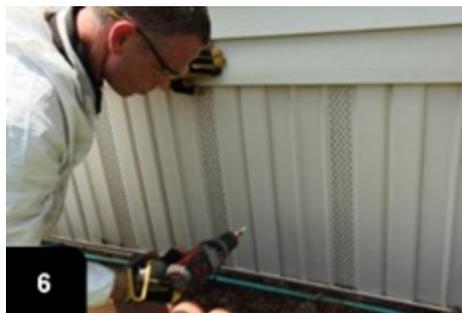
Wrap piers and columns at least six inches high. Use additional material to cover any gaps and holes in *vapor barrier*



Secure *vapor barrier* to ground with corrosion-resistant landscape staples, or weigh it down with ballast



Remove tools and excess



Reinstall skirting

material

- A full ground laid moisture barrier **must** be installed on mobile homes with accessible underbellies, relatively tight skirting or when insulated skirting is installed.
- A moisture barrier may be omitted in areas where run off is likely to collect. For homes that received insulated skirting, ground insulation **must not** be installed in areas where the moisture barrier has been omitted.
- When installing insulated skirting without adequate clearance a minimum of 2 manual or thermostatic vents may be installed.

MH 2.0403.4b - Material specification

Desired Outcome:

Durable, effective ground moisture barrier that provides ongoing 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):

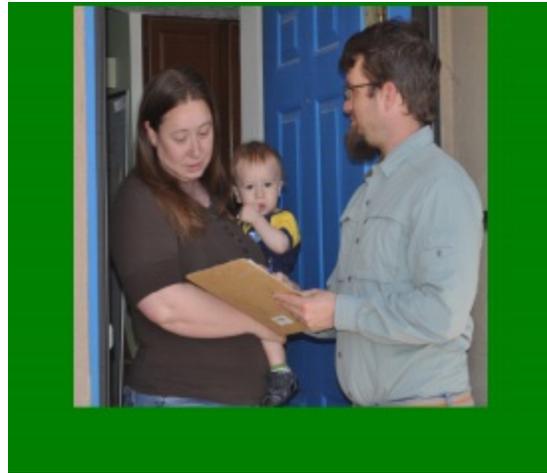
Ensure *crawl space* is accessible for service and maintenance

without damaging the integrity of the ground moisture barrier



Best Practice

Barrier **must** be at least 6 mil, able to withstand puncture and last 10 years



Best Practice

Talk to occupant about expected life of ground barrier and eventual need to replace it

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 6 mil or thicker).

- From IRC definition of *vapor retarders*:
 - Class I: ≤ 0.1 perm (called impermeable),
 - Class II: 0.1 to 1.0 perm (called semi-impermeable), and
 - Class III: >1.0 perm to 10 perms (called semi-permeable).

MH 2.0403.4c - Overlap seams

Desired Outcome:

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

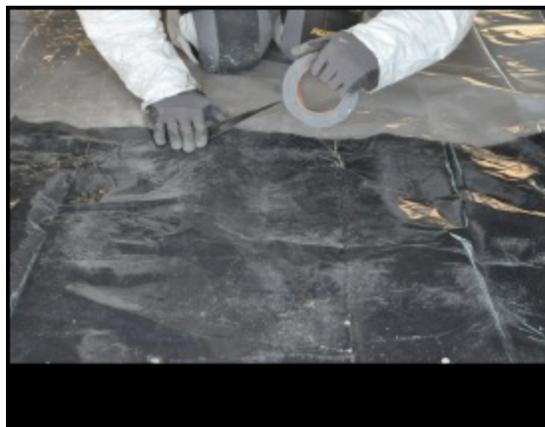
Specification(s):

When seams exist, they will be overlapped a minimum of 12 inches using reverse or upslope lapping technique

Objective(s):

Keep water under the liner

Reduce likelihood of damage at seams



In Progress

Layer moisture barrier in a reverse shingle pattern so that uphill sheeting lays under downhill

Tools:

1. Stapler
2. Utility knife
3. Drill

Best Practice

Once layered, secure seams with landscape staples or tape

Materials:

1. Landscaping staples
2. Plastic sheeting (at least 6 mil)
3. Ballast
4. Furring strips
5. Moisture-resistant adhesive tape

Two different colors of poly used to highlight different layers



Determine which direction ground slopes and, if not working from uphill down, fold back barrier at lower areas



Measure uphill barrier at least 12 inches and mark where downhill barrier should reach



Layer downhill barrier over uphill to marked position, overlapping 12 inches, in reverse shingle pattern



Fasten seam with tape or landscape staples to prevent barrier from moving and allowing moisture *infiltration*

- The moisture barrier ***must*** extend up the exterior walls and support columns at least 12 inches and be sealed with appropriate sealants.

MH 2.0403.4d - Fastening

Desired Outcome:

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

Specification(s):

Ground moisture barrier may be fastened to ground with durable fasteners

Objective(s):

Prevent movement of the ground moisture barrier



Best Practice

Taping seams with waterproof adhesive tape can prevent barrier from moving

Tools:

1. Hammer



Best Practice

Fasten moisture barrier in place using ballast or corrosion-resistant fasteners, such as landscaping staples

Materials:

1. Landscaping staples
2. Ballast
3. Water-resistant adhesive tape

MH 2.0404.2 *Crawl Spaces* — Preliminary Dehumidification

MH 2.0404.2a - Close vents

Desired Outcome:

A dry and moisture controlled space ensured

Specification(s):

Vents and other openings will be closed after ensuring sufficient combustion air for fuel burning appliances in accordance with IRC

Objective(s):

Reduce moisture load coming from outside of the *crawl space*



Before

Verify that adequate combustion air is available before closing vents



Best Practice

Closed *manufactured home* foundation vent

IRC requires 50 cubic feet of volume in spaces where combustion appliances are located for every 1,000 Btuh of input. Ensure this requirement is met before closing off *crawl space* vents.



Close vents to reduce moisture load from outdoor air

MH 2.0404.2b - Drying

Desired Outcome:

A dry and moisture controlled space ensured

Specification(s):

If liquid moisture is present, the area will be dried until any liquid moisture is eliminated

Objective(s):

Reduce moisture in the *crawl space*

Improve work environment



Before

Eliminate water in *crawl space* before work



After

Dry *crawl space*

Tools:

1. Wet/dry vacuum
2. Fan

Materials:

1. Mops
2. Towels

MH 2.0404.2c - Drying Time

Desired Outcome:

A dry and moisture controlled space ensured

Specification(s):

Space will be dehumidified until wood moisture content in solid, untreated lumber is less than 20%

Objective(s):

Reduce moisture content of wood



After correcting drainage and bulk moisture issues, use portable dehumidifiers to dry the space



After

Space has been dehumidified until moisture content in untreated lumber is less than 20%

Tools:

1. Moisture meter
2. Dehumidifier

MH 2.05 Radon

MH 2.0501 Air Sealing

MH 2.0501.2 Pier and Skirting Foundations - Venting

MH 2.0501.2a - Venting

Desired Outcome:

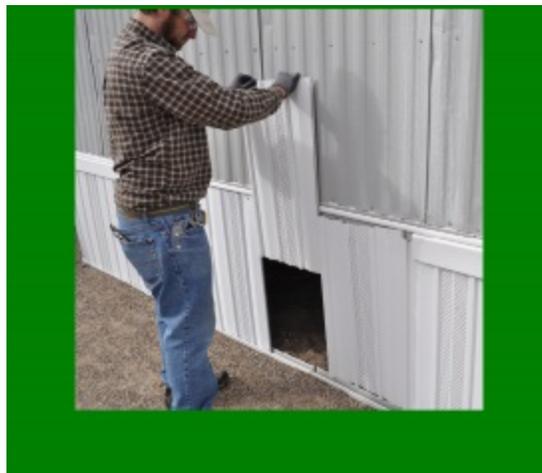
Pollutants are effectively vented

Specification(s):

Pier and skirting foundations will be vented in accordance with local climate conditions or code as required

Objective(s):

Provide ventilation for pollutant sources (e.g., moisture, radon, soil gases)



After

Use ventilated skirting as required by local code

Tools:

1. Snips
2. Circular saw with fine-toothed paneling or vinyl siding blade (reversing the

Materials:

1. Skirting panels
2. Top rails, front and back
3. Ground channels and 7-

- blade may help reduce chipping) inch spikes
3. Mallet
 4. Screw gun
 4. Screws

MH 2.0501.2b - Occupant education

Desired Outcome:

Pollutants are effectively vented

Specification(s):

Occupants will be educated on purpose, operation, and maintenance of vents

Objective(s):

Ensure vents function as intended



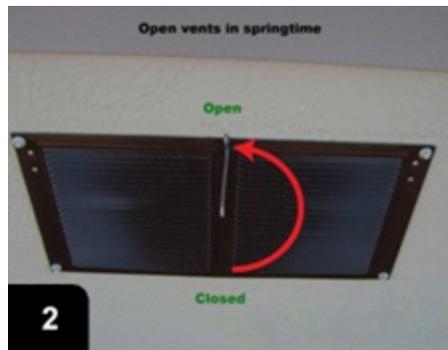
Teach homeowners how and when to operate foundation

vents

Instruct homeowners that vents are intended to provide a path to outdoors for pollutants and soil moisture. Ideal settings for vents may be climate-dependents, but typically vents may be closed throughout the fall and winter when the air is relatively dry to conserve heat. They can be reopened when warmer weather begins in spring.



Close vents in fall or winter when heating season starts



Open foundation vents in spring time when weather warms

MH 2.06 Electrical

MH 2.0602 Electric Hazards

MH 2.0602.1 Static Electric Shock

MH 2.0602.1a - Rigid fill tube

Desired Outcome:

Prevention of static electric shock to the insulation installer when using rigid tubing

Specification(s):

Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded

Objective(s):

Prevent injury to the installer



Best Practice

Rigid fill tubes should be low-conductivity and be grounded

Tools:

1. Wrench

Materials:

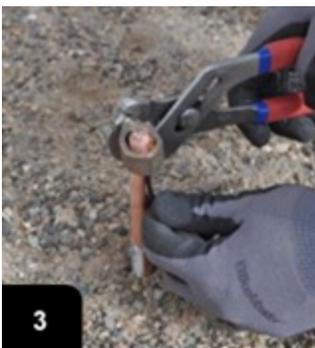
1. Couplers
2. Schedule 40 PVC fill tube
3. Grounding wire
4. Grounding rod



Select rigid fill tubes that are low conductivity – Schedule 40 PVC fill tube



Attach grounding wire to fill tubes to minimize shock risk



Attach grounding wire to rod
with coupler

Blow insulation

MH 2.0602.1b - Metal coupler grounding

Desired Outcome:

Prevention of static electric shock to the insulation installer when using rigid tubing

Specification(s):

For an additional level of protection, the metal coupler on the hose will be connected to the grounding wire

Grounding wire will be connected to the grounding rod

Grounding rod will be driven into the ground a minimum of 8' when possible; grounding wire will be connected in compliance with local code and authority having jurisdiction

Objective(s):

Divert static discharge of electricity to ground instead of installer



Unsafe

Ungrounded fill tubes can build up static electricity during insulation blowing

Best Practice

Fill tubes should be grounded to prevent electric shock to workers

MH 2.0602.2 House Current Electric Hazard

MH 2.0602.2a - Metal skin and frame grounding

Desired Outcome:

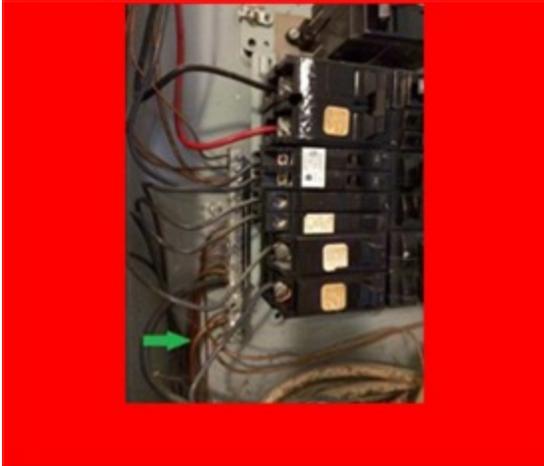
Prevention of injury to the installer and occupant, and prevent damage to the structure, if required by authority having jurisdiction

Specification(s):

Metal skin and frame will be grounded through the panel box to avoid electrical shock

Objective(s):

Prevent injury to the installer



Locate 6- or 8-gauge solid copper ground wire in panel box



Verify that the ground wire is attached to the chassis (and metal siding if so equipped)

Tools:

1. Flashlight
2. Screwdriver (to remove panel box cover)

The frame and metal siding ground wire attachment points can be found under the home below the electric service entrance and panel box.

MH 2.0602.2b - Metal fill tube grounding

Desired Outcome:

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

Specification(s):

For an additional level of protection, metal fill tube will be connected to the grounding wire

Grounding wire will be connected to the copper grounding rod that is driven into the ground a minimum of 8' when possible and required by code or authority having jurisdiction

Objective(s):

Divert house electric current to ground instead of installer in the event of contact with a live wire



Best Practice

To prevent static electric shock, a grounding rod should be utilized

Tools:

1. Sledgehammer
2. Wrench



Best Practice

Attach grounding wire to metal of fill tube, not to flexible tubing

Materials:

1. Grounding rod, at least 8'
2. Grounding wire
3. Metal coupler

4. Metal fill tube



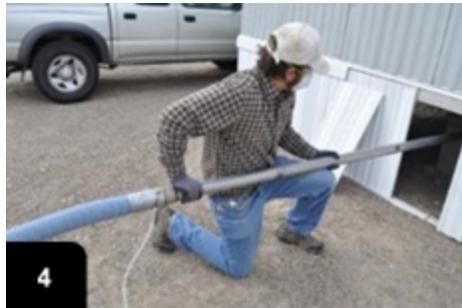
A copper grounding rod should be submerged at least 8 feet underground



Attach grounding wire to grounding rod with acorn coupler



Attach grounding wire to metal fill tube with metal coupler



Proceed with blowing insulation without fear of static shock

MH 2.0602.2c - Electrical tool safety

Desired Outcome:

Prevention of injury to the installer and occupant, and prevent damage to the structure, if required by authority

having jurisdiction

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 electric cords will not be used

Water sources (e.g., condensate pans) and electrical sources will be kept separate

Metal ladders will be avoided

Aluminum foil products will be kept away from live wires

For arc flash hazards, NFPA will be consulted

Objective(s):

Avoid electrical shock and arc flash hazards



Unsafe

Inspect house for unsafe electrical situations



Use GFCIs and three-wire extension cords for all power tools

Best Practice

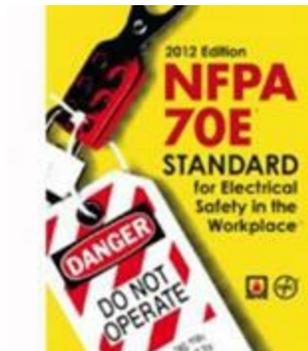
Attics and *crawl spaces* should be inspected closely for electrical safety before work begins



Electrical wiring should not be located near a water source



Use fiberglass ladders in place of metal



Follow NFPA guidelines for arc flash hazards

MH 2.0602.2d - Aluminum wiring

Desired Outcome:

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

Specification(s):

If aluminum wiring is present, work on the home will be stopped until the suspect wiring is inspected and determined to be safe by a licensed electrician

After energy retrofit is completed, wiring will be re-inspected by a licensed electrician

Objective(s):

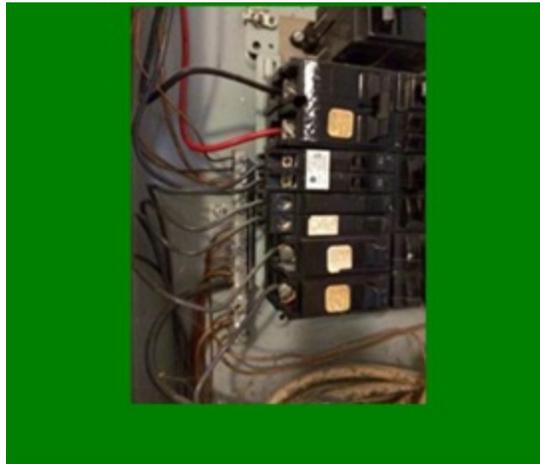
Prevent injury to installer and occupant

Prevent damage to structure



Unsafe

Have a certified electrician perform a load test before any weatherization work if aluminum wire is present.



Safe

This panel does not contain aluminum wire.

Tools:

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

Check for the presence of aluminum wire (identified by its light gray color). If aluminum wire is present, do not work on the home until a certified electrician has performed a thorough inspection and determined that the wiring is safe.



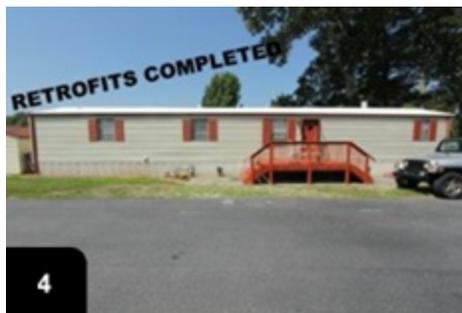
Inspect panel box for presence of (silver or gray colored) aluminum wire



Have a certified electrician inspect every aluminum wire connection in the home



After electrician verifies wiring is safe, proceed with



Perform retrofit measures

retrofit work



Perform retrofit measures.
When retrofit is complete,
have certified electrician re-
check wiring for safety

- Weatherization materials **must not** be installed over or adjacent to outlets, switches or junction boxes that contain aluminum wiring.
- If the outlet or switch has aluminum wiring, insulators **must not** be installed.

MH 3 Air Sealing

MH 3.10 Attics

MH 3.1001 Penetrations and Chases

MH 3.1001.4 General Penetrations (Electrical, HVAC, Plumbing, Vent Termination, Recessed Lighting)

MH 3.1001.4a - Work assessment

Desired Outcome:

Penetrations sealed to prevent air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Installer pre-work assessment will be conducted to determine:

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

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1001.4b - Air sealing penetrations

Desired Outcome:

Penetrations sealed to prevent air leakage and moisture movement between *unconditioned* 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 penetration or hole

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

All accessible damaged *vapor barriers* will be repaired

Penetration through the air barrier will be repaired

Objective(s):

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

Ensure sealant is effective and durable

- All materials used to seal direct penetrations **must** form a permanent and airtight seal.



Before

Gaps around floor penetrations, such as plumbing, HVAC, and electrical

Tools:

1. Headlamp
2. Caulk gun



After

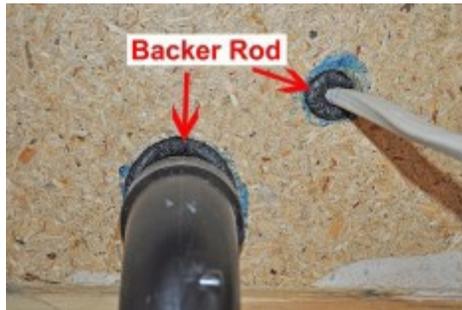
Gaps should be sealed to maintain air barrier

Materials:

1. Backer rod
2. Sealant
3. Adhesive tape
4. Plastic sheeting (at least 6 mil)



Prepare work space by



Infill with backer rod

removing any insulation



Apply appropriate caulking to ensure backing/infill does not move



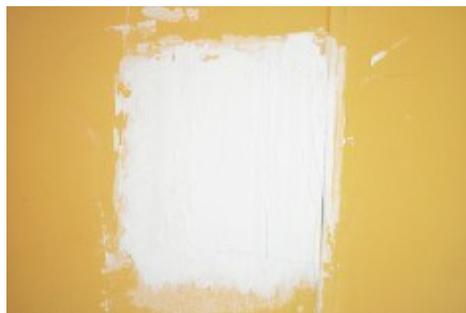
Visually inspect to verify no gaps remain



Patch holes in air and/or vapor barriers as well



Repair *vapor barrier*



Complete seal

MH 3.1001.4c - Sealant selection

Desired Outcome:

Penetrations sealed to prevent air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

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

Sealants will be compatible with all adjoining surfaces

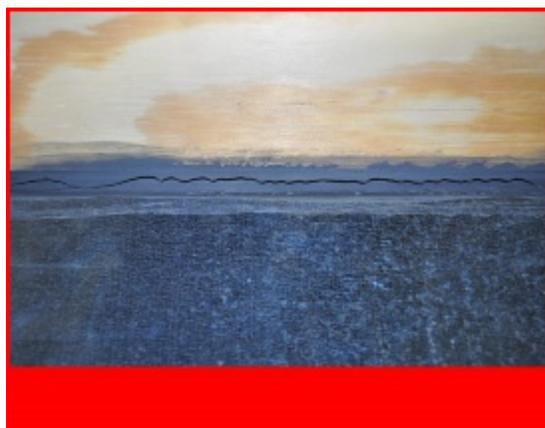
Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction

Objective(s):

Create a permanent seal

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

Create a continuous seal



Bad Practice

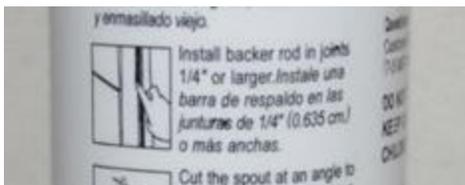
Avoid sealants that do not allow for expansion between dissimilar materials

Tools:

1. Caulk gun
2. Spray foam gun



Caulking can be used to span gaps up to 1/4 inch



Check manufacturer specifications to verify spanning capabilities

Best Practice

Flexible sealants compensate for differential expansion and maintain a seal

Materials:

1. Caulk
2. Spray foam



Spray foam can be used to span gaps up to 3 inches



Also check manufacturer specs for incompatibility with intended surfaces

- Caulking **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat sources*.
- Openings wider than 1/4 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.
- All openings from the water heater compartment into the *conditioned space* **must** be sealed with metal or 5/8" fire code gypsum.

MH 3.1001.4d - Ceiling hole repair

Desired Outcome:

Penetrations sealed to prevent air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Ceiling repair material **must** meet or exceed strength of existing ceiling material

Ceiling repair **must** span from truss to truss or add blocking

as needed for support

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

All accessible damaged *vapor barriers* will be repaired

Penetrations through the air barrier **must** be repaired

Objective(s):

Ensure ceiling is structurally sound

Minimize air leakage

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

Ensure sealant does not fall out



Before

Hole in drywall ceiling



In Progress

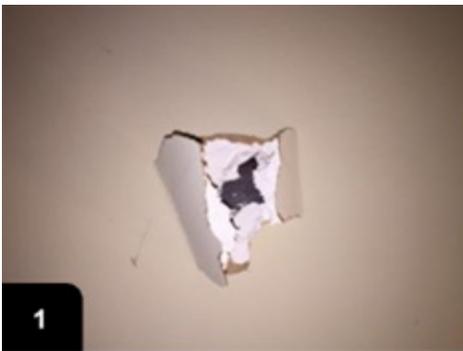
Drywall patch in place

Tools:

Materials:

1. 1/2-inch and 12-inch drywall taping knives
2. Sanding block or sanding sponge
3. Utility knife
4. Keyhole saw
5. Screw gun
1. Drywall or paneling
2. Fiberglass joint tape
3. Joint compound
4. Drywall screws
5. Support material if needed (typically 1x4, 1x6, or 2x4 dimensional lumber)

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



Replace any missing insulation and repair holes in *vapor barrier*



Prepare the hole by cutting the edges clean and square



Cut drywall and fasten in place



Add joint tape and first coat of joint compound

MH 3.1001.4e - Materials

Desired Outcome:

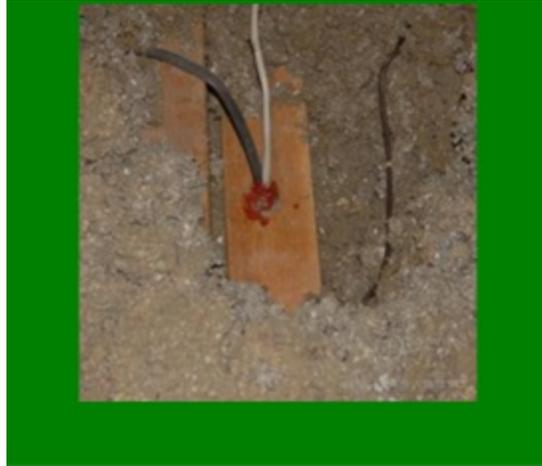
Penetrations sealed to prevent air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair



Best Practice

Choose durable, high quality sealants that are compatible with existing materials

Tools:

1. Caulking gun
2. Reusable spray foam gun
3. Utility knife

Materials:

1. Caulk
2. Foam sealant
3. Foam board
4. Drywall
5. Joint compound

- Caulking **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat sources*.
- Openings wider than 1/4 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.
- All openings from the water heater compartment into the *conditioned space* **must** be sealed with metal or 5/8" fire code gypsum.

MH 3.1001.4f - High temperature application

Desired Outcome:

Penetrations sealed to prevent air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Only noncombustible materials will be used in contact with chimneys, vents, and flues Local codes will be referenced

Objective(s):

Prevent a fire hazard

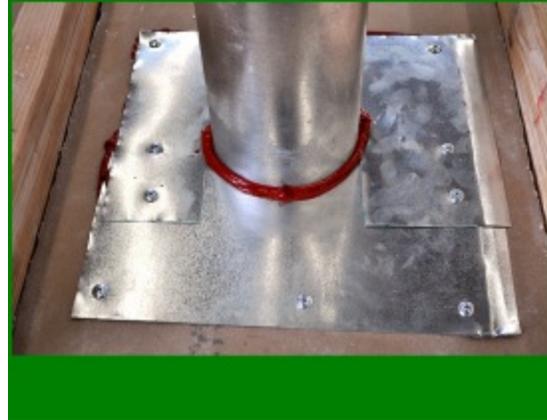


Before

Gaps around combustion exhaust flues need to be sealed

Tools:

1. Drill/screwdriver
2. Caulk gun
3. Metal snips



After

Sealed penetrations and chases should utilize high-temperature materials

Materials:

1. Fire caulk
2. Non-combustible material such as aluminum or galvanized steel flashing or cement board
3. Appropriate fasteners



Prepare work area by removing any insulation and debris

Use high-temperature caulking (600F min)



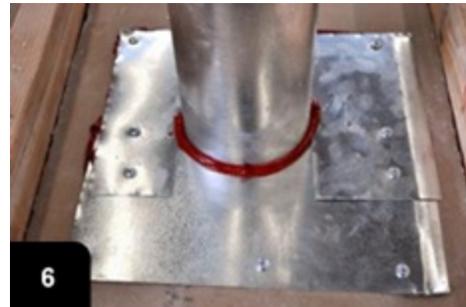
Apply first ring of caulking to match shape of opening



Apply second ring of caulking to size and shape of rigid material



Fasten rigid material and apply additional caulking



Fasten rigid material to cover penetration and seal against flue with caulk

- All openings from the water heater compartment into the *conditioned space* **must** be sealed with metal or 5/8" fire code gypsum.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat*

sources.

MH 3.11 Walls

MH 3.1101 *Manufactured Housing Walls*

MH 3.1101.1 Exterior Holes and Penetrations

MH 3.1101.1a - Work assessment

Desired Outcome:

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

Specification(s):

Installer pre-work assessment will be conducted to determine:

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

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

- All materials to seal direct penetrations ***must*** form a

permanent and airtight seal

MH 3.1101.1b - Materials

Desired Outcome:

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

Specification(s):

Like material and/or compatible materials will be used for repairs

Materials will be selected to comply with *manufactured housing* rules and regulations (e.g., Manufactured Housing Institute)

Objective(s):

Select materials to ensure durable and permanent repair



Before

Hole in exterior wall of *manufactured home* aluminum siding



After

Completed wall patch

Tools:

1. Sheet metal nibbler
2. Power saw
3. Snips
4. Screw gun
5. Caulking gun

Materials:

1. Aluminum siding or flashing
2. Oriented Strand Board (OSB) sheathing
3. Vinyl siding
4. Galvanized steel
5. Corrosion-resistant fasteners
6. High quality caulk formulated for exterior use



Replace damaged siding



Use siding that matches the existing material's contour, texture, and color

- Caulking **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** be

specifically manufactured for installation around *heat sources*.

- Openings wider than 1/4 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.
- All openings from the water heater compartment into the heated space **must** be sealed with metal or 5/8" fire code drywall.

MH 3.1101.1c - Exterior wall air sealing

Desired Outcome:

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

Specification(s):

All holes and penetrations on exterior surface of exterior walls will be sealed to ensure resistance to outdoor elements

Intentionally ventilated walls will not be sealed at vent locations (e.g., weep holes)

All holes and penetrations on the interior surface of exterior walls will be repaired

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

Objective(s):

Minimize air leakage

Maintain durability

Ensure resulting closure is permanent and supports expected load

Ensure sealant is effective and durable



Before

Hole in exterior wall of
manufactured home
aluminum siding



After

Completed wall patch

Tools:

1. Caulk gun

Materials:

1. Weatherproof caulk



Seams on aluminum siding **must** be tight.



Through the wall exhaust fan sealing.



Do not seal intentionally ventilated wall assemblies!



Backing or infill substrate may be needed for some wall patches.



Exterior electrical outlet

sealing.

- Caulking **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat sources*.
- Openings wider than 1/4 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.
- All openings from the water heater compartment into the heated space **must** be sealed with metal or 5/8" fire code drywall.

MH 3.1101.2 Interior Holes and Penetrations

MH 3.1101.2a - Work assessment

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture

movement between *unconditioned* and *conditioned space*; all repairs will maintain structural integrity

Specification(s):

Installer pre-work assessment will be conducted to determine:

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

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1101.2b - Interior wall air sealing

Desired Outcome:

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

Specification(s):

All accessible holes and penetrations in top and bottom plates will be sealed

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

Objective(s):

Minimize air leakage

Maintain durability

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

Ensure sealant is effective and durable



Before

Unsealed penetrations through top plate



After

Sealed wiring penetrations through top plate

Tools:

1. Caulking gun
2. Reusable spray foam gun

Materials:

1. Caulk
2. Spray polyurethane foam
3. Foam backer rod or pieces of fiberglass batt



Locate and expose penetrations to prepare for sealant



Use caulk or foam (approved by local code) to seal wiring penetrations through top plate



Ensure that all accessible gaps, holes, and penetrations are filled

- A maximum of \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** be checked at the end of each measure to determine its cost effectiveness.
- All materials used to seal direct penetrations **must** form a permanent and airtight seal.

MH 3.1101.2c - Materials

Desired Outcome:

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

Specification(s):

Like material and/or compatible materials will be used for repairs

Materials will be selected to comply with *manufactured housing* rules and regulations (e.g., Manufactured Housing Institute)

Objective(s):

Select materials to ensure durable and permanent repair



Before

Identify wall material and patch holes with like material, such as drywall or paneling



In Progress

Patch has been cut from drywall the same thickness as existing wall material

Tools:

1. Utility knife
2. Drill
3. Saw
4. Tape measure
5. Taping knife

Materials:

1. Drywall
2. Paneling
3. Fasteners
4. Wood for support
5. Spackle

- Caulking **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat sources*.
- Openings wider than 1/4 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.
- All openings from the water heater compartment into the heated space **must** be sealed with metal or 5/8" fire code drywall.

MH 3.1101.3 Holes, Penetrations, and Marriage Line

MH 3.1101.3a - Work assessment

Desired Outcome:

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

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Structural integrity
- Insect infestation
- Accessibility
- Number, type, size, and location of penetrations
- Identify marriage walls and lines

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1101.3b - Marriage wall air sealing of holes and penetrations

Desired Outcome:

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

Specification(s):

All accessible holes and penetrations in top and bottom plates will be sealed

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

Objective(s):

Minimize air leakage

Maintain durability

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

Ensure sealant is effective and durable



Before

Cobwebs may indicate air leaks at the marriage line



After

Completed air sealing at marriage line

Tools:

1. Caulking gun
2. Reusable spray foam gun

Materials:

1. Code approved rigid insulation board
2. Caulk
3. Spray foam
4. Foam backer rod or fiberglass batt insulation



Clean belly wrap before air sealing



Stuff wide gaps in the marriage line with fiberglass insulation or foam backer rod before applying sealant



Apply foam or caulking over backer

MH 3.1101.3c - Marriage line air sealing

Desired Outcome:

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

Specification(s):

All accessible holes and penetrations at marriage lines will be sealed continuously at end walls, floors, and ceiling

Backing or infill will be provided at the marriage line as needed

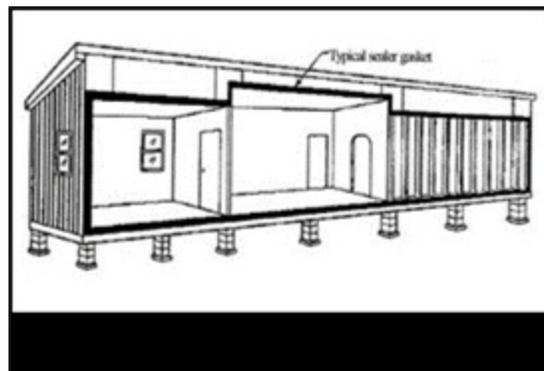
All remaining gaps will be sealed with an approved material

Objective(s):

Minimize air leakage

Maintain durability

Ensure sealant is effective and durable



Identify leaks in marriage line using a blower door

Tools:

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

Materials:

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

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



Identify leaks in marriage



Foam, caulk, and seal leaks

line using a blower door and smoke

between halves of double wide *manufactured homes*

- A maximum of \$50 in material and labor per 100 CFM^{50} reduction in air leakage may be spent in the *Nebraska Weatherization Assistance Program*. The CFM^{50} reductions **must** be checked at the end of each measure to determine its cost effectiveness.

MH 3.1101.3d - Materials

Desired Outcome:

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

Specification(s):

Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair



Before

Hole in exterior wall of
manufactured home
aluminum siding



After

Completed wall patch

Tools:

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

Materials:

1. Aluminum siding or flashing
2. Caulk (formulated for exterior use)
3. Corrosion-resistant fasteners

- Caulking **must** be paintable and **must** be clear or a color complementary to the surface to which it is applied.
- Caulking installed around heat-producing sources **must** be specifically manufactured for installation around *heat sources*.
- Openings wider than 1/4 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.
- *Spray-applied insulation* may be used as an air sealing material.
- All openings from the water heater compartment into the heated space **must** be sealed with metal or 5/8" fire code drywall.

MH 3.12 Windows and Doors

MH 3.1201 Maintenance, Repair, and Sealing

MH 3.1201.5 *Manufactured Housing* Windows and Doors

MH 3.1201.5a - Work assessment

Desired Outcome:

Windows and doors are operable, sealed, and weather-tight

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Number
- Type
- Operating condition
- Wall construction

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

- Exterior doors that are beyond repair ***must*** be replaced.
- Door insect screens may be repaired or replaced.
- Weather strips, thresholds, door bottoms and sweeps

must be replaced as directed by blower door air sealing and *infiltration* reduction.

- Broken or missing storm door glass **must** be repaired or replaced.
- Primary windows or window sashes that are beyond repair **must** be replaced.
- Window insect screens may be repaired or replaced.
- Broken or missing window glass **must** be repaired or replaced.

MH 3.1201.5b - Lead paint assessment

Desired Outcome:

Windows and doors are operable, sealed, and weather-tight

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

MH 3.1201.5c - Operable windows and doors

Desired Outcome:

Windows and doors are operable, sealed, and weather-tight

Specification(s):

All *egress windows* will be operable as required by local codes

All *egress doors* will be operable as required by local codes

Objective(s):

Maintain operability of *egress windows* and doors



Safe

Windows and doors should be free and clear of obstructions and operate smoothly with no special knowledge.



Window sill height should be no more than 44 inches from the floor.



Egress windows should be more than 24 inches high.



Egress windows should be more than 20 inches wide.



Doors should open easily from the inside, with no key or special knowledge of the locking system.



Manufactured housing should have two egress doors located away from one another. Stairs or ramps

may be needed outside.

MH 3.1201.5d - Air *infiltration*

Desired Outcome:

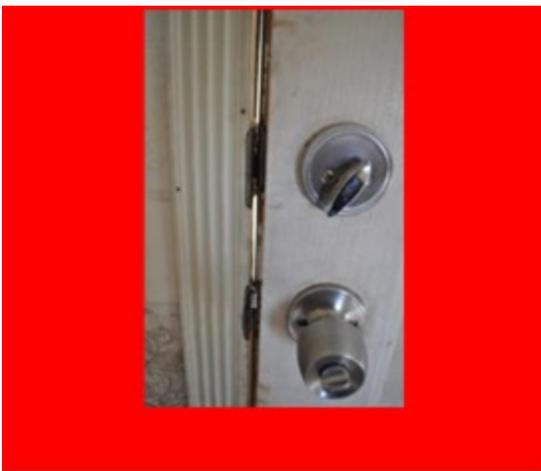
Windows and doors are operable, sealed, and weather-tight

Specification(s):

Details that reduce air *infiltration* will be repaired, replaced, sealed, or installed (e.g., plastic gliders, weather-stripping, cranks, latches, locks, knobs, thresholds)

Objective(s):

Reduce air *infiltration*



Before

Light visible through door jamb indicates air *infiltration*



After

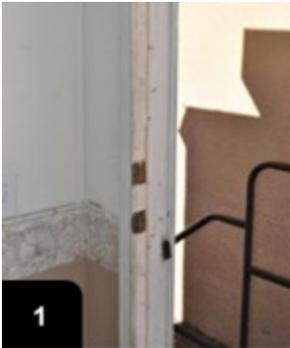
After weather-stripping and adjustment of door in jamb, air *infiltration* is eliminated

Tools:

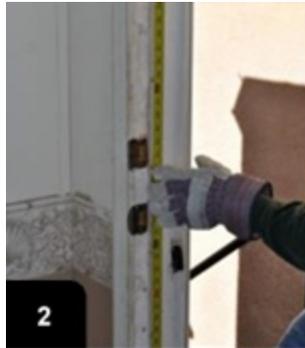
1. Drill/screwdriver
2. Utility knife
3. Tape measure
4. Caulk gun
5. Metal snips

Materials:

1. Weather-stripping
2. Door sweep
3. Fasteners
4. Caulk
5. Felt corner pads



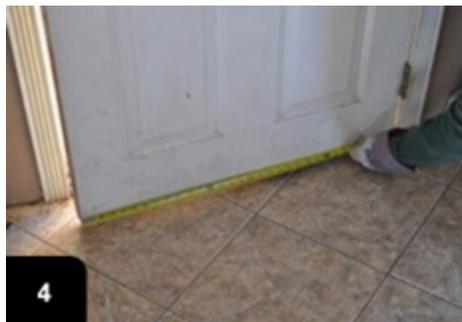
Door jamb is missing any weather-stripping



Measure door jamb for weather-stripping



Install new weather-strip



Measure bottom of door for door sweep



Install new door sweep



Adjust strike-plate and door jambs as necessary to secure a good fit



If properly adjusted, light should no longer be visible around door and air movement should no longer be detected

- 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.
- Foam or felt tape door weather-strips are not eligible for reimbursement under the NeWAP.
- **Minor** door adjustments such as tightening the hinges or

adjusting the strike plate **must** be completed.

- 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 **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 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.

- Replacement window glass **must not** be less than "B" grade single strength.
- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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 window glass are broken, the window glass **must** be replaced with a standard glass pane.

MH 3.1201.5e - Water *infiltration*

Desired Outcome:

Windows and doors are operable, sealed, and weather-tight

Specification(s):

Details that reduce water *infiltration* will be repaired, replaced, or installed (e.g., replace missing glazing on sash, exterior caulking, exterior storm windows, storm doors, drip cap, J-channel, flashing)

Objective(s):

Reduce water *infiltration*



Install and caulk drip caps over *manufactured home* windows



Install and caulk drip caps over *manufactured home* doors

Tools:

1. Caulking gun
2. Cordless driver/drill
3. Razor scraper
4. Metal snips

Materials:

1. Caulk formulated for exterior use with 20-year or greater durability
2. Glass
3. Glazing strips
4. J-channel
5. Putty tape
6. Flashing

- 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.
- Foam or felt tape door weather-strips are not eligible for

reimbursement under the NeWAP.

- **Minor** door adjustments such as tightening the hinges or adjusting the strike plate **must** be completed.
- 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 **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 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.

- Replacement window glass **must not** be less than "B" grade single strength.
- Replacement window glass **must be** tempered when required by state and local code jurisdictions.
- 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 **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 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 window glass are broken, the window glass **must** be replaced with a standard glass pane

MH 3.1201.5f - Materials

Desired Outcome:

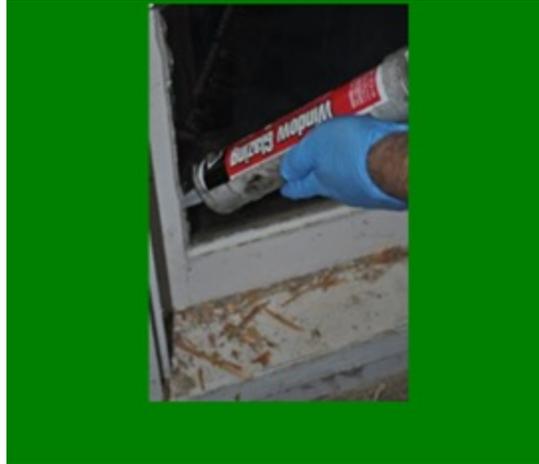
Windows and doors are operable, sealed, and weather-tight

Specification(s):

Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair



Best Practice

Read manufacturer specifications to ensure proper use of materials

MH 3.1201.5g - Quality assurance

Desired Outcome:

Windows and doors are operable, sealed, and weather-tight

Specification(s):

Windows and doors will be adjusted to properly fit the jamb and allow for ease of operation and security

Objective(s):

Ensure proper operation of the window, door, and hardware

Ensure air and watertight installation

MH 3.1201.5h - Occupant education and maintenance

Desired Outcome:

Windows and doors are operable, sealed, and weather-tight

Specification(s):

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

Objective(s):

Ensure long-term weather-tightness

MH 3.1201.6 Interior Storm Windows

MH 3.1201.6a - Work assessment

Desired Outcome:

Minimize air *infiltration* through existing leaky windows while maintaining safe egress for occupants

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Number
- Type
- Size
- Condition of opening

Objective(s):

Verify scope of work

- Broken or missing storm door glass **must** be repaired or replaced.
- One-light storms **must** be fastened with clips, full-length magnetic strips or other means that completely seal the window and allow for easy attachment and/or removal.
- Self-storing storms **must** be aluminum frame combination windows.
- If the primary window lacks a screen, the storm window **must** be installed with a screen insert.
- Storms **must not** be installed over fixed windows.

MH 3.1201.6b - Fixed storm window

Desired Outcome:

Minimize air *infiltration* through existing leaky windows while maintaining safe egress for occupants

Specification(s):

Fixed interior storm windows will not be installed in egress locations

Objective(s):

Safety



Unsafe

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



Safe

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

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

MH 3.1201.6c - Installing operable storm window

Desired Outcome:

Minimize air *infiltration* through existing leaky windows while maintaining safe egress for occupants

Specification(s):

Operable interior storm windows will be installed in accordance with manufacturer specifications

Objective(s):

Minimize air leakage

Provide safe egress for occupants



Before

No interior storm window has been installed.



After

Storm window has been installed according to manufacturer's specifications and operates smoothly.

Tools:

1. Drill

Materials:

1. Mechanical fasteners
2. Weather-stripping



Ensure the perimeter surfaces are clean and ready to accept sealant.



Install weather-strip or other appropriate sealant to the perimeter of the opening.



Install the window, ensuring it is level in the opening.



Secure the window to the opening, being sure the mechanical fasteners compress the desired sealant.



Storm window has been installed according to manufacturer's specifications

and operates smoothly.

MH 3.1201.6d - Health & safety

Desired Outcome:

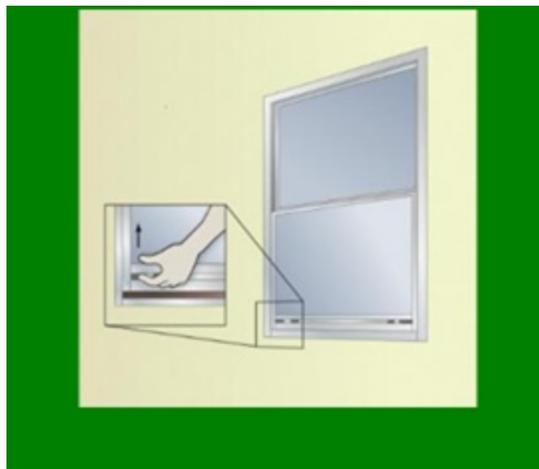
Minimize air *infiltration* through existing leaky windows while maintaining safe egress for occupants

Specification(s):

Interior storm windows will be operable and egress rated in egress locations

Objective(s):

Provide safe egress for occupants



Safe

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

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

MH 3.1201.6e - Occupant education

Desired Outcome:

Minimize air *infiltration* through existing leaky windows while maintaining safe egress for occupants

Specification(s):

Occupants will be educated on the proper use and maintenance of storm windows

Objective(s):

Ensure weather-tightness and safety

MH 3.1202 Repairing/Replacing Cracked and Broken Glass

MH 3.1202.3 Replacing Damaged Window Glass in *Manufactured Housing*

MH 3.1202.3a - Work assessment

Desired Outcome:

Glass complete and intact

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Number
- Type
- Location
- Operating condition
- Wall construction
- Size

Objective(s):

Ensure that work space is safe and ready for glass replacement

Verify scope of work

MH 3.1202.3b - Lead paint assessment

Desired Outcome:

Glass complete and intact

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

MH 3.1202.3c - Broken glass removal

Desired Outcome:

Glass complete and intact

Specification(s):

Damaged glass will be removed

Objective(s):

Safely remove old glass



Before

Broken or cracked window glass should be replaced to minimize air leakage



In Progress

Broken glass needs to be cleared away completely before installing new glass

Tools:

1. Brush
2. Dust pan

3. Vacuum
4. Utility knife
5. Gloves



1 Remove exterior stops—these will probably not be salvageable



2 Wearing protective gloves, remove large glass pieces carefully



3 Sweep up all remaining small glass slivers



4 Sash should be completely clear of debris before moving forward with installation

MH 3.1202.3d - Opening preparation

Desired Outcome:

Glass complete and intact

Specification(s):

Opening will be cleaned

Original sealant/material will be removed

Objective(s):

Prepare opening for new glass



In Progress

Remove all debris, glazing tape, and glass from sash



In Progress

Sash surface *must* be clean before mounting new glass

Tools:

1. Scraper
2. Lint-free cloth

Materials:

1. Cleaning solution or cleaning wipes



Clean all sealant and glazing off sash to return to smooth surface



Clean sash with cleaning solution and lint-free cloth. Allow to dry before applying sealant

MH 3.1202.3e - New glass installation

Desired Outcome:

Glass complete and intact

Specification(s):

Replacement glass will be sized to original width, height, and depth

Stops will be replaced or installed

Glass will be sealed in accordance with original installation design

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

Tempered or *safety glass* will be used as required by local code

Objective(s):

Install, seal, and secure new glass in place



In Progress

Sash should be completely clear debris before installing new glass

Tools:

1. Caulk gun
2. Tape measure



After

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

Materials:

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



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



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



Apply sealant to sash with bead at least 3/16" wide



Run sealant bead around entire sash to seal glass from the interior



Install new glass, ensuring



Apply glazing or install

1/8" gap from frame on all sides

replacement stops to seal window from exterior



Clean glass to ensure than no out of place adhesive or glazing remains to bake onto glass

MH 3.1203 Replacement

MH 3.1203.3 Replacement of *Manufactured Housing* Windows and Doors

MH 3.1203.3a - Work assessment

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Number
- Type
- Operating condition
- Wall construction

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

- 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.
- Damaged decorative window glass **must** be replaced with a standard glass pane.
- If the client refuses a standard window glass pane, the 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 window glass are broken, the window glass **must** be replaced with a standard glass pane.

MH 3.1203.3b - Lead paint assessment

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

MH 3.1203.3c - Window or door selection - Approved Variance

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

Window or door units will be designed for *manufactured home* use and will be ENERGY STAR[®] qualified

Rough opening will be measured before ordering replacements

Access to emergency egress points, such as primary windows or exit doors, will be considered during the selection of retrofit window or door units

In cases where the exterior walls in the manufactured home will accept house type replacement windows, they may be installed

Objective(s):

Ensure proper size, type, and operation of window or door

MH 3.1203.3d - Rough opening preparation

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

Existing units will be removed Opening will be cleaned

Any damaged framing will be replaced

Opening for installation will be prepared in accordance with manufacturer specifications

Objective(s):

Provide a clean opening for replacement unit

MH 3.1203.3e - Window and door installation

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

Window or door units will be installed in accordance with manufacturer specifications

Objective(s):

Ensure replacement window or door operates properly

Ensure replacement window or door has a weather-tight fit



Best Practice

Window is installed per manufacturer's specifications and adheres to local codes.



Best Practice

Door is installed to manufacturer's specifications and adheres to local codes.



Door has a lockset that is easily operable from the inside without a key or special instruction.



Egress doors are the proper width for egress.



Egress doors are the proper height for egress.



Windows are the proper height for egress.



Windows are the proper width for egress.



Window sill height is within code guidelines.

MH 3.1203.3f - Safety

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

Egress windows will only be replaced with egress windows

Objective(s):

Provide safe egress for occupants



Safe

*Egress window in bedroom
of manufactured house*

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

MH 3.1203.3g - Maintenance and occupant education

Desired Outcome:

Smooth operation and an airtight and weather-tight fit of replacement windows and doors

Specification(s):

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

Objective(s):

Ensure long-term weather-tightness

MH 3.13 Floors

MH 3.1301 Penetrations

MH 3.1301.1 Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Bottom Board

MH 3.1301.1a - Work assessment

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Structural integrity
- Standing water
- Raw sewage
- Insect infestation
- Pests
- Accessibility
- Number, type, size, and location of penetrations

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1301.1b - Soft bottom board repair

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Patching material will be provided as needed to meet the specific characteristics of the bottom board material and the characteristics of the hole

Patch will have a service life of a minimum of 20 years

Objective(s):

Minimize air leakage Keep insulation in place

Ensure repair materials are compatible

Ensure patch will support insulation

MH 3.1301.1c - Hard bottom board repair

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Patching will be provided as needed to meet both the specific characteristics of the bottom board material and the characteristics of the hole

Patch will not bend, sag, or move once installed

Patch will be permanent

Objective(s):

Minimize air leakage

Ensure repair materials are compatible

Minimize hole size to ensure successful use of sealant

Ensure closure is permanent and supports insulation

Ensure sealant does not fall out

MH 3.1301.1d - Bottom board penetrations

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Combustion air supplies will be labeled for identification and will not be blocked or sealed

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

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

Objective(s):

Ensure combustion equipment is not compromised

Minimize air leakage around penetrations



Before

Unsealed penetration through bottom board



After

Properly sealed penetration through *manufactured home* bottom board

Tools:

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

Materials:

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



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



Seal around penetrations with compatible materials like foam board, belly board, house wrap, or Flex Mend (tm)

MH 3.1301.1e - Materials

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Materials will be selected to comply with *manufactured housing* rules and regulations (e.g., Manufactured Housing Institute)

Surface preparation and material selected will be used or installed in accordance with product manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair

MH 3.1301.2 Electrical, HVAC, Plumbing, Gas, Dryer Vent, and General Penetrations Through Flooring

MH 3.1301.2a - Work assessment

Desired Outcome:

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

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Structural integrity
- Insect infestation
- Pests
- Accessibility
- Plumbing leaks
- Number, type, size, and location of penetrations

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1301.2b - Floor air sealing (decking, subfloor, floor decking)

Desired Outcome:

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

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 expected load

Ensure sealant is effective and durable



Gaps around floor penetrations, such as plumbing, HVAC, and electrical



Gaps should be sealed to maintain air barrier

Tools:

1. Headlamp

Materials:

1. Backer rod
2. Sealant



Prepare work space by removing any insulation



Infill with backer rod



Apply appropriate caulking to ensure backing/infill does not move



Visually inspect to verify no gaps remain

MH 3.1301.2c - Sealant selection

Desired Outcome:

Penetrations sealed to minimize air leakage and moisture

movement between *unconditioned* and *conditioned space*; all repairs will maintain structural integrity

Specification(s):

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

Sealants will be compatible with all adjoining surfaces

Sealants will be continuous and meet fire barrier specifications, if required

Objective(s):

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:

Materials:

1. Caulk gun
2. Spray foam gun

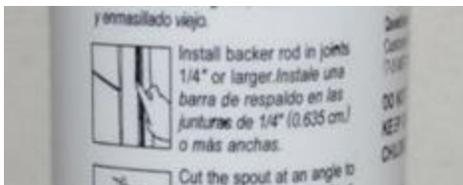


Caulking can be used to span gaps up to 1/4 inch

1. Caulk
2. Spray foam



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

MH 3.1301.2d - Floor repair

Desired Outcome:

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

Specification(s):

Floor repair material will meet or exceed strength of existing floor material

Repair will span from joist to joist and blocking added as needed to support floor

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

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

Objective(s):

Ensure floor is structurally sound

Minimize air leakage



Before

Remove floor coverings from damaged area



After

Completed floor repair

Tools:

1. Circular saw

Materials:

1. 5/8" or 3/4" oriented

- | | |
|---|---|
| 2. Reciprocating saw | strand board or plywood subflooring |
| 3. Caulking gun | 2. Polyurethane caulk |
| 4. Cordless driver/drill | 3. Construction adhesive |
| 5. Framing square | 4. 2" deck screws |
| 6. Speed square | 5. 3" deck screws |
| 7. Utility knife | 6. 8-penny galvanized ring shank or spiral shank nails |
| 8. Sawhorses | 7. 16-penny galvanized ring shank or spiral shank nails |
| 9. Clamps | 8. 2x4, or 2x6 blocking material for nailers |
| 10. Jig saw or keyhole saw | 9. Air sealing foam (one- or two-part SPF) |
| 11. Paddle bits to drill starter holes in floor | 10. Belly repair tape |

Paddle bits may be used to drill starter holes at the corners of the area to be patched. Cut the new patch 1/4" shorter than the hole in both length and width to allow room for expansion and contraction. Make sure to cut the patch so that the strength axis is perpendicular to the joists (the strong direction in plywood and OSB is parallel to the 8' length).



Carefully remove trim and floor coverings from area to be repaired



Cut out damaged area even with the inside edges of the floor joists

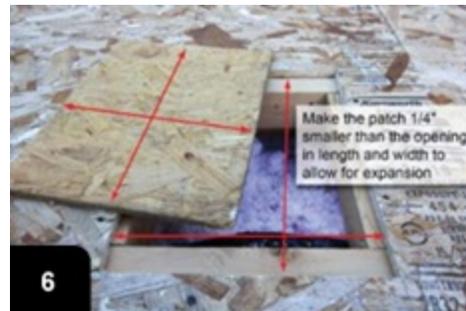
Mark the joist locations on either side of the damaged area



Cut four 2x4 blocks to support the patch



Install nailers flat against the joists. Finish by toenailing or screwing 2x4s between the joists



Make the patch 1/4" smaller than the opening in length and width to allow for expansion.



Apply subfloor adhesive to nailers



Fasten with 2" deck screws

MH 3.1301.2e - Structural materials

Desired Outcome:

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

Specification(s):

Materials will be selected to comply with *manufactured housing* rules and regulations (e.g., Manufactured Housing Institute)

Materials will be used or installed in accordance with manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair



After

Use materials with sufficient strength to span openings and support repair materials without bending or sagging

Tools:

1. Screw gun
2. Drill
3. Circular saw
4. Hammer or nail gun

Materials:

1. Typically 1x2, 1x4, 2x4, or 2x6 dimensional lumber. Steel angle may also be used to create sturdy repairs
2. Nails
3. Screws
4. Nuts, bolts, and washers
5. Staples

MH 3.1301.2f - High temperature application

Desired Outcome:

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

Specification(s):

Only noncombustible materials will be used in contact with chimneys, combustion exhaust vents, and flues

Objective(s):

Prevent a fire hazard



Before

Gaps around combustion exhaust flues need to be sealed

Tools:

1. Drill/screwdriver
2. Caulk gun



After

Sealed penetrations and chases should utilize high-temperature materials

Materials:

1. Fire caulk
2. Non-combustible material

3. Metal snips

such as aluminum or galvanized steel flashing or cement board

3. Appropriate fasteners



Prepare work area by removing any insulation and debris



Use high-temperature caulking (600F min)



Apply first ring of caulking to match shape of opening



Apply second ring of caulking to size and shape of rigid material



5
Fasten rigid material and apply additional caulking



6
Fasten rigid material to cover penetration and seal against flue with caulk

MH 3.1302 Floor Framing

MH 3.1302.1 Floor Framing - Bay Window

MH 3.1302.1a - Work assessment

Desired Outcome:

Floor/framing around bay windows sealed and weather-tight

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Accessibility
- Number
- Type
- Size
- Operating condition
- Condition of opening

- Wall construction type

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1302.1b - Lead paint assessment

Desired Outcome:

Floor/framing around bay windows sealed and weather-tight

Specification(s):

Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise; documentation of testing results will be kept on file

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.

See [2.0100.1p - Lead paint assessment](#) for steps and photos.

MH 3.1302.1c - Air *infiltration*

Desired Outcome:

Floor/framing around bay windows sealed and weather-tight

Specification(s):

Details that reduce air *infiltration* will be repaired, replaced, sealed, or installed

Bay window floor framing that connects interior to exterior underpinning and insulation **must** be removed to seal gaps, cracks, and joints

Blocking **must** be installed on perimeter rail (rim joist) if missing

Seal all gaps, cracks, and joints of all framing in bay window assembly

Insulation **must** be replaced or installed in full contact with subfloor

Underpinning will be replaced and sealed

Objective(s):

Reduce air *infiltration*

MH 3.1302.1d - Water *infiltration*

Desired Outcome:

Floor/framing around bay windows sealed and weather-tight

Specification(s):

Details that reduce water *infiltration* will be repaired, replaced, or installed

Objective(s):

Reduce water *infiltration*

MH 3.1302.1e - Materials

Desired Outcome:

Floor/framing around bay windows sealed and weather-tight

Specification(s):

Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):

Ensure proper use and installation of materials

MH 3.14 *Basements and Crawl Spaces*

MH 3.1488 *Special Considerations*

MH 3.1488.2 *Skirting Manufactured Homes*

MH 3.1488.2a - *Work assessment*

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Type (ventilated or unventilated, insulated or non-insulated)
- Extent of repair/replacement
- Accessibility
- Moisture and drainage
- Structural integrity of foundation (e.g., piers and supports)
- Structural integrity of perimeter rail/rim joist
- Integrity of existing skirting support material
- Presence of infestation or pests

Problems will be corrected before skirting work begins

Objective(s):

Ensure work space is safe and ready for repair or installation

Verify scope of work

MH 3.1488.2b - Repair and installation

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Manufacturer specifications will be followed when applicable

No exposed wood will be left unfinished (e.g., wood to be painted, sealed, treated)

If framing is required for skirting, framing will be structurally sound

Skirting will be installed to allow for movement (e.g., no screws or nails directly through panels)

Skirting installation will allow for expansion, contraction, and frost heaving

Objective(s):

Match existing skirting

Provide resistance from outdoor elements

Limit pest access

MH 3.1488.2c - Venting

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Venting will be in accordance with local climate conditions or code as required

Objective(s):

Achieve and maintain building durability

MH 3.1488.2d - Insulated skirting

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Insulated skirting may be installed where belly is inaccessible and not repairable

Objective(s):

Reduce conductive heat loss through floor assembly

MH 3.1488.2e - Flashing

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Flashing or proper caulking will be installed between skirting and *manufactured home*, if required by authority having jurisdiction

Objective(s):

Prevent water penetration

MH 3.1488.2f - Materials

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Like material and/or compatible materials will be used for repairs (e.g., galvanized metal, aluminum, alkaline copper quaternary treated lumber)

Selected materials will be corrosion resistant

Objective(s):

Achieve/increase durability

MH 3.1488.2g - Fasteners

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Like material and/or compatible materials will be used for repairs (e.g., galvanized metal, aluminum, alkaline copper quaternary treated lumber)

Fasteners will be corrosion resistant

Objective(s):

Achieve/increase durability

MH 3.1488.2h - Structural

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Existing skirting support material will be structurally sound and completely intact; any damaged framing will be replaced

Objective(s):

Provide adequate support

MH 3.1488.2i - Skirting stiffener/high wind support

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Skirting support (e.g., vinyl blowout rods, horizontal bracing)

for other types) will be placed in high- wind locations

Objective(s):

Increase strength to resist wind loading

MH 3.1488.2j - Occupant education

Desired Outcome:

Wind, weather, debris, and pests are excluded from the underside of the home

Specification(s):

Occupants will be educated on maintenance of skirting (e.g., floating panels are not tightly screwed to framing, string trimmers may damage skirting)

Objective(s):

Increase durability

MH 3.16 Ducts

MH 3.1601 Duct Preparation

MH 3.1601.4 Support for Horizontal, Suspended Ducts

MH 3.1601.4a - 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 where feasible in accordance with flex duct manufacturer specifications and local codes

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)

Metal ducts will be supported by metal strapping, rods, or other materials, where feasible

Objective(s):

Eliminate falling and sagging

MH 3.1601.5 Preparation and

Mechanical Fastening

MH 3.1601.5a - Preparation

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

Surrounding insulation will be cleared to expose joints being sealed; salvage for reuse if possible Duct surface to receive sealant will be cleaned

Objective(s):

Gain access while maintaining insulation value

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



Before

Locate disconnected or damaged ducts and clean work area of debris



After

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

Materials:

1. Cleaning solution or cleaning wipes



When making connections at interior walls, mastic should be applied to boot and wall, and allowed to dry entirely

MH 3.1601.5b - Metal to metal

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

Ducts will be fastened with a minimum of three equally spaced screws

Objective(s):

Ensure durable joints



Before

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

Tools:

1. Drill



After

At minimum, use three fasteners evenly spaced

Materials:

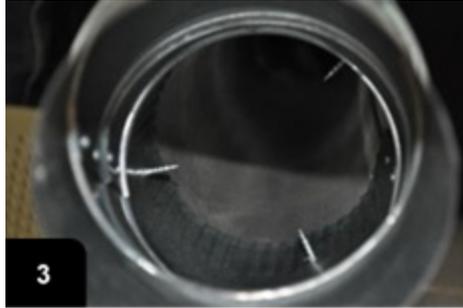
1. Fasteners



Realign and join ducts to create a smooth transition



Use fasteners to hold duct together and prevent future dislocation



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

MH 3.1601.5c - Flex to metal

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

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

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

All connections, regardless of fastener, will be sealed

Objective(s):

Ensure durable joints



Before

Disconnected ducts are useless and need to be reconnected and securely fastened

Tools:

1. Band tensioner
2. Brush



After

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

Materials:

1. Tie bands
2. Mastic or other appropriate sealant



Apply mastic to flange



Slide inner liner onto flange with sealant



Using band tensioner, securely attach liner in place with tie band



Slide insulation and outer casing over metal ducting



Extend insulation and casing until in contact with other insulation



Secure insulation and casing in place using tie band and band tensioner

MH 3.1601.5d - Duct board to duct board

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

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

Objective(s):

Ensure durable joints

MH 3.1601.5e - Duct board to flexible duct

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

Metal take-off collar specifically designed for the thickness of the duct board will be used All finger tabs will be bent down securely

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

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

Objective(s):

Ensure durable joints

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



Bad Practice

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

Tools:

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



Best Practice

Flex duct, starting collar, and backer ring installed and sealed to duct board

Materials:

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

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

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



1 Gather materials



2 Place backer ring inside duct board. Insert collar and bend tabs into place.



3 Fasten the collar to the backer ring by driving at least three equally spaced screws through the collar, duct board



4 Coat joint between starting collar and duct board with mastic. Liberally coat the metal collar where flex attaches



Slide flex duct liner over mastic-coated metal collar



Secure with properly tensioned zip tie.



Coat seam with mastic



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

MH 3.1601.5f - Duct board plenum to air handler cabinet

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

Flange/c-channel will be fastened with screws with the duct board installed between c-channel flanges

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

Objective(s):

Ensure durable joints



Best Practice

Duct board plenum fastened with C-channel and screws

Tools:

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

Materials:

1. Fiberglass duct board
2. C-channel (same width as duct board)
3. Sheet metal screws longer than the duct board thickness
4. Foil tape (for assembling duct board)
5. Mastic
6. Mesh tape (for gaps larger than 1/4")
7. Flex duct

8. Zip ties
9. Starting collar

MH 3.1601.5g - Boot to wood

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

Predrill for screws or use ring shanked nails to fasten boot to wood

Objective(s):

Ensure durable joints



Before

Unattached ducts are useless



After

Damaged ducts should be repaired and securely fastened and sealed

Tools:

1. Drill
2. Hammer

Materials:

1. Metal screws
2. Ring-shank nails



Replace damaged ducting if necessary



Use ring-shank nails to hold ducting in place to subfloor



Drill pilot holes for metal fasteners



Use metal fasteners to secure duct to subfloor



After securely fastened, duct should be sealed with mesh and mastic

MH 3.1601.5h - Boot to gypsum

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

Specification(s):

If accessible, boot hanger will be fastened to adjacent framing with screws or nails. Boot will be connected to boot hanger with screws.

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

Objective(s):

Ensure durable joints



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

Tools:

1. Caulking gun or foam gun
2. Cordless driver/drill

Materials:

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

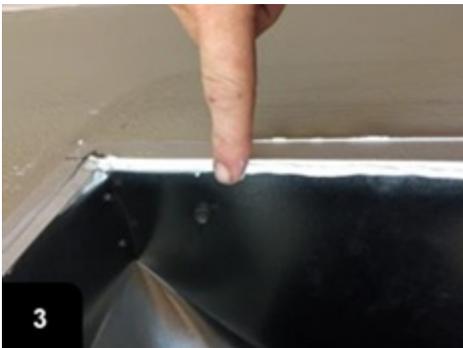
Fasten boot hangers to adjacent framing, or screw through the boot into adjacent framing. Polyurethane caulk is a durable adhesive, and can accommodate up to 50% expansion and contraction. Mastic and mesh tape also form a strong, permanent seal. Spray foam may be used to seal boots into the opening once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



Remove diffuser



Caulk the boot to the gypsum board. Angle the tip forward and force caulk into the joint



Wipe the caulk into the joint and smooth it as you go



Wipe away excess caulk (use water on siliconized acrylic, alcohol on silicone, and solvent on polyurethane caulk)

MH 3.1601.5i - Duct board to flex

Desired Outcome:

Ducts and plenums properly fastened to prevent leakage

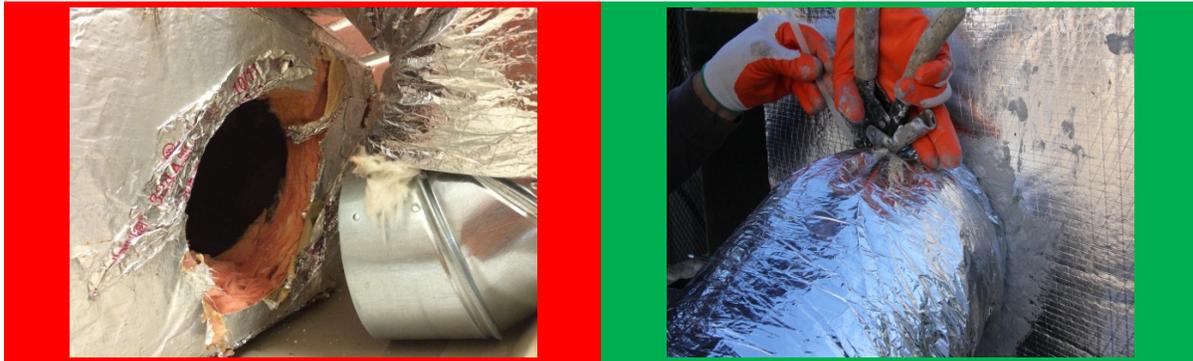
Specification(s):

Metal take-off collar with a hip and an internal metal backer will be used

Take-offs will be in accordance code Requirements

Objective(s):

Ensure durable joints



Bad Practice

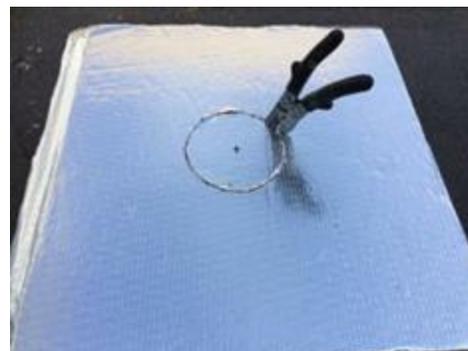
Improper attachment of flex to duct board

After

Flex duct correctly installed and sealed to duct board



Select a backer ring and flex duct installation tools



Cut the proper size hole in duct board



Select starting collar with tabs matching the thickness of the duct board



Insert the starting collar, bend tabs over and install at least 3 screws through the collar, duct board, and backer ring



Starting collar with tabs bent over and screws through the duct board and backer ring



Apply mastic liberally and install flex duct

MH 3.1602 Duct Sealing

MH 3.1602.8 Supply Plenum (Furnace to Trunk Duct Connection) in Both Upflow

and Downflow Air Handler Configurations

MH 3.1602.8b - Preparation

Desired Outcome:

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

Specification(s):

Debris will be removed

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

Floor will be prepared to receive the appropriately sized plenum

Objective(s):

Provide unobstructed path for work access and air flow
Ensure adhesion of materials to be installed

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



After

Closet prepared for furnace installation

Tools:

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

Materials:

1. Rags



Dust walls and floor of cabinet. Sweep debris into



Vacuum cabinet clean

piles for pickup. Wipe down walls and floor



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



Scrape loose material from insides of cabinet



Apply mastic to inside seams of plenum

MH 3.1602.8c - Plenum rebuild or repair

Desired Outcome:

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

Specification(s):

Plenum will be rebuilt or repaired using compatible materials and will be:

- Mechanically fastened
- Sealed
- Durable
- Structurally sound
- Insulated
- Equipped with a *vapor retarder* where climate appropriate
- If possible, flow diverter or turning vanes will be installed for air flow and/or balancing (e.g., bullhead Ts, offset air handler)

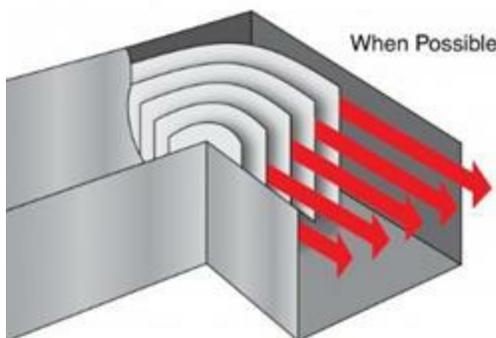
Objective(s):

Minimize restrictions

Maximize air flow and air distribution

Minimize moisture issues

Prevent condensation on plenum



Best Practice

Whenever possible, install



In Progress

Rebuilding and sealing a

turning vanes in plenums to
reduce turbulence and
improve airflow

leaky existing plenum

Materials:

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

Using turning vanes reduces turbulence and increases air flow. Use mastic and mesh tape on the outside of duct board plenums. Properly install metal starting collars to duct board and flex duct to metal collars (see [MH 3.1601.5e - Duct board to flexible duct](#) for details)

MH 3.1602.8d - Repair work access

Desired Outcome:

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

Specification(s):

Point of access options include:

Option 1: Through the trunk duct

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

Option 2: Remove *crossover duct*

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

Option 3: Remove air handler

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

Option 4: Through the furnace panel

- Replace and seal panels

Objective(s):

Repair work access

Prevent condensation

Minimize heat loss and heat gain from plenum



After

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

Tools:

1. Utility knife
2. Saw
3. Pry bar
4. Screw gun
5. Hammer
6. Drill
7. Disposable brushes

Materials:

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

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

Always wear hand protection when working with sharp objects.



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



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



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



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



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



Plenum to duct trunk
connection coated with
mastic sealant

MH 3.1602.8e - Safety testing

Desired Outcome:

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

Specification(s):

Equipment will be cycled

Combustion appliance zone (CAZ) test will be performed where combustion appliances are utilized

Objective(s):

Verify operation

Identify unsafe equipment operating conditions

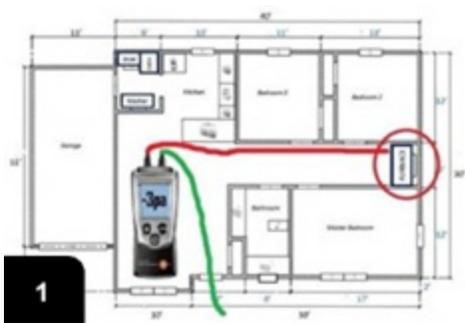


Unsafe

Conduct spillage and depressurization testing at the end of the work day

Tools:

1. Manometer
2. Smoke pencil
3. Mirror
4. Stopwatch or watch with second hand



Run depressurization test at



Complete spillage test using

the end of the work day

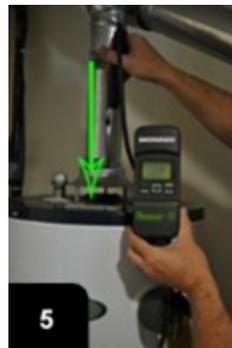
chemical smoke pencil or mirror



Test for spillage on all sides of draft diverter. Check spillage on all atmospheric combustion appliances



Check carbon monoxide levels on all combustion appliances, including direct vent equipment



Check carbon monoxide levels on all combustion appliances

MH 3.1602.8f - Performance testing

Desired Outcome:

Deliver all air from air handler to the trunk duct without

leakage or restriction

Specification(s):

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

Objective(s):

Document post-retrofit duct leakage test has been performed



Best Practice

Test duct performance using pressure pan or duct blaster, before and after work

Tools:

1. Duct blaster
2. Blower door
3. Manometer
4. Pressure Pan



Best Practice

Record readings before and after to determine improvement in performance

Materials:

1. Duct mask



Perform duct blaster testing before beginning work. Record results



Perform duct blaster testing after completion of work and compare to 'before reading. Record results



Set-up blower door to perform pressure pan testing before and after work



Perform pressure pan test on ductwork before beginning work. Record result



Perform pressure pan test after work is completed and compare to 'before' reading

Record test results to determine improvement of performance

MH 3.1602.9 *Crossover Ducts*

MH 3.1602.9a - Work assessment

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Location
- Types
- Leakage points

Objective(s):

Verify scope of work



In Progress

Locate the best access and egress points



In Progress

Locate *crossover duct* and determine what type of system will work best for home

MH 3.1602.9b - Flexible *crossover duct* connections

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

Flexible *crossover duct* connections will be added, rebuilt, or repaired using compatible materials and will be:

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

Whenever possible, rigid elbow or equivalent will be installed

in *crawl space crossover ducts*

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

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

New flex duct installation will be insulated to a minimum of R-8

When feasible, 26-gauge hard duct should be installed

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

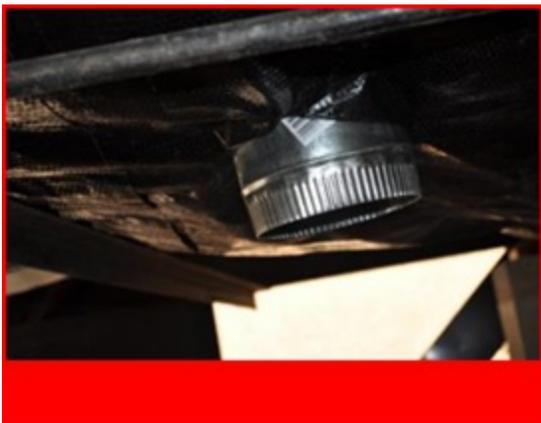
Objective(s):

Ensure lasting durable connections

Minimize air leakage and heat transfer

Maintain duct diameter around the turns

Maximize air flow and distribution



Before

Unattached ducts are



After

Crossover ducts should be

useless

attached securely, sealed to reduce leakage, and insulated to R-8

Tools:

1. Band tensioner
2. Drill
3. Brush

Materials:

1. Tie bands
2. Mastic or other appropriate sealant
3. Elbow duct
4. R-8 (min)insulated flexible duct with *vapor retarder*



Attach elbow duct and orient in correct direction to minimize duct run



Fasten elbow in place with at least three evenly-spaced fasteners



3
Apply mastic at metal-to-metal connection



4
Apply mastic to all elbow joints and flange



5
Slide inner liner onto flange with sealant



6
Fasten inner liner with tie band using band tensioner



7
Extend insulation and exterior casing up over elbow until they reach belly



8
Secure insulation and exterior casing place with tie band



Use band tensioner to ensure that insulation and casing remain tight against belly

MH 3.1602.9c - Support

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

Crossover ducts will be installed so they are not in contact with the ground

Crossover ducts will be supported in accordance with flex duct manufacturer specifications, local codes

Support materials will be applied in accordance with manufacturer specifications for interior dimensions and will not crimp ductwork, dip, or sag

Objective(s):

Maximize air flow and distribution

Minimize condensation

Minimize air leakage and heat transfer



Before

Flexible ducting should not come in contact with ground

Tools:

1. Drill
2. Utility knife



After

Supports should be evenly spaced, securely fastened to floor joists and should not compress or kink duct

Materials:

1. Fabric straps
2. Fasteners

MH 3.1602.9d - Through-the-rim *crossover duct*

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

Through-the-rim *crossover ducts* will be located and accessed through the bottom liner and branch duct; all branch *crossover duct* connections and end caps will be located and accessed

Hole size (air pathway) will be maximized between branch crossover and trunk

All connections will be mechanically fastened and sealed inside duct

End caps will be sealed

Objective(s):

Ensure all connections are identified

Maximize air flow and distribution

Ensure lasting durable connections

Minimize air leakage

MH 3.1602.9e - Repair work access for through-the-rim crossover

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

Access hole in the trunk duct will be repaired and sealed

Insulation will be reinstalled

Bottom liner/belly will be repaired

Objective(s):

Repair work access

Minimize heat transfer

MH 3.1602.9f - Attic crossover

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

Access to the attic will be created for all attic areas that contain *crossover ducts*, where feasible

Plenum boxes and *crossover duct* connections will be rebuilt, mechanically fastened, and sealed

Access holes will be repaired

Objective(s):

Ensure lasting durable connections

Minimize air leakage

Maximize air flow and distribution

Repair work access

MH 3.1602.9g - Combustion Appliance Zone (CAZ) testing

Desired Outcome:

Deliver all air from trunk to trunk without leakage or

restriction

Specification(s):

CAZ testing will be performed where combustion appliances are utilized

Objective(s):

Identify unsafe equipment operating conditions



See
[SWS 2.0101.1a - 2.0201.1e](#)
for CAZ testing

Best Practice

Complete *combustion appliance zone* testing to ensure a healthy, safe environment

Tools:

1. Manometer
2. Mirror
3. Chemical smoke puffer
4. Stopwatch or watch with second hand
5. Gas leak detector
6. Combustion analyzer

7. 1/4" air line tubing

At the end of each day in which duct sealing or repair is performed, conduct *combustion appliance zone* (CAZ) testing in accordance with the NREL Standard Work Specifications, details [2.0201.1a through 2.0201.1e](#).

MH 3.1602.9h - Performance testing

Desired Outcome:

Deliver all air from trunk to trunk without leakage or restriction

Specification(s):

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

Objective(s):

Document post-retrofit duct leakage test has been performed



Best Practice

Test duct performance using pressure pan or duct blaster, before and after work

Tools:

1. Duct blaster
2. Blower door
3. Manometer
4. Pressure Pan



Run duct blaster test before beginning work and record result

Best Practice

Record readings before and after to determine improvement in performance

Materials:

1. Duct mask



Run duct blaster test after work and compare with 'before' reading. Record result



Set-up blower door to perform pressure pan testing



Perform pressure pan test on ductwork before beginning work. Record result



Perform pressure pan test after work is completed and compare to 'before' reading



Record readings before and after to determine if performance has improved

MH 3.1602.10 Hard and Flex Branch Ducts

MH 3.1602.10a - Work assessment

Desired Outcome:

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

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Location
- Connection types
- Leakage points

Access holes will be created for the work done at each location

Objective(s):

Verify scope of work

Gain access to duct connections

MH 3.1602.10b - Reduce excess flex duct length

Desired Outcome:

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

Specification(s):

Excess flex duct will be removed between the takeoff at trunk and floor register boot

Objective(s):

Improve air flow



Before

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



After

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

MH 3.1602.10c - Duct connection repairs

Desired Outcome:

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

Specification(s):

Hard and flex duct branch connections will be rebuilt or repaired using compatible materials and will be mechanically fastened and sealed

Ends will be sealed

Objective(s):

Ensure lasting durable connections

Minimize air leakage

Maximize air flow and distribution



In Progress

Here the worker is rebuilding a hard connection to the trunk line.

Tools:

1. Drill
2. Tin snips
3. Inspection mirror
4. Utility knife



After

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

Materials:

1. Metal boot material
2. Mesh tape
3. Mastic
4. Replacement grille



Measure the dimensions required for the new boot.



Fit the new boot on to the trunk line.



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



Mechanically fasten the boot to the subfloor.



Install a new grille on the rebuilt boot.

MH 3.1602.10d - Repair work access

Desired Outcome:

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

Specification(s):

Access hole in the trunk/branch duct will be repaired and sealed

Insulation will be reinstalled

Bottom liner/belly will be repaired

Objective(s):

Repair work access

Minimize heat transfer



Before

Tools:



After

Materials:

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

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



Thoroughly clean duct with solvent before applying foil tape and mastic



Secure edges of repair with foil tape and then liberally coat with mastic



Overlap foil tape with mastic by at least one inch on all sides



Apply belly repair tape and fasten with outward clinching (stitch) staples.



Spray adhesive will help adhere the tape

MH 3.1602.10e - *Combustion Appliance Zone (CAZ)* testing

Desired Outcome:

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

Specification(s):

CAZ testing will be performed where combustion appliances

are utilized

Objective(s):

Identify unsafe equipment operating conditions



See
[SWS 2.0101.1a -](#)
[2.0201.1e](#)
for CAZ testing

Best Practice

Complete *combustion appliance zone* testing to ensure a healthy, safe environment

Tools:

1. Manometer
2. Mirror
3. Chemical smoke puffer
4. Stopwatch or watch with second hand
5. Gas leak detector
6. Combustion analyzer
7. 1/4" air line tubing

At the end of each day in which duct sealing or repair is performed, conduct *combustion appliance zone* (CAZ) testing in accordance with the NREL Standard Work Specifications, details [2.0201.1a through 2.0201.1e](#).

MH 3.1602.10f - Performance testing

Desired Outcome:

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

Specification(s):

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

Objective(s):

Document post-retrofit duct leakage test has been performed



Best Practice



Best Practice

Test duct performance using pressure pan or duct blaster, before and after work

Record readings before and after to determine improvement in performance

Tools:

1. Duct blaster
2. Blower door
3. Manometer
4. Pressure Pan

Materials:

1. Duct mask



Perform duct blaster testing before beginning work.
Record results



Perform duct blaster testing after completion of work and compare to 'before reading.
Record results



Set-up blower door to perform pressure pan testing before and after work



Perform pressure pan test on ductwork before beginning work. Record result



Perform pressure pan test after work is completed and compare to 'before' reading



Record test results to determine improvement of performance

MH 3.1602.11 Air Sealing System

MH 3.1602.11a - New component to new component sealant selection

Desired Outcome:

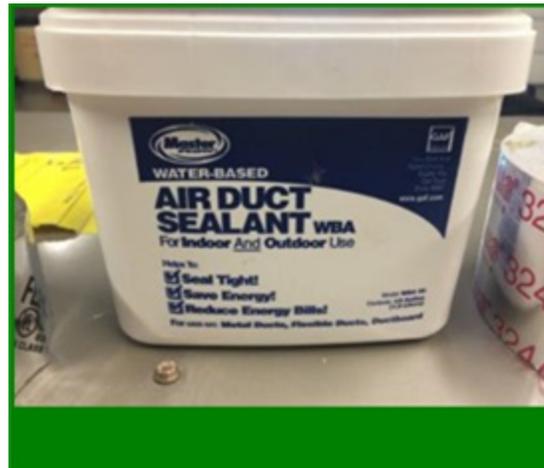
Ducts and plenums sealed to prevent leakage

Specification(s):

Any closure system used will meet or exceed applicable standards

Objective(s):

Ensure effectiveness of air sealing system



Mastic sealant is an approved, durable, and effective sealant

Tools:

1. Utility knife
2. Disposable brushes

Materials:

1. Fiberglass mesh tape (use, along with mastic, to cover gaps wider than 1/4-inch and to add strength to assemblies)
2. Mastic (air duct sealant)
3. Spray polyurethane foam

Seal and mechanically fasten all duct connections to metal flanges. Fasten round metal ducts with at least three screws equally spaced around the diameter, and make sure that the ducts and fittings are inserted at least 1 inch. DO NOT USE unlisted duct tape as a sealant on any duct.

Exceptions:

- . Spray polyurethane foam shall be permitted to be applied without additional joint seals.
- . Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
- . Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.



Use fiberglass mesh tape to cover gaps; coat with at least 2 mm of mastic



Coat seams with mastic (air duct sealant)



Use tape to assemble joints, then coat with at least 2 mm of mastic

MH 3.1602.11b - New component to existing component

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

Duct surface to receive sealant will be cleaned

Seams, cracks, joints, holes, and penetrations less than 1/4" will be sealed using fiberglass mesh and mastic

Mastic alone will be acceptable for holes less than 1/4" that are more than 10 feet from air handler

Holes greater than 3/4" will be patched with metal or joint will be rebuilt to reduce the gap size

Seams, cracks, joints, holes, and penetrations between 1/4" and 3/4" will be sealed in two stages:

- They will be backed using temporary tape (e.g., foil tape) as a support before 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 (fiberglass mesh and mastic) to the duct

Reinforce seal

Support mastic and fiberglass mesh during curing



Before

Unsealed metal ductwork



After

Mastic and mesh tape used to seal metal ductwork

Tools:

1. Zip tie tensioning tool
2. Utility knife
3. Disposable brushes
4. Tin snips

Materials:

1. Mastic
2. Fiberglass mesh tape
3. Metal starting collar
4. Foil tape

5. Screw gun



1
Fasten collar into plenum with screws that reach through the tabs and plenum into a backing ring. Apply mastic liberally

5. Sheet metal



2
Apply mastic to metal collar



3
Install duct liner onto collar and secure with properly tensioned zip tie



4
Apply additional mastic over zip tie and edge of flex duct liner

MH 3.1602.11c - Existing component to existing component

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

Duct surface to receive sealant will be cleaned

Fiberglass mesh and mastic will overlap temporary tape by at least 1 inch on all sides

Seams, cracks, joints, holes, and penetrations larger than 3/4" will be repaired using rigid duct material

Fiberglass mesh and mastic will overlap repair joint by at least 1 inch 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 mastic and fiberglass mesh during curing



Before



After

Tools:

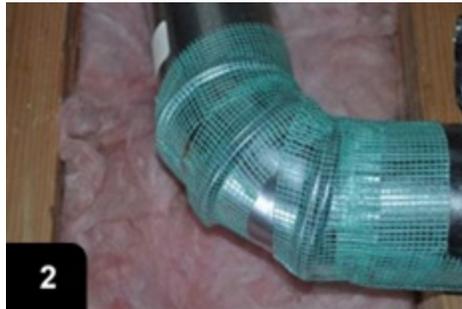
1. Brush

Materials:

1. Mastic
2. Fiberglass mesh tape



Prepare work area by assessing any safety concerns and cleaning duct surface



Wrap joint with fiberglass mesh tape



Apply mastic to seal joint

MH 3.1602.11d - Performance testing

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

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

Objective(s):

Document post-retrofit duct leakage performed



Best Practice

Test duct performance using pressure pan or duct blaster, before and after work

Tools:

1. Duct blaster
2. Blower door
3. Manometer
4. Pressure Pan



Perform duct blaster testing before beginning work.
Record results

Best Practice

Record readings before and after to determine improvement in performance

Materials:

1. Duct mask



Perform duct blaster testing after completion of work and compare to 'before reading.
Record results



Set-up blower door to perform pressure pan testing before and after work



Perform pressure pan test on ductwork before beginning work. Record result



Perform pressure pan test after work is completed and compare to 'before' reading



Record test results to determine improvement of performance

MH 3.1602.12 Air Sealing System Components

MH 3.1602.12a - Duct boot to interior surface

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

Gaps between boot and gypsum less than a 1/4" will be sealed using mastic or appropriate flexible caulking

Gypsum edge will be wetted before applying mastic

Objective(s):

Prevent air leakage



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:

1. Utility knife
2. Spray bottle
3. Putty knife

Materials:

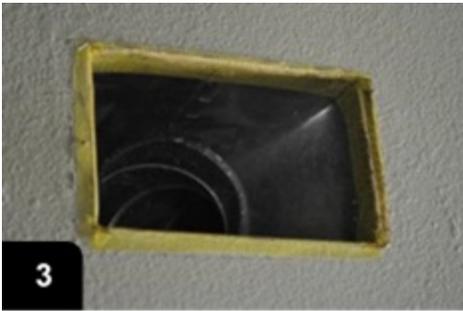
1. Mastic
2. Fiberglass mesh tape



Remove grill to expose duct boot and gaps



Wet the edges of the drywall to ensure a good bond



Cut mesh tape to fit around duct boot and cover gaps



Apply mastic over mesh tape to create heat resistant, durable bond



Once mastic is set, grill can be replaced and mastic should not show

MH 3.1602.12b - Air handler cabinet outside *conditioned space*

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

Joints will be sealed and cracks/holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape)

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

MH 3.1602.12c - Performance testing

Desired Outcome:

Ducts and plenums sealed to prevent leakage

Specification(s):

Pre- and post-retrofit duct leakage will be performance tested

using a duct blaster or pressure pan, and results will be documented and reported to the homeowner and/or program

Objective(s):

Document post-retrofit duct leakage test has been performed



Best Practice

Test duct performance using pressure pan or duct blaster, before and after work

Tools:

1. Duct blaster
2. Blower door
3. Manometer
4. Pressure Pan



Best Practice

Record readings before and after to determine improvement in performance

Materials:

1. Duct mask



Perform duct blaster testing before beginning work. Record results



Perform duct blaster testing after completion of work and compare to 'before reading. Record results



Set-up blower door to perform pressure pan testing before and after work



Perform pressure pan test on ductwork before beginning work. Record result



Perform pressure pan test after work is completed and compare to 'before' reading

Record test results to determine improvement of performance

MH 3.1602.13 Return—Framed Platform<

MH 3.1602.13a - Preparation

Desired Outcome:

The return duct is 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



After

Vacuum out debris and dirt from the return to prepare work area

Tools:

1. Shop vacuum

MH 3.1602.13b - Infill and backing

Desired Outcome:

The return duct is 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 all loads (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. Drywall
2. Fire-resistant caulk
3. Fasteners



Do **NOT** use EPS in air returns due to proximity to combustion appliances

MH 3.1602.13c - Sealant selection

Desired Outcome:

The return duct is installed to prevent air leakage

Specification(s):

Sealants will be compatible with their intended surfaces

Sealants will be continuous and meet fire barrier specifications

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 and compatible with surface

Tools:

1. Caulk gun
2. Utility knife
3. Taping knife

Materials:

1. Fiberglass mesh
2. Siliconized caulk
3. Mastic

Paraphrased from IRC: Wall and ceiling finishes will have a flame spread index of 200 or less and a smoke-developed index of 450 or less

MH 3.17 Additions

MH 3.1701 Attached Additions

MH 3.1701.1 Holes, Penetrations, and Connection Seam

MH 3.1701.1a - Work assessment

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Structural integrity
- Roof leaks
- Insect infestation
- Accessibility
- Mechanical attachment
- Location of marriage wall seams
- Number, type, size, and location of penetrations

Objective(s):

Ensure work space is safe and ready for air sealing

Verify scope of work

MH 3.1701.1b - Hole, seam, line, and penetration sealing

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Marriage wall seams will be sealed continuously at walls, floors, and ceiling connection

All accessible holes and penetrations in the addition envelope will be sealed

Backing or infill will be provided as needed, when accessible

Objective(s):

Minimize air leakage

Maintain durability and/or flexibility

Ensure sealant is effective and durable

MH 3.1701.1c - Materials

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned*

and *conditioned space*

Specification(s):

Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair

MH 3.1701.1d - Addition exterior wall air sealing

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

All holes and penetrations on exterior surface of exterior walls will be sealed to ensure resistance to outdoor elements

Intentionally ventilated walls will not be sealed at vent locations (e.g., weep holes)

All holes and penetrations on the interior surface of exterior walls will be repaired

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

Objective(s):

Minimize air leakage

Maintain durability

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

Ensure sealant is effective and durable

MH 3.1701.1e - Addition interior wall air sealing

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

All accessible holes and penetrations in top and bottom plates will be sealed

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

Objective(s):

Minimize air leakage

Maintain durability

Ensure resulting closure is permanent and supports expected load

Ensure sealant is effective and durable

MH 3.1701.1f - Addition floor air sealing (decking, subfloor, floor decking)

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

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 expected wind and mechanical pressure loads

Ensure sealant is effective and durable

MH 3.1701.1g - Sealant selection

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

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

Sealants will be compatible with all adjoining surfaces

Sealants will be continuous and meet fire barrier specifications, if required

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

Tools:

1. Caulk gun



Best Practice

Flexible sealants compensate for differential expansion and maintain a seal

Materials:

1. Caulk

2. Spray foam gun

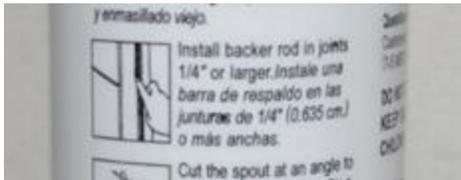


Caulking can be used to span gaps up to 1/4 inch

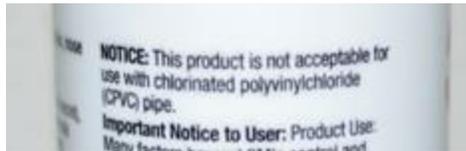
2. Spray foam



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

MH 3.1701.1h - Floor repair

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Floor repair material will meet or exceed strength of existing floor material

Repair will span from joist to joist and blocking added as needed to support floor

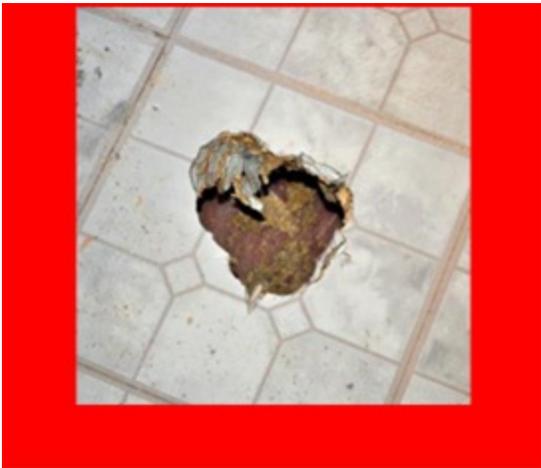
Patches smaller than 144 square inches will not require repairs from joist to joist

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

Objective(s):

Ensure floor is structurally sound

Minimize air leakage



Before

Holes in the floor should be repaired



After

Completed floor patches should be air sealed to prevent leakage from belly

Tools:

Materials:

1. Saw
2. Tape measure
3. Caulk gun
4. Marker
5. Utility knife
6. Drill

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



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



Mark damaged area to be removed to create most efficient patch



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



Once damaged area has been removed, measure for new patch and cut

joists

replacement subflooring to size



Clean debris from surrounding area and mounting surfaces



Apply sealant to mounting surfaces



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



Seal gaps around patched-in subfloor to create air seal between *conditioned space* and *crawl space*

MH 3.1701.1i - Structural materials

Desired Outcome:

The exterior of the seam is weather-tight and connection

between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Materials will be used or installed in accordance with product manufacturer specifications

Objective(s):

Select materials to ensure durable and permanent repair



Use materials with sufficient strength to span openings and support repair materials without bending or sagging

Tools:

1. Caulking gun
2. Nail gun
3. Screw gun

Materials:

1. Nominal 2X framing lumber
2. 7/16" OSB or 1/2" CDX plywood

3. Nails or screws
4. Construction adhesive

MH 3.1701.1j - Ceiling hole repair

Desired Outcome:

The exterior of the seam is weather-tight and connection between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Ceiling repair material **must** meet or exceed strength of existing ceiling material

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

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

All accessible damaged *vapor barriers* will be repaired

Penetrations through the air barrier **must** be repaired

Objective(s):

Ensure ceiling is structurally sound

Minimize air leakage

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

Ensure sealant does not fall out



Before

Replace any missing insulation and repair holes in *vapor barrier*



After

Drywall patch before final sand and prime

Tools:

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

Materials:

1. Drywall or paneling
2. Fiberglass joint tape
3. Joint compound
4. Drywall screws or nails
5. Support material if needed (typically 1x4, 1x6, or 2x4 dimensional lumber)

For small holes, enlarge to a rectangular shape and install 1 X 4 blocks above two edges of the hole. For larger holes, enlarge opening to centers of nearest trusses and fasten the

patch to the framing. For small holes, enlarge to a rectangular shape and install 1 X 4 blocks above two edges of the hole. For larger holes, enlarge opening to centers of nearest trusses and fasten the patch to the framing.



Replace any missing insulation and repair holes in *vapor barrier*



Prepare the hole by cutting the edges clean and square



Cut drywall and fasten in place



Add joint tape and coat of joint compound

MH 3.1701.1k - High temperature application

Desired Outcome:

The exterior of the seam is weather-tight and connection

between house and addition is properly sealed to minimize air leakage and moisture movement between *unconditioned* and *conditioned space*

Specification(s):

Only noncombustible materials will be used in contact with chimneys, vents, and flues

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. Non-combustible material such as aluminum or

galvanized steel flashing
or cement board

3. Appropriate fasteners



Prepare work area by removing any insulation and debris



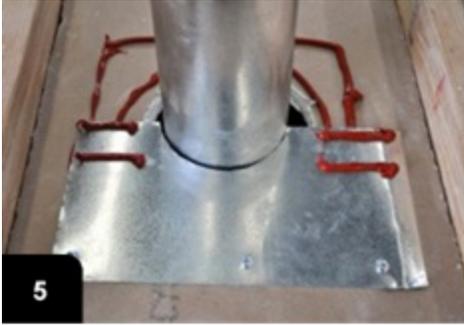
Use high-temperature caulking (600F min)



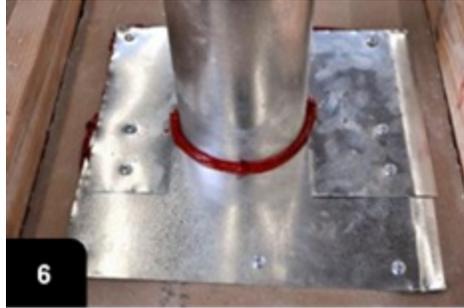
Apply first ring of caulking to match shape of opening



Apply second ring of caulking to size and shape of rigid material



Fasten rigid material and apply additional caulking



Fasten rigid material to cover penetration and seal against flue with caulk

MH 4 Insulation

MH 4.10 Attics

MH 4.1003 Attic Ceilings

MH 4.1003.8 Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Roof Side Lift)

MH 4.1003.8a - Attic, ceiling, and roof verification

Desired Outcome:

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

Specification(s):

All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads

A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place

All ventilation systems will maintain a continuous connection and terminate to the outdoors

All broken mushroom vents will be replaced or removed and

sealed

All plumbing stacks will be terminated to the outdoors

Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures

All recessed lights will be labeled as having an air leakage rate not more than 2.0 *CFM* when tested in accordance with ASTM E 283 at a 75 pascals pressure differential

All obvious ceiling penetrations will be sealed

The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials

All roof, attic, and ceiling assemblies will be structurally sound; loose ceiling panels will be secured

Temporary ceiling bracing will be recommended during the insulation installation process

Dishing and pooling issues that allow standing water will be addressed

All known roof water leaks will be repaired before insulation installation

Objective(s):

Ensure occupant and worker safety

Verify attic space is ready to insulate

Ensure structural integrity of the roof and ceiling assembly

Prevent intrusion of bulk moisture

Prevent damage during the insulation installation process



Before

Roof leak, missing cap on vent



After

Properly connected and sealed roof vent

Tools:

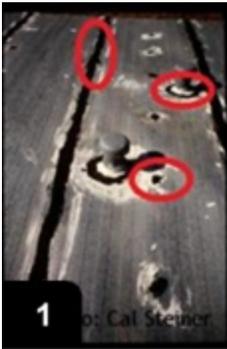
1. Scaffolding and ladders
2. Screw gun
3. Long, flat pry bar
4. 5-in-one paint scraper tool
5. Flashlights and headlamps
6. Digital camera

Materials:

1. Wooden blocks

Inspect and correct each of the specified items: flues terminated to outside, 2" clearance to combustibles from flues, ventilation ducts terminated outdoors, non-airtight, non-IC rated recessed lighting replaced with airtight, IC-rated recessed units, broken mushroom vents replaced or removed, plumbing vents terminated outdoors, ceiling penetrations sealed, structural defects in roof, attic, and ceiling assemblies corrected, ponds on roof remedied, and all

roof leaks repaired.



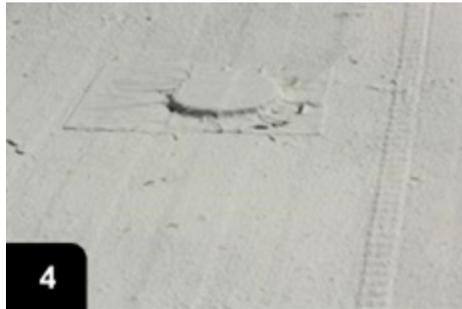
Inspect roof for evidence of water pooling, leaks, or damage. Verify proper vent terminations



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

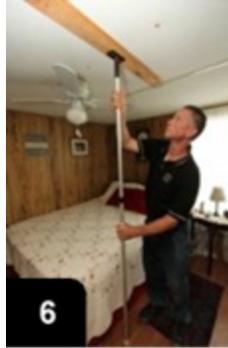


Verify presence of rain caps on all vents



Inspect all patches and repairs, and correct deficiencies if necessary





Use temporary supports to avoid ceiling collapse during insulation install

Verify at least 2" clearance to combustibles, unless flue is designed for zero clearance. Repair if needed



Add fasteners wherever needed to firmly attach ceiling to the trusses



Investigate all water stains and sources of moisture. Repair before insulating the attic



After opening the roof edge,
verify proper clearance to
combustibles and inspect
vent connections

MH 4.1003.8b - Attic access

Desired Outcome:

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

Specification(s):

Fasteners will be removed from the J channel and the roof
edge on the most easily accessible side of the house

Roof will be separated from the heel plate and siding roof will
be lifted and propped to accommodate fill tube

Length of opening will be enough to allow ease of access and
reattachment while minimizing potential damage from high
winds

If sub-sheathing is present, access will be gained through
sub-sheathing

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

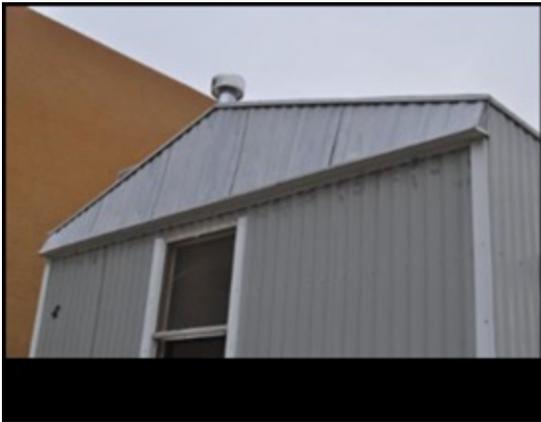
Objective(s):

Create access to the full attic cavity

Protect roof from wind damage during installation

Ensure ease of roof reattachment

Determine insulation installation technique



Best Practice

Pitched, bowed, and vaulted roofs are good candidates for insulation via roof side lift

Tools:

1. Pry bar
2. Drill
3. Utility knife
4. Pliers



Best Practice

Insulation can be installed without disturbing the interior environment

Materials:

1. Wood blocks





Ensure a safe work environment by setting up scaffolding. Work in manageable sections

Remove fasteners from the J-channel



Cut through putty tape and pry J-channel away from roof seam



Work in manageable sections to minimize roof damage. One section of J-channel is a long enough area



Remove staples as



Place blocks to lift roof and

necessary to lift roof and inspect underneath

enable inspection of roof cavity for obstructions and other concerns



Work in small sections to minimize flexing of roof and risk of wind damage



Once visual inspection has shown roof cavity to be viable, begin blowing insulation

MH 4.1003.8c - Blowing machine set up

Desired Outcome:

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

Specification(s):

Blowing machine pressure test will be performed with air on full, feed off, and gate closed. Hose outlet pressure will be set in accordance with manufacturer specifications.

Objective(s):

Ensure machine is capable of delivering uniform insulation density and coverage.



In Progress

Before loading insulation, check to ensure that machine is operating properly



Best Practice

Test insulation blowing machine's pressure to ensure it is operating within manufacturer's parameters

Tools:

1. Hex wrench
2. Pressure gauge



Set-up blowing machine on dry, level surface near electrical source and



Check electrical connections before operation

insulation site



Make sure feed is off for testing and gate is closed



Adjust blower to full, or maximum



Using pressure gauge at feed outlet, verify that machine is working within manufacturer's specifications



If testing shows machine is operating properly, attach hose and tighten fitting to minimize slippage



Open gate to allow for feed of insulation, turn on feed

MH 4.1003.8d - Fiberglass blown insulation installation

Desired Outcome:

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

Specification(s):

Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot

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

Fill tube will be inserted within 6 inches of the end of each attic cavity

Insulation will be installed into the void of the attic cavity:

- If existing insulation is roof-mounted, insulation will be blown below
- If existing insulation is ceiling-mounted, insulation will be blown above

- If existing insulation is mounted at both locations, insulation will be blown in between

Avoid overfilling of roof edges and above attic trusses

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

Objective(s):

Fill entire attic cavity to the prescribed R-value to reduce air *infiltration*

Avoid clogging of the cavity and the fill tube

Prevent damage to the ceiling

Allow roof to be returned to original position

Fire safety will be maintained



In Progress



If insulation is roof mounted, blow below it.



If insulation is ceiling mounted, blow above it.



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



Insulation meets ASTM E 84.

MH 4.1003.8e - Roof reattachment

Desired Outcome:

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

Specification(s):

If existing J channel is damaged, it will be replaced

Existing sealant will be removed from the roof edge and J channel

At a minimum, new sealant will be reinstalled at the original location

Roof and J channel will be fastened to the original location with new screws

All seams, edges, and penetrations will be sealed as necessary

Objective(s):

Prepare roof edge and J channel for reattachment

Reattach roof edge and J channel without leaks



Before

If salvageable, clean J-channel before reattachment



After

Attach J-channel using old holes and new fasteners

Tools:

1. Drill
2. Utility knife

Materials:

1. Fasteners
2. J-channel

3. Snips



If J-channel is salvageable, clean thoroughly before applying putty tape

3. Putty tape



Apply putty tape to new or reused J-channel to seal roof seam



Using new fasteners, attach J-channel along roof seam and seal as necessary

MH 4.1003.8f - Verification of details

Desired Outcome:

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

Specification(s):

Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process

Objective(s):

Verify the integrity of the house has been maintained



Best Practice

Exterior should be inspected to verify that roof has not been damaged



Best Practice

Interior ceiling should also be inspected to make sure that no damage was incurred

MH 4.1003.8g - Onsite documentation

Desired Outcome:

Consistent, uniform thermal boundary and air barrier between the *conditioned space* 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

MH 4.1003.9 Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Exterior Access from Top of Roof)

MH 4.1003.9a - Attic, ceiling, and roof verification

Desired Outcome:

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

Specification(s):

All combustion appliance flues will be terminated to the outdoors and terminations will maintain proper clearance above snow loads

A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place

All ventilation systems will maintain a continuous connection and terminate to the outdoors

All broken mushroom vents will be replaced or removed and sealed

All plumbing stacks will be terminated to the outdoors

Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures

All recessed lights will be labeled as having an air leakage rate not more than 2.0 *CFM* when tested in accordance with ASTM E 283 at a 75 pascals pressure differential

All obvious ceiling penetrations will be sealed

The space between combustion appliance flues and the ceiling will be sealed with fire-rated materials

All roof, attic, and ceiling assemblies will be structurally sound:

- Loose ceiling panels will be secured
- Temporary ceiling bracing will be recommended during the insulation installation process
- Dishing and pooling issues that allow standing water will be addressed

All known roof water leaks will be repaired before installing installation

Objective(s):

Ensure occupant and worker safety

Verify attic space is ready to insulate

Ensure structural integrity of the roof and ceiling assembly

Prevent intrusion of bulk moisture

Prevent damage while installing insulation



Before

Roof leak, missing cap on vent



After

Properly connected and sealed roof vent

Tools:

1. 2-1/2" hole saw
2. Power drill
3. Borescope
4. Inspection mirror

Materials:

1. Material requirements will vary based on conditions
2. Drywall or paneling
3. IC/Airtight recessed lights

5. Flashlight

4. Fire caulk

5. Vent terminations

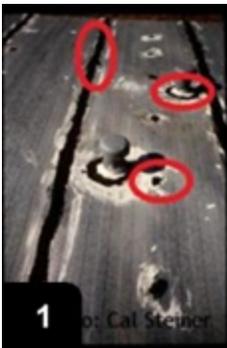
6. Silicone caulk

7. Galvanized sheet metal and screws

8. Roof cement

9. Temporary ceiling bracing

Inspect and correct each of the specified items: flues terminated to outside, 2" clearance to combustibles from flues, ventilation ducts terminated outdoors, non-airtight, non-IC rated recessed lighting replaced with airtight, IC-rated recessed units, broken mushroom vents replaced or removed, plumbing vents terminated outdoors, ceiling penetrations sealed, structural defects in roof, attic, and ceiling assemblies corrected, ponds on roof remedied, and all roof leaks repaired.



Inspect roof for evidence of water pooling, leaks, or damage. Verify proper vent terminations



Inspect all patches and repairs, and correct deficiencies if necessary



Verify presence of rain caps on all vents



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



Verify at least 2" clearance to combustibles, unless flue is designed for zero clearance. Repair if needed



Repair and refasten sagging or unsecured ceiling panels. Caulk and seal seams to prevent insulation spilling into house



Use temporary supports to avoid ceiling collapse during insulation install

MH 4.1003.9b - Attic access

Desired Outcome:

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

Specification(s):

Access to the attic cavity will be created through the gable vents

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

Objective(s):

Create access to the full attic cavity

Maintain the integrity of the roof truss

Protect roof from wind damage during installation

Determine technique for installing insulation

MH 4.1003.9c - Blowing machine set up

Desired Outcome:

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

Specification(s):

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

Hose outlet pressure will be set in accordance with manufacturer specifications

Objective(s):

Ensure machine is capable of delivering uniform insulation density and coverage



In Progress

Before loading insulation, check to ensure that machine is operating properly



Best Practice

Test insulation blowing machine's pressure to ensure it is operating within manufacturer's parameters

Tools:

1. Pressure gauge
2. Generator

See [MH 4.1104.3c - Blowing machine set up](#) for steps and photos.

MH 4.1003.9d - Fiberglass blown insulation installation

Desired Outcome:

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

Specification(s):

Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot

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

Fill tube will be inserted within 6 inches of the end of each attic cavity

Insulation will be installed into the void of the attic cavity:

- If existing insulation is roof-mounted, insulation will be blown below
- If existing insulation is ceiling-mounted, insulation will be blown above
- If existing insulation is mounted at both locations, insulation will be blown in between

Insulation will be filled no higher than the top of the truss

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

Objective(s):

Fill entire attic cavity to the prescribed R-value to reduce air *infiltration*

Avoid clogging of the cavity and the fill tube

Prevent damage to the ceiling

Allow roof to be returned to original position

Fire safety will be maintained



In Progress

Always wear PPE appropriate to the work environment and job at hand.



If insulation is roof mounted, blow below it.



If insulation is ceiling mounted, blow above it.



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



Insulation meets ASTM E 84.

MH 4.1003.9e - Patching and sealing openings

Desired Outcome:

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

Specification(s):

If the roof is sliced:

- A solid metal ridge cap will be centered over the slice
- A flexible and durable sealant will be sandwiched between the roof and the ridge cap
- Screws will be installed to prevent wrinkles and create a permanent seal
- Screws will not go into any wood framing
- A durable and flexible final coating will be applied over the screws and edge of the ridge cap to create a continuous seal between the roof and the perimeter of the ridge cap

For holes that are drilled or cut, the initial patch will be applied using the following procedure:

- At least 6 inches of surface surrounding the opening will be cleaned before patch is installed
- Sealant will be continuous and applied in between the patch and the roof
- Sealant will be an all-weather adhesive that is flexible and durable

If a metal patch is used:

- Patch will overlap the opening by 2" on all sides
- Gauge will be equal to or greater than the roof material
- Fasteners will be installed to prevent wrinkles and create a permanent seal
- If a plug is used, it will be flanged and have a tight fit
- Screws will not go into any wood framing

A durable and flexible 45 mil adhesive patch will be applied in accordance to manufacturer specifications over the initial patch and will have at a minimum:

- Tear strength of 640g
- Elongation of 380%

- Application temperature no lower than 55°F and no greater than 110°F
- Services temperature no less than -25°F and no greater than 150°F
- Adhesive patch will overlap the initial patch by 2" on all sides
- A durable and flexible final coating will be applied over the adhesive patch to create a continuous seal between the roof and the perimeter of the patch
- All remaining seams, edges, and penetrations will be sealed as necessary

Objective(s):

Effectively patch and seal all openings

Create a durable patch that will prevent roof leaks



In Progress

Rough cut hole that will need to be sealed.



In Progress

Placing sealant around the exposed edges of the roof patch ensures a watertight seal.

Tools:

1. Roller
2. Self-adhering patch
3. Sheet metal
4. 6 inch duct cap (to match 6 inch hole)
5. Heat gun
6. Drill



Insert 6 inch plug and seal around the perimeter of the opening.



Firmly push the plug into place, until it is flush with the roof surface.



Use a 10"x10" sheet metal patch to mark the center of



Apply sealant to the underside of the sheet metal

the hole.



Secure the metal patch to the roof being sure to place mechanical fasteners through the sealant.

patch.



Apply a 14"x14" self-adhering roof patch on top of the sheet metal patch.



Use a heat gun to make the adhesive pliable to get the best possible seal.



Forcefully roll the patch into place, starting from the center and working toward the edge.

MH 4.1003.9f - Verification of details

Desired Outcome:

Consistent, uniform thermal boundary and air barrier

between the *conditioned space* and *unconditioned space*

Specification(s):

Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process

Objective(s):

Verify the integrity of the house has been maintained



In Progress

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



After

Document and repair any damage the workers caused.

Tools:

1. IR camera

MH 4.1003.9g - Onsite documentation

Desired Outcome:

Consistent, uniform thermal boundary and air barrier between the *conditioned space* 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 complete

Comply with 16 CFR 460.17

MH 4.1003.10 Installing Fiberglass Blown Insulation for Flat, Bowed, or Vaulted Ceilings (via Interior Access

through the Ceiling)

MH 4.1003.10a - Attic, ceiling, and roof verification

Desired Outcome:

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

Specification(s):

All combustion appliance flues will be terminated to the exterior of the house and terminations will maintain proper clearance above snow loads

A distance no less than 2" will be maintained between any combustion appliance flue and combustible materials, unless zero clearance flue is in place

All ventilation systems will maintain a continuous connection and terminate to the outdoors

All broken mushroom vents will be replaced or removed and sealed

All plumbing stacks will be terminated to the outdoors

Non-IC rated light fixtures will be replaced with airtight IC-rated fixtures, if feasible and only when installed measures will compromise the fire rating of the fixture

All recessed lights will be labeled as having an air leakage rate not more than 2.0 CFM when tested in accordance with ASTM E 283 at a 75 pascals pressure differential

All obvious ceiling penetrations will be sealed

The space between combustion appliance flues and the

ceiling will be sealed with fire-rated materials

All roof, attic, and ceiling assemblies will be structurally sound:

- Loose ceiling panels will be secured
- Temporary ceiling bracing will be recommended while installing installation
- Dishing and pooling issues that allow standing water will be addressed

All known roof water leaks will be repaired before installing installation

Objective(s):

Ensure occupant and worker safety

Verify attic space is ready to insulate

Ensure structural integrity of the roof and ceiling assembly

Prevent intrusion of bulk moisture

Prevent damage while installing insulation



Best Practice



Best Practice

90+ flue terminates above the snow line and penetrations have been sealed.



Plumbing stacks **must** be terminated to the outdoors.

Flue penetrations have been sealed correctly from the interior.



Dishing and pooling issues **must** be addressed.



Mushroom vents **must** be replaced, or removed and sealed.



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



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

MH 4.1003.10b - Construction prep

Desired Outcome:

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

Specification(s):

Special precautions will be taken to limit fiberglass and construction dust exposure to the occupant and occupant belongings

Objective(s):

Protect occupant health and safety

Protect occupant belongings



Bad Practice

Improperly prepared workspace with cellulose all over client belongings and bedroom

Tools:

1. Utility knife



Best Practice

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

Materials:

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

MH 4.1003.10c - Attic access

Desired Outcome:

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

Specification(s):

Equidistant holes will be drilled in a straight row parallel to the longitudinal exterior wall of the ceiling

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

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

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

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

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

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

Objective(s):

Create access to the full attic cavity

Determine insulation installation technique

Prevent damage to ceiling

Create a professionally finished ceiling



In Progress

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

Tools:

1. Holesaw bit
2. Drill
3. Borescope
4. Camera



In Progress

Hole is the proper size in relation to the fill tube.

Materials:

1. Protective plastic

MH 4.1003.10d - Blowing machine set up

Desired Outcome:

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

Specification(s):

Blowing machine pressure test will be performed with air on full, feed off, and gate closed Hose outlet pressure will be set in accordance with manufacturer specifications

Objective(s):

Ensure machine is capable of delivering uniform insulation density and coverage



In Progress

Before loading insulation, check to ensure that machine is operating properly



Best Practice

Test insulation blowing machine's pressure to ensure it is operating within manufacturer's parameters

Tools:

1. Pressure gauge
2. Hex wrench

See [MH 4.1104.3c - Blowing machine set up](#) for steps and

photos.

MH 4.1003.10e - Fiberglass blown insulation installation

Desired Outcome:

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

Specification(s):

Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot

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

Fill tube will be inserted within 6 inches of the end of each attic cavity

Insulation will be installed into the void of the attic cavity:

- If existing insulation is roof-mounted, insulation will be blown below
- If existing insulation is ceiling-mounted, insulation will be blown above
- If existing insulation is mounted at both locations, insulation will be blown in between

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

Objective(s):

Fill entire attic cavity to the prescribed R-value to reduce air *infiltration*

Avoid clogging of the cavity and the fill tube

Prevent damage to the ceiling

Fire safety will be maintained



In Progress

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



If insulation is roof mounted, blow below it.



If insulation is ceiling mounted, blow above it.



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



Insulation meets ASTM E 84.

MH 4.1003.10f - Patching and sealing holes

Desired Outcome:

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

Specification(s):

Holes will be plugged or covered and sealed to be aesthetically pleasing. If existing trim was removed, it will be reinstalled.

Objective(s):

Create an airtight seal

Create a visually acceptable ceiling finish



In Progress

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

Tools:

1. Color matched plug

Materials:

1. Color matched plug

MH 4.1003.10g - Verification of details

Desired Outcome:

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

Specification(s):

Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process

Objective(s):

Verify the integrity of the house has been maintained

Verify the integrity of the house has been maintained



In Progress

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



After

Document and repair any damage the workers caused.

MH 4.1003.10h - Onsite documentation

Desired Outcome:

Consistent, uniform thermal boundary and air barrier between the *conditioned space* 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

MH 4.1003.11 Installing Fiberglass Blown Insulation in Roof-Over Constructions

MH 4.1003.11a - Roof-over overview

Desired Outcome:

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

Specification(s):

If occupant will allow access from interior, installation through the ceiling is preferred

Attic space created by the roof-over will be accessed in accordance with the Single-Family Attic Access SWS

If the roof-over does not allow physical access to the roof-

over attic, access to the original attic will be gained through roof venting

If existing insulation height in the attic is less than the height of the heel plate (original attic), access will be made through the original roof and the original attic cavities will be filled before blowing insulation over the original roof

At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage

If existing insulation height is equal to or greater than the height of the heel plate (original attic), the insulation will be installed in the end cavities before blowing on top of the original roof

Access to the end cavities will be gained and insulation will be installed

At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage

Insulation will not be installed on top of the original roof until the end cavities are insulated and air sealed in original attic

If insulation is installed on top of the original roof, it will be installed in accordance with the Single- Family SWS Loose Fill Blown Fiberglass Insulation Installation

Objective(s):

Gain access to the combined attic spaces

Address thermal bridging

Correctly insulate the combined attic spaces

MH 4.1003.11b - Onsite documentation

Desired Outcome:

Consistent, uniform thermal boundary and air barrier between the *conditioned space* 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

MH 4.1088 Special Considerations

MH 4.1088.6 Installing Insulation at Flat and Cathedral Ceiling Transition

Wall

MH 4.1088.6a - Insulation installation verification

Desired Outcome:

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

Specification(s):

A visual inspection of the highest point of the transition wall will be completed

Access points will be determined from the gable end, roof, ceiling, or interior paneling

Objective(s):

Verify the height and the accessibility of the attic

MH 4.1088.6b - Access attic

Desired Outcome:

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

Specification(s):

Attic will be accessed through the location that allows the most efficient and effective insulation coverage

Objective(s):

Gain access to the flat and cathedral ceiling transition wall

MH 4.1088.6c - Blowing machine set up

Desired Outcome:

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

Specification(s):

Blowing machine pressure test will be performed with air on full, feed off, and gate closed Insulation will be blown against the transition wall until the wall is covered

Objective(s):

Ensure machine is capable of delivering uniform insulation density and coverage to meet manufacturer specifications for loose blown insulation

Create a thermal barrier at the transition wall



In Progress

Before loading insulation, check to ensure that machine is operating properly



Best Practice

Test insulation blowing machine's pressure to ensure it is operating within manufacturer's parameters

See [MH 4.1104.3c - Blowing machine set up](#) for steps and photos.

MH 4.1088.6d - Spray two-part foam

Desired Outcome:

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

Specification(s):

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

Spray polyurethane foam (SPF) will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer

Objective(s):

Insulate and seal transition wall

MH 4.1088.6e - Batt

Desired Outcome:

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

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

Vapor barrier will be installed based on regional considerations

Objective(s):

Insulate to prescribed R-value

MH 4.1088.6f - Patching and sealing access points

Desired Outcome:

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

Specification(s):

Created access points will be covered and sealed in an aesthetically pleasing manner

Existing access points (e.g., gable vent) will be returned to the original condition

If existing trim was removed, it will be reinstalled

Objective(s):

Create an airtight seal

Create an aesthetically pleasing finish

MH 4.1088.6g - Verification of details

Desired Outcome:

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

Specification(s):

Installation process will be considered complete when installer has verified that damage has not occurred to the roof or ceiling assemblies during the installation process

Objective(s):

Verify the integrity of the house has been maintained



In Progress

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



After

Document and repair any damage the workers caused.

MH 4.1088.6h - Onsite documentation

Desired Outcome:

Consistent, uniform thermal boundary and air barrier between the *conditioned space* 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 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

MH 4.11 Walls

MH 4.1101 Preparation

MH 4.1101.5 Exterior Wall *Dense Packing*

MH 4.1101.5a - Preparation

Desired Outcome:

Walls properly prepared to receive *dense pack* insulation

Specification(s):

Lead 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 of the *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

When accessing wall cavities, the interior will be masked to

control dust during drilling

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

Blowing machine pressure test will be performed with air on highest level, feed off, 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 the 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

MH 4.1101.5b - 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:

- Blown fiberglass, mineral fiber, rock and slag wool, or

spray foam 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 cubic feet per minute per square foot at 50 pascals

- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot when the wall sheathing and interior cladding will endure this level of pressure
- Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density in accordance with manufacturer specifications
- The number of bags installed will be confirmed and will match the number to achieve 1.5-1.6 pounds per cubic foot
- 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

MH 4.1104 *Manufactured Housing Wall Insulation*

MH 4.1104.1 *Stuffing Wall Cavities with Fiberglass Batts*

MH 4.1104.1a - *Access wall cavities*

Desired Outcome:

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

Specification(s):

If skirting overlaps siding, skirting will be detached to allow access to the wall cavity

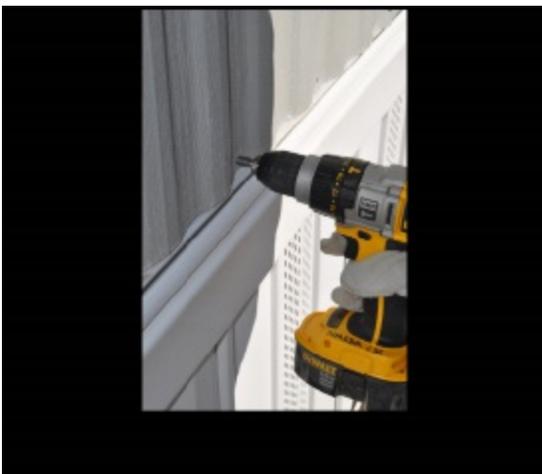
Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6 inches without damaging the siding

Temporary fasteners will be installed near the bottom of the siding panels at the seams to prevent separation

If a sub-sheathing is present under the siding, access through the sub-sheathing will be required

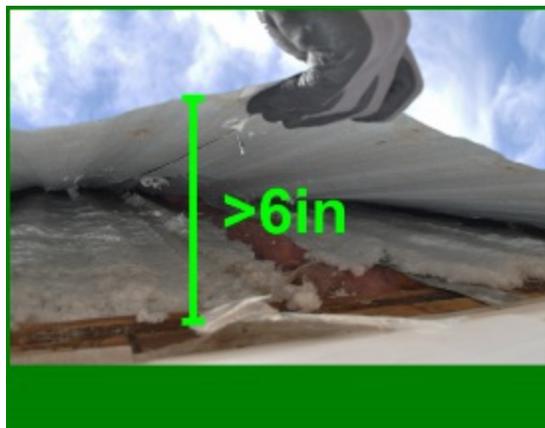
Objective(s):

Gain access to the wall cavity without damaging or separating the siding



In Progress

Remove fasteners from along bottom and side seams to access wall cavity



After

Remove enough fasteners to create at least a 6 inch gap without damaging siding

Tools:

1. Drill



If skirting overlaps siding, remove skirting



Temporarily fasten siding panels at joint to hold seam together



Seam should remain together with temporary fastener

MH 4.1104.1b - Exterior wall cavity inspection

Desired Outcome:

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

Specification(s):

Wall cavities will be inspected for moisture damage, pest locations, and integrity of the wiring, and holes to the interior

Siding will be repaired as necessary

Location of belt rails, obstructions, and existing insulation will be identified

All interior surfaces of exterior walls will be inspected for loose paneling joints, occupant wall hangings, location of switches and outlets, and other wall obstructions

Objects will be removed from the interior surfaces of the walls being insulated Interior paneling will be repaired as necessary

Objective(s):

Prepare wall cavity for insulation

Prevent water leaks from occurring



Before



In Progress

Take note of obstacles in the wall cavity, such as belt rails and electrical wiring

Assess that holes in both exterior siding and interior walls have been patched before beginning installation

Tools:

1. Drill
2. Utility knife
3. Taping knife
4. Caulk gun

Materials:

1. Spackle
2. Metal siding patch
3. Caulk
4. Fasteners



Obstacles should be noted and planned for—insulation should be tucked behind belt rails



Holes in exterior siding should be patched



Apply sealant to back of patch to maintain air barrier



Ensure that patch is securely fastened and water-tight



Holes and penetrations in the interior wall should be patched as well



Verify that patches to both interior and exterior have been completed before beginning installation

MH 4.1104.1c - Fiberglass batt installation tool (stuffer)

Desired Outcome:

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

Specification(s):

A sheet of polycarbonate, such as Lexan, will be cut to the

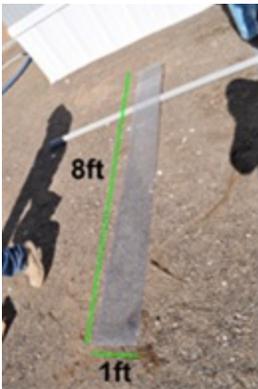
following specifications to create a stuffer tool:

- Approximately 1' x 8' x 1/4" with a 5 degree bend 7' 1/2" from the bottom
- All corners of the Lexan (polycarbonate) will be rounded and all edges will be sanded
- Other clear sheet plastics will not be used due to a tendency to shatter under stress

Objective(s):

Create a tool to install a fiberglass batt into the cavity

Ensure worker safety



Best Practice

Insulation stuffing tool should be made of 1/4" polycarbonate, cut to 1' wide and 8' long

Tools:

1. Tape measure



Best Practice

At one end, a bend of 5 degrees (175 degree supplement) should be made 7 1/2" from narrow edge

Materials:

1. Polycarbonate, like Lexan

2. Table saw with fine-toothed blade
 3. Sander
 4. Heat gun
 5. Clamp
 6. Protractor
 7. Heat-resistant gloves
2. Sandpaper

Most crews should have this tool in their supply. If one needs to be fabricated, find someone who has worked with polycarbonate before and ensure correct tool usage as well as proper PPE during fabrication.

MH 4.1104.1d - Fiberglass batt installation

Desired Outcome:

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

Specification(s):

Thickness of the batt will fill the void without deforming siding or damaging structure

Fiberglass batts will fill the cavity (e.g., batt may be cut approximately 1 inch longer to ensure proper fill and allow for lap at the top)

Flexible membrane will have an appropriate *perm rating* for the region

Flexible membrane will be cut 2" wider than the cavity and

approximately 1' longer than the batt

Stuffer tool, membrane, and fiberglass batt will be aligned for installation

Stuffer tool will be used to install the fiberglass batt and membrane at the same time

Excess fiberglass batt and membrane *vapor retarder* extending below the cavity will be rolled and tucked into the cavity

A poly-encased fiberglass batt may be used in place of the fiberglass batt and membrane assembly

The membrane will be installed in contact with the side of the wall that is compatible with the local climate zone

Objective(s):

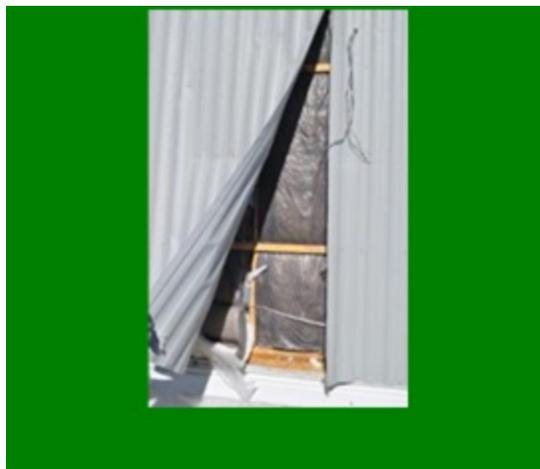
Maintain integrity of the batt

Aid in the installation process



Before

Uninsulated and under-insulated wall cavities can



After

Fiberglass batt should fill entire cavity without

be filled from the exterior with fiberglass batts

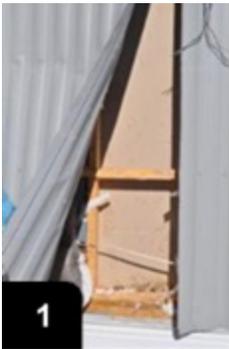
creating bulging in exterior paneling

Tools:

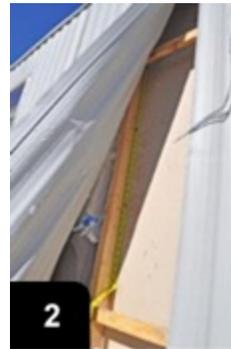
1. Tape measure
2. Utility knife

Materials:

1. Fiberglass batts, may be wrapped
2. *Vapor barrier* appropriate for region



Uninsulated wall cavity can be accessed from exterior of mobile home through paneling



Measure length of cavity



Measure depth of cavity

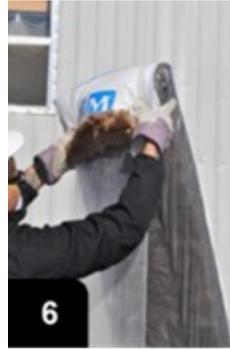


Select appropriate batt

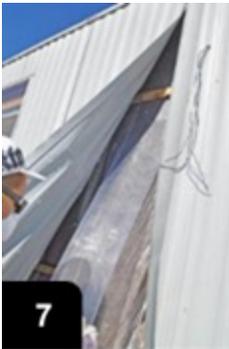
thickness and R-value.
Wrapped batts provide a
built in *vapor barrier*



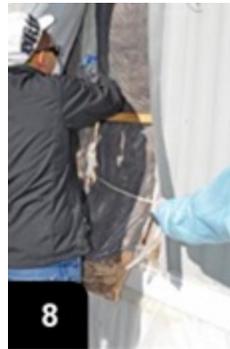
Measure batt to length of
cavity with extra for overlap
from stuffing tool



Lap cut batt over bent end
of stuffing tool



Beginning with lapped end,
tuck batt under top belt rail
and stuff batt up to top of
cavity. Remove stuffing tool



Tuck bottom of batt behind
bottom belt rail. If longer
than cavity, cut to within 1
inch longer, roll and tuck
into cavity

MH 4.1104.1e - Sub-sheathing patch and repair

Desired Outcome:

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

Specification(s):

Sub-sheathing will be patched or repaired as necessary

Objective(s):

Ensure the integrity of the drainage plane

MH 4.1104.1f - Reattachment

Desired Outcome:

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

Specification(s):

If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting

Siding will be reattached with new fasteners

Siding will be reattached without bulges or wrinkles

Objective(s):

Ensure the integrity of the drainage plane

Return siding to existing conditions without damage



In Progress

After wall cavities have been stuffed, paneling needs to be put back into place and refastened



After

Once work is finished, reattach siding and skirting, ensuring neither have been damaged

Tools:

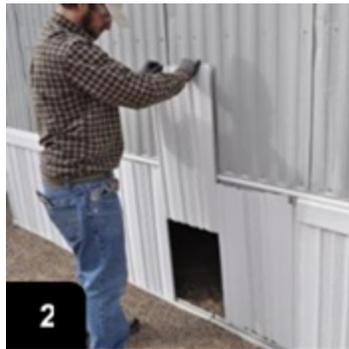
1. Drill

Materials:

1. Fasteners



Using new fasteners, reattach paneling



Reinstall skirting, if necessary



Reattach trim, if necessary



Verify that siding and skirting have not been damaged and show no signs of bulging

MH 4.1104.1g - Onsite documentation

Desired Outcome:

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

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

MH 4.1104.2 Fiberglass Blown Insulation Installation (Lifting Siding)

MH 4.1104.2a - Access wall cavities

Desired Outcome:

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

Specification(s):

If skirting overlaps siding, skirting will be removed

Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6 inches without damaging the siding

Temporary fasteners will be installed near the bottom of the siding panels at the seams

If a sub-sheathing is present under the siding, access through the sub-sheathing will be required

Objective(s):

Gain access to the wall cavity without causing damage or separation of the siding

MH 4.1104.2b - Exterior wall cavity inspection

Desired Outcome:

Consistent, uniform thermal boundary and air barrier

between the *conditioned space* and *unconditioned space*

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Moisture damage
- Presence of infestation or pests
- Location and integrity of wiring
- Holes to the interior and exterior
- Loose paneling or siding
- Location of belt rails
- Location of wall obstructions (switches, outlets)
- Existing insulation
- Wall hangings for removal during work

Problems will be corrected before work begins

Objective(s):

Prepare wall cavity for insulation

Prevent water leaks

MH 4.1104.2c - Blowing machine set up

Desired Outcome:

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

Specification(s):

Blowing machine pressure test will be performed with air on

full, feed off, and gate closed

Hose outlet pressure will be set according to manufacturer specifications

Objective(s):

Achieve uniform insulation density and coverage



In Progress

Before loading insulation, check to ensure that machine is operating properly



Best Practice

Test insulation blowing machine's pressure to ensure it is operating within manufacturer's parameters

Tools:

1. Pressure gauge
2. Hex wrench

See [MH 4.1104.3c - Blowing machine set up](#) for steps and

photos.

MH 4.1104.2d - Fiberglass blown insulation installation

Desired Outcome:

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

Specification(s):

Insulation will meet a flame spread rating of 25 or less and a smoke development rating of 450 or less when tested in accordance with ASTM E84

Insulation will be installed to a density of 1.5 to-1.6 pounds per cubic foot

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

Special precaution will be taken not to overfill the bottom of the cavity

Fill tube will be inserted from the bottom of the wall cavity within 6 inches of the top of the cavity between the interior paneling and any existing insulation

Objective(s):

Fire safety maintained

Fill entire wall cavity to the prescribed R-value to reduce air *infiltration*

Ensure bottom portion of siding will reattach properly

Avoid clogging of the cavity and the fill tube

MH 4.1104.2e - Sub-sheathing patch and repair

Desired Outcome:

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

Specification(s):

Sub-sheathing will be patched or repaired as necessary

Objective(s):

Ensure the integrity of the drainage plane

MH 4.1104.2f - Reattachment

Desired Outcome:

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

Specification(s):

If skirting was removed, skirting will be reinstalled to shed water to the outside of the skirting

Siding will be reattached with new fasteners

Siding will be reattached without bulges or wrinkles

Objective(s):

Ensure the integrity of the drainage plane

Reattach siding without damage

MH 4.1104.2g - Onsite documentation

Desired Outcome:

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

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

MH 4.1104.3 Fiberglass Blown Insulation Installation (via Penetrations through or Behind the Siding)

MH 4.1104.3a - Access wall cavities

Desired Outcome:

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

Specification(s):

With T-111, OSB, or plywood type siding:

- Access to exterior wall cavities will be gained and sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers
- Drilled holes will be large enough to accommodate an appropriately sized fill tube
- Holes will be drilled around the perimeter of the home, parallel to the bottom plate and an equal distance apart
- The line of holes will be located under the lowest window sill when possible

With lap siding:

- Course of siding will be unhooked or removed
- Holes sufficiently large for the fill tube will be drilled in every wall cavity

Objective(s):

Gain access to the wall cavity

Ensure holes are easily covered with an aesthetically pleasing trim strip

MH 4.1104.3b - Exterior wall cavity inspection

Desired Outcome:

Consistent, uniform thermal boundary and air barrier

between the *conditioned space* and *unconditioned space*

Specification(s):

Installer pre-work assessment will be conducted to determine:

- Moisture damage
- Presence of infestation or pests
- Location and integrity of wiring
- Holes to the interior and exterior
- Loose paneling or siding
- Location of belt rails
- Location of wall obstructions (switches, outlets)
- Existing insulation
- Wall hangings for removal during work

Problems will be corrected before work begins

Objective(s):

Prepare wall cavity for insulation

Prevent water leaks

MH 4.1104.3c - Blowing machine set up

Desired Outcome:

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

Specification(s):

Blowing machine pressure test will be performed with air on

full, feed off, and gate closed

Hose outlet pressure will be set in accordance with manufacturer specifications

Objective(s):

Ensure machine is capable of delivering uniform insulation density and coverage



In Progress

Before loading insulation, check to ensure that machine is operating properly



Best Practice

Test insulation blowing machine's pressure to ensure it is operating within manufacturer's parameters

Tools:

1. Pressure gauge
2. Hex wrench



Set-up blowing machine on dry, level surface near electrical source and insulation site



Check electrical connections before operation



Make sure feed is off for testing and gate is closed



Adjust blower to full, or maximum



Using pressure gauge at feed outlet, verify that



If testing shows machine is operating properly, attach

machine is working within manufacturer's specifications

hose and tighten fitting to minimize slippage



Open gate to allow for feed of insulation, turn on feed

MH 4.1104.3d - Fiberglass blown insulation installation

Desired Outcome:

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

Specification(s):

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

Insulation will be installed to a density of 1.5 to 1.6 pounds per cubic foot

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

Fill tube will be inserted within 6 inches of the top of the cavity between the interior paneling and any existing insulation

Objective(s):

Fill entire wall cavity to the prescribed R-value to reduce air *infiltration*

Avoid clogging of the cavity and the fill tube

Fire safety will be maintained

MH 4.1104.3e - Plug and seal holes

Desired Outcome:

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

Specification(s):

Holes will be plugged and sealed

Objective(s):

Ensure the integrity of the drainage plane

MH 4.1104.3f - Final wall assembly

Desired Outcome:

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

Specification(s):

For T-111 and equivalent siding:

- A pre-primed trim will be centered and installed over the holes
- Height of the trim will span from 1 inch above to 1 inch below the hole
- A continuous caulk seal will be applied between the trim and siding
- Caulk seal will be above the holes
- Top edge of the trim will be sealed to the siding with a continuous caulk seal

For lap siding:

- Siding will be reattached without bulges or wrinkles
- Siding will be hooked into the original position

Objective(s):

Ensure the integrity of the drainage plane

Return siding to existing conditions without damage

MH 4.1104.3g - Onsite documentation

Desired Outcome:

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

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

MH 4.1104.4 Spray Foam Insulation Installation in Cavities above Doors and Windows

MH 4.1104.4a - Access wall cavities above doors and windows

Desired Outcome:

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

Specification(s):

All interior surfaces of the cavities planned to be insulated
will be inspected for loose paneling joints, occupant wall
hangings, and other wall obstructions

Objects will be removed from the interior surfaces of the
exterior walls as needed

Interior paneling will be repaired and secured as necessary

Holes will be drilled from the interior of the house

A hole no larger than the spray nozzle will be drilled in each cavity above the door or window

When possible, the hole will be drilled in the panel groove

Objective(s):

Prepare wall cavity for insulation

Prevent damage from overspray to occupant possessions

MH 4.1104.4b - Cavity inspection

Desired Outcome:

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

Specification(s):

Cavity will be probed to assess conditions and volume of cavity

Objective(s):

Determine the approximate amount of foam to be installed in the cavity

MH 4.1104.4c - Insulation installation

Desired Outcome:

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

Specification(s):

Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 or UL 723

Foam insulation will be separated from the interior of the building by an approved thermal barrier at a minimum of 1/2" gypsum wallboard or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275

Two-part foam selection will be based on regional considerations

100% of each cavity will be filled to a consistent density without bulging of panels or siding

Objective(s):

Fill entire wall cavity to the prescribed R-value to reduce air *infiltration*

Fire safety will be maintained

MH 4.1104.4d - Final wall assembly

Desired Outcome:

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

Specification(s):

A color-corresponding sealant will be applied to the access hole

Objective(s):

Ensure wall is aesthetically pleasing

MH 4.1104.4e - Onsite documentation

Desired Outcome:

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

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

MH 4.13 Floors

MH 4.1302 *Manufactured Housing* Belly Preparation

MH 4.1302.1 Prepare Belly Floor Cavity for Insulation

MH 4.1302.1a - Work assessment

Desired Outcome:

Belly floor cavity ready for insulation

Specification(s):

Gas, water, waste, and electrical lines will be checked for:

- Plumbing leaks
- Gas/oil leaks
- Attachment
- Standing water
- Raw sewage
- Pests

Objective(s):

Ensure that floor space is safe and ready for work

Verify scope of work

MH 4.1302.1b - Preparation

Desired Outcome:

Belly floor cavity ready for insulation

Specification(s):

Where bottom board/rodent barrier is missing or damaged and accessible, the following will be ensured:

- Duct sealing completed
- Gas, water, and electrical lines secured at least every 4' to a floor joist or framing member
- Water line will be located on the warm side of the insulation; if not, the water lines will be insulated appropriately
- No water or gas leaks are present
- Waste lines are sloped to 1/4" per foot
- Bottom board/rodent barrier is sound/strong enough to support insulation

When bottom board is intact, the following will be ensured:

- Holes and penetrations in the bottom board and decking sealed
- No water or gas leaks present
- Bottom board is sound/strong enough to support insulation
- Water lines are secured to the floor joists/warm side of the insulation; if not, the water lines will be insulated appropriately

Problems will be corrected before floor cavity insulation work begins

Objective(s):

Ensure problems are corrected before floor cavity insulation work begins

Keep pipes from freezing

MH 4.1303 *Manufactured Housing* Floor Cavity Insulation

MH 4.1303.1 Insulation of Floor Cavity with Blown Material

MH 4.1303.1a - R-value

Desired Outcome:

Consistent, uniform thermal boundary and air barrier between the *conditioned space* and *unconditioned space* that reduces heat flow

Specification(s):

Insulation will be installed in accordance with recommended R-value and density

Objective(s):

Insulate to prescribed R-value for the climate zone

Zone	Floor
1	R13
2	R13-R19
3	R19-R25
4 to 8	R25-R30

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

Area de recubrimiento para aplicaciones de
Piso neto por

Thermal Resistance R-value Resistencia al flujo calórico Valor R	Cavity Depth/ Installed Thickness inches Espesor instalado/ Espacio de la cavidad Pulgadas	Minimum Installed Density lb/N ² Densidad mínima instalada libras/p ²
13	3.5	1.0
20	5.5	1.0
14	3.5	1.4
22	5.5	1.4
15	3.5	1.8
23	5.5	1.8

* BSS - Blow-In Blanket® System; Sistema de Manta de Fibra de Vidrio al Soplo

Consult density chart on insulation packaging to determine proper insulation application to achieve prescribed R-value

MH 4.1303.1b - Work assessment

Desired Outcome:

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

Specification(s):

Road and rodent barrier **must** be intact and free from holes and capable of supporting the insulation

Objective(s):

Ensure bottom board is intact

Ensure insulation is supported

Protect cavity from infestation

MH 4.1303.1c - Insulate floors

Desired Outcome:

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

Specification(s):

Each cavity will be insulated to specified R-value and density

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

Objective(s):

Eliminate voids and settling

MH 4.1303.1d - Materials

Desired Outcome:

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

Specification(s):

Flame spread index of selected materials will not exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E84 or UL 723

Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 or UL 723

Foam insulation will be separated from the interior of the building by an approved thermal barrier at a minimum of

1/2" gypsum or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275

Selected material will be of minimal water absorbency

Selected material will be noncorrosive

Objective(s):

Ensure durability

Prevent moisture damage

Fire safety will be maintained

MH 4.1303.1e - Occupant Education

Desired Outcome:

Consistent thermal boundary between *conditioned* and *unconditioned space* that reduces 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 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 signed, dated receipt documenting information about insulation installed



Documentation should include insulation material and R-value



Provide occupant with copies of all documentation



Communicate professionally with occupant to provide information and support

MH 4.1303.2 Insulation of Floor Cavity with Batt Material

MH 4.1303.2a - R-value

Desired Outcome:

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

Specification(s):

Insulation will be installed in accordance with recommended R-value and density

Objective(s):

Insulate to prescribed R-value for the climate zone

Zone	Floor
1	R13
2	R13-R19
3	R19-R25
4 to 8	R25-R30

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

Area de recubrimiento para aplicaciones de
Piso neto por

Thermal Resistance R-value Resistencia al flujo calorífico Valor R	Cavity Depth/ Installed Thickness inches Espesor instalado/ Espacio de la cavidad Pulgadas	Minimum Installed Density lb/ft ³ Densidad mínima instalada libras/p ³
13	3.5	1.0
20	5.5	1.0
14	3.5	1.4
22	5.5	1.4
15	3.5	1.8
23	5.5	1.8

* BIAS - Blow-In Blanket® System; Sistema de Manta de Fibra de Vidrio al Soplo

Consult density chart on insulation packaging to determine proper insulation application to achieve prescribed R-value

Materials:

1. Fiberglass batts

MH 4.1303.2b - Work assessment

Desired Outcome:

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

Specification(s):

Ensure complete accessibility of floor cavity

Clean floor cavities

Remove all remnants of previous insulation and bottom board

Objective(s):

Ensure work area is clean, safe, and ready to accept insulation



Before

Cavity spaces that are to be insulated need to be cleared of old insulation and debris



After

Once cavity is cleared, it is ready for new insulation



Remove old rodent barrier and insulation



Cavities should be completely cleared of debris

Tools:

1. Utility knife

MH 4.1303.2c - Insulate floors

Desired Outcome:

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

Specification(s):

Each cavity will be insulated to specified R-value and density

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

Insulation will be in contact with subfloor

Insulation will not have gaps, voids, or be compressed

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

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

Ducts and water lines will be insulated for climate conditions

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

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

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

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

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

Objective(s):

Eliminate voids

Minimize conductive heat transfer across the floor system

Ensure durability

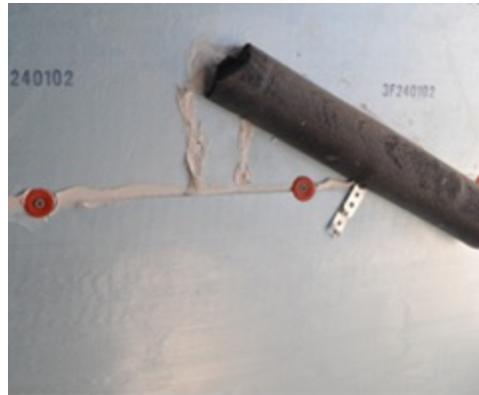
Minimize convective heat transfer

Keep pipes from freezing



Before

Uninsulated floors over *unconditioned spaces* are an energy drain



After

In addition to fiberglass batt insulation, a rigid air barrier will be sealed and mechanically fastened in place

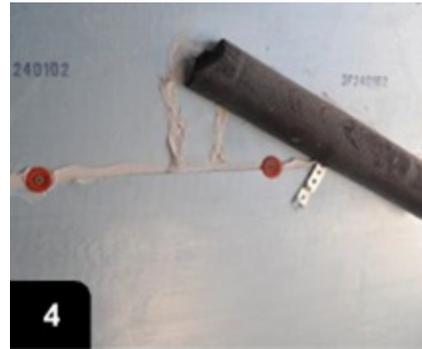


If fiberglass insulation is kraft-faced, ensure kraft is in contact with subfloor



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

Notch insulation around pipes, blocks, and other obstructions



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



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



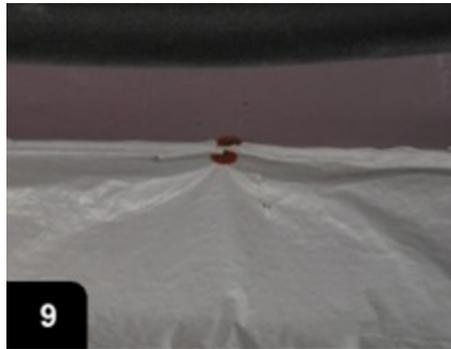
Water lines and ducts should be insulated if running below joists



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



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



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

Tools:

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

Materials:

1. Fiberglass batts, may be kraft-faced
2. Metal tape
3. Insulation supports (lightning rods)

4. Fasteners
5. Caulk
6. Duct insulation

MH 4.1303.2d - Materials

Desired Outcome:

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

Specification(s):

Insulation materials will be of minimal water absorbency and flame spread, and smoke-developed index for insulation will be in accordance with IRC

Foam plastic insulation will comply with IRC

Fasteners will be corrosion resistant

Objective(s):

Ensure durability

Prevent moisture damage





Bad Practice

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

Best Practice

Fiberglass batts are a good choice for insulating floor cavities



Code approved insulation board is a non-absorbent insulation option



Use only corrosion resistant, exterior screws as fasteners in floor cavities



Do not use EPS (expanded polystyrene) foam board in

floor cavities due to flame
spread rate

Materials:

1. Code approved rigid insulation board
2. Fiberglass batts
3. Corrosion resistant exterior screws

MH 4.1303.2e - Occupant education

Desired Outcome:

Consistent thermal boundary between *conditioned* and *unconditioned space* that reduces 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 signed, dated receipt documenting information about insulation installed



Documentation should include insulation material and R-value



Provide occupant with copies of all documentation



Communicate professionally with occupant to provide information and support

MH 4.1303.3 Insulation of Floor Cavity with Spray Foam Material

MH 4.1303.3a - R-value

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces heat flow

Specification(s):

Insulation will be installed in accordance with recommended R-value

Objective(s):

Insulate to prescribed R-value for the climate zone

MH 4.1303.3b - Work assessment

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces heat flow

Specification(s):

Ensure complete accessibility of floor cavity

Objective(s):

Ensure work area is clean, safe, and ready to accept insulation

MH 4.1303.3c - Preparation

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces heat flow

Specification(s):

All floor areas will be open and accessible for spray foam application

Any openings in the subfloor larger than 1/4" will be covered with appropriate materials Insulation dams or end blockers will be installed where needed

All surfaces where spray foam 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 below 19%; if tested at or above this percent of moisture, insulating the floor will be deferred until moisture level is corrected

Clean floor cavities

Remove all remnants of previous insulation and bottom board

Objective(s):

Prepare all substrate surfaces for the application of spray foam

MH 4.1303.3d - Installation

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces heat flow

Specification(s):

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

In accordance with manufacturer specifications, spray foam will be applied to desired thickness using the maximum pass thickness onto subfloor between floor joists and all rim/band joists

Rim/band joist will be sealed

When desired, underside of joists will be covered with spray foam to provide a layer of continuous insulation

Each cavity will be insulated to specified R-value

Insulation ***must*** be in contact with subfloor

Insulation will not have gaps or voids

Ducts and water lines will be insulated for climate conditions

Objective(s):

Insulate and seal floors Eliminate voids

Minimize conductive and convective heat transfer across the floor system

Ensure durability

MH 4.1303.3e - Materials

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces heat flow

Specification(s):

Insulation will be installed in accordance with manufacturer specifications

Flame spread index of selected materials will not exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E 84 or UL 723

Flame spread index of foam insulation will not exceed 75 and a smoke-developed index of no more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E 84 or UL 723

Foam insulation will be separated from the interior of the building by an approved thermal barrier at minimum 1/2"

gypsum or a material that is tested in accordance with the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275

Objective(s):

Ensure durability

Ensure worker safety

Ensure proper installation

Fire safety will be maintained

MH 4.1303.3f - Fire protection

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces heat flow

Specification(s):

Spray foam will be separated from the occupied space of the building with a 15-minute thermal barrier (typically 15/32" sheathing, 1/2" gypsum board, or approved thermal barrier coating) or as approved by ASTM E84 Requirements

Spray foam designed to be used as a fire block does not require a thermal barrier installed prior to application

Objective(s):

Provide necessary fire protection for combustible spray foam insulation

MH 4.1303.3g - Occupant education

Desired Outcome:

Installation of a consistent thermal boundary between *conditioned* and *unconditioned space* that reduces 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 signed, dated receipt documenting information about insulation installed

Section	Material	Thickness	R-Value
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
1.10
1.11
1.12
1.13
1.14
1.15
1.16
1.17
1.18
1.19
1.20

Documentation should include insulation material and R-value



Provide occupant with copies of all documentation



Communicate professionally with occupant to provide information and support

MH 4.16 Ducts

MH 4.1601 Insulating Ducts

MH 4.1601.3 Insulation and *Vapor Barrier*

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

Desired Outcome:

Minimize condensation

Specification(s):

Ducts will have continuous insulation and *vapor barrier*

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

Objective(s):

Minimize condensation

MH 4.1601.3b - Ducts within floor assemblies

Desired Outcome:

Minimize condensation

Specification(s):

Inspection and/or testing will be conducted to determine whether ducts are within thermal, pressure, and vapor boundary

If ducts are within thermal, pressure, and vapor boundary, no action will be required

If ducts are not within thermal, pressure, and vapor boundary, continuous air barrier, insulation, and *vapor retarder* will be installed either on the ducts or at the belly liner

Objective(s):

Minimize condensation

MH 4.1601.3c - Exposed metal

Desired Outcome:

Minimize condensation

Specification(s):

All exposed metal will have continuous insulation and *vapor retarder*

Objective(s):

Minimize condensation

MH 4.1601.5 Insulating Metal Ducts

MH 4.1601.5a - Selection of duct

insulation material

Desired Outcome:

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

Specification(s):

Duct insulation will be a minimum of R-8, in accordance with local code or buried under attic insulation, whichever is a greater R-value, and have an attached and continuous *vapor barrier*

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

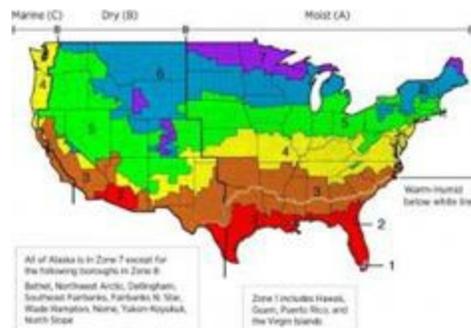
Properly insulated ducts operate at much higher rates of efficiency



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

MH 4.1601.5b - Duct sealing

Desired Outcome:

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

Specification(s):

All accessible ducts will be sealed with a UL-181 mastic 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. UL-181 mastic
2. Fiberglass mesh tape



1



2

Prepare work area by assessing any safety concerns.

Wrap joint with fiberglass mesh tape.



3

Apply UL 181 mastic to seal joint.

MH 4.1601.5c - 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 mechanically fastened (e.g., stitch staples, tie bands) and sealed with no exposed metal

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

Mechanical fastening will be sufficient to securely hold the duct insulation in place and tight to the duct

Objective(s):

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

Ensure performance of the installed material

Minimize condensation



Before

Materials holding insulation in place should not compress or kink duct

Tools:

1. Scissors
2. Metal snips



After

Durable materials can be attached without compressing insulation

Materials:

1. Nylon twine
2. Wire
3. Tie bands

MH 4.1601.5d - Taping of the *vapor barrier*

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 *vapor barrier* will be taped so that no metal is exposed

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 manufacturer approved tape to preserve *vapor barrier*

Tools:

1. Utility knife

Materials:

1. Tape
2. R-8 duct insulation with *vapor barrier*

- Tears and joints **must** be sealed using non-toxic and water-resistant mastic.
- Mesh tape **must** be used when openings and tears are over 1/16 of an inch.
- Appropriate manufacturer recommended sealing tape may be used only when the installation of mastic is not feasible.
- The insulation **must** have a *vapor barrier*.

MH 4.1601.5e - Vermin proofing**Desired Outcome:**

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

Specification(s):

Vermin access points will be identified and treated appropriately (e.g., seal access holes)

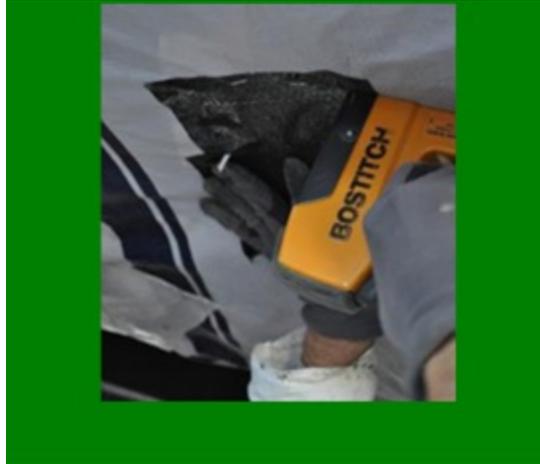
Objective(s):

Ensure long-term durability of the building materials



Before

Holes in air barrier should be patched to deter vermin



After

Ensure that patch is well sealed and securely fastened



Holes in ducting should be patched to discourage vermin



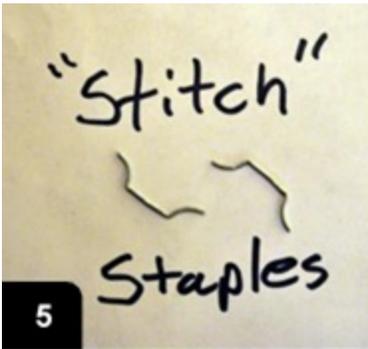
Holes in belly air barriers allow vermin access to insulation and ducting



Use adhesive patch to air seal



Stitch staple patch to securely fasten physical barrier



Stitch staples bend outward to hold in place for the long-term



Holes in exterior walls are another point of vermin entry



Apply sealant to back of patch to maintain air barrier



Flex patch to contour to wall



Securely fasten patch in place with screws and apply additional sealant to deter water

MH 5 Heating and Cooling

MH 5.30 Forced Air

MH 5.3001 Design

MH 5.3001.3 Replace Return Air Systems that Incorporate Floor Cavity (Belly) and/or Attic as the Return Air Pathway

MH 5.3001.3a - Close return air openings

Desired Outcome:

Effective, efficient, safe, and durable return air system

Specification(s):

Existing return air openings will be closed off and sealed with a durable material equivalent in strength to the surrounding material

Disturbed materials suspected to contain asbestos or lead content will be assessed and removed in accordance with EPA regulations

Objective(s):

Minimize air leakage

Improve indoor environmental quality

Ensure safe and legal renovation

- The costs associated with the testing (excluding vermiculite), removal and remediation of Asbestos materials are not eligible expenditures in the *Nebraska Weatherization Assistance Program*.

MH 5.3001.3b - Alternate return air system

Desired Outcome:

Effective, efficient, safe, and durable return air system

Specification(s):

Alternate return air opening will be provided to the furnace closet (e.g., replace louvered door or install grilles); whenever possible, follow manufacturer specifications for amount needed

Return duct design will be in accordance with ANSI/ACCA 1 Manual D Residential Duct Systems

A continuous and adequate return air pathway to the air handler will be installed

Objective(s):

Ensure sufficient return air is provided to the system

MH 5.3001.3c - Zone pressure test

Desired Outcome:

Effective, efficient, safe, and durable return air system

Specification(s):

Pressures will be measured with the furnace fan operating across interior doors that can be closed and have a supply and/or return behind them

Rooms should not exceed 3 pascals of pressure

Pressure testing will be performed with all interior doors closed and the air handler running

Objective(s):

Ensure sufficient return air is provided to the system

Minimize moisture intrusion from negative pressures

Improve indoor air quality

MH 5.3001.3d - *Combustion Appliance Zone (CAZ) testing*

Desired Outcome:

Effective, efficient, safe, and durable return air system

Specification(s):

CAZ testing will be performed where combustion appliances are utilized

Objective(s):

Identify unsafe equipment operating conditions

See



SWS 2.0101.1a -
2.0201.1e
for CAZ testing

Best Practice

Complete *combustion appliance zone* testing to ensure a healthy, safe environment

Tools:

1. Manometer
2. Mirror
3. Chemical smoke puffer
4. Stopwatch or watch with second hand
5. Combustion analyzer
6. 1/4" air line tubing
7. Gas leak detector

At the end of each day in which duct sealing or repair is performed, conduct *combustion appliance zone* (CAZ) testing in accordance with the NREL Standard Work Specifications, details [2.0201.1a through 2.0201.1e](#).

MH 5.3001.3e - Occupant education

Desired Outcome:

Effective, efficient, safe, and durable return air system

Specification(s):

Occupant will be educated on changes, how to operate and maintain the system, and any potential health concerns (e.g., lead, asbestos)

Objective(s):

Ensure occupant is educated

MH 5.3003 System Assessment and Maintenance

MH 5.3003.11 Heating and Cooling Controls

MH 5.3003.11a - 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



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.com for recycling options.

MH 5.3003.11b - 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

MH 5.3003.11c - 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) at both the interior (e.g., floor, sheetrock) and exterior air barriers (e.g., bottom liner, side walls)

Objective(s):

Ensure controls operate as designed

Minimize *infiltration* and exfiltration from house

MH 5.3003.11d - 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

Mounting location for air leakage and conductance that would affect the thermostat operation (e.g., marriage walls, exterior walls) will be accessed

Thermostats will not be exposed to extreme temperatures, radiant *heat sources*, and drafts

Objective(s):

Ensure controls operate as designed

MH 5.3003.11e - 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

MH 5.3003.11f - Thermostat selection: heat pump

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

A thermostat with supplementary heat lockout that can interface with an outdoor temperature sensor will be selected

Objective(s):

Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load

MH 5.3003.11g - Heat pump: supplementary heat

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Supplementary heat lockout on air-to-air heat pumps will be set to the economical balance point

ANSI/ACCA 3 Manual S Residential Equipment Selection will be referenced for set points when using different types of heat pumps

Objective(s):

Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load

MH 5.3003.11h - 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 ambient compressor lockout will be disabled

ANSI/ACCA 3 Manual S Residential Equipment Selection will be referenced for low ambient compressor lockout when using different types of heat pumps

Objective(s):

Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load

MH 5.3003.11i - Heat pump: outside temperature 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

MH 5.3003.11j - 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

MH 5.3003.11k - 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

MH 5.3003.11l - 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

MH 5.3003.11m - Humidistat: location

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Humidistat will be installed to reflect humidity of the zone in which it is installed

Humidistat will be installed in a dry location

Objective(s):

Ensure controls operate as designed

- The costs associated with the installation of humidistats are not eligible expenses in the *Nebraska Weatherization Assistance Program*.

MH 5.3003.11n - Ventilation control

Desired Outcome:

Heating and cooling controls installed and set properly

Specification(s):

Ventilation controls will be connected to operational control system, as originally designed in the factory

Powered ventilation system alarm will be set to "on;" controls

will be reset to factory settings

Objective(s):

Ensure proper operation of the mechanically dampered and powered ventilation systems

MH 5.3003.11o - 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
- Educate property manager/occupant about fan on/auto or vent/auto operations
- Educate the property manager/occupant about ventilation, as it applies to controls
- Instruct the property manager/occupant to never leave the fan set to "on" or "vent" in humid climates
- Educate property manager/occupant about possible moisture problems when thermostat is set low for extended periods of time during the summer

Objective(s):

Ensure equipment and controls operate as designed

Provide comfort throughout house

Ensure property manager/occupant knows how to operate the system

Minimize moisture problems

MH 5.3003.15 Combustion Analysis of Oil-Fired Appliances

MH 5.3003.15a - Oil system: smoke test

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

Specification(s):

Smoke test will be conducted before any combustion testing is completed

Smoke spot reading will be in accordance with burner manufacturer specifications

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Before

Smoke tests determine if oil-fired appliances burn cleanly by testing soot

Tools:

1. Smoke testing pump



Place filter paper in testing pump and draw air through paper



Best Practice

Verify oil-fired furnaces and water heaters are operating safely

Materials:

1. Filter paper



Remove paper and verify draw was successful by checking for soot



Compare level of soot deposit against smoke chart. A rating of 0 is ideal



Appliances with ratings of 3 or higher should be cleaned and tuned

MH 5.3003.15c - Oil filter

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

Specification(s):

Filter will be present, clean, and leak free

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

Filter is present, clean, and shows no signs of leakage

MH 5.3003.15d - Fuel pressure

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

Specification(s):

Measurement will be verified in accordance with manufacturer specifications

Objective(s):

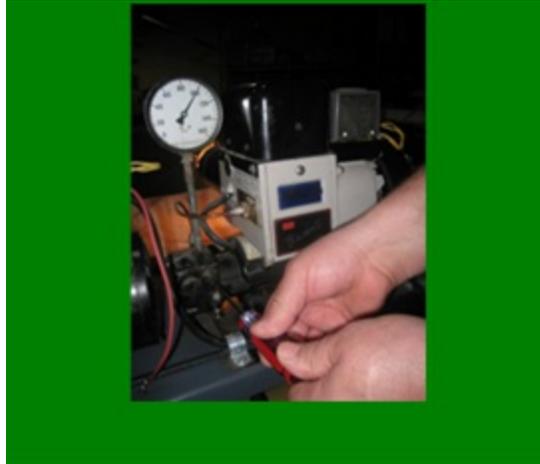
Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

Check oil-fired furnaces and water heaters for proper fuel pressure



After

Verify that fuel pressure matches manufacturer's specifications

MH 5.3003.15e - Oil system: steady state efficiency (SSE)

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

Specification(s):

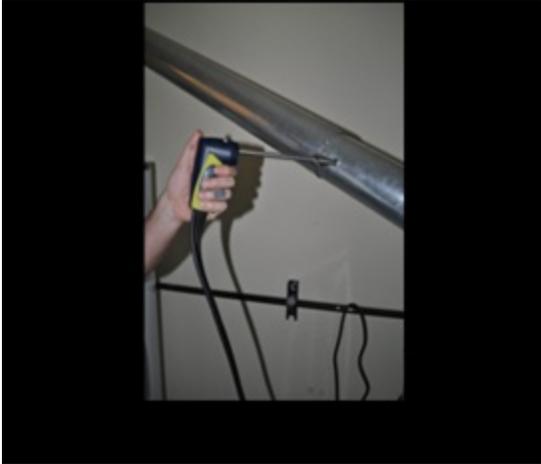
Measurement will be verified in accordance with manufacturer specifications

Objective(s):

Ensure equipment:

- operates as designed
- operates safely

- operates efficiently
- is durable



Best Practice

Test flue gases to determine steady state efficiency



Best Practice

At steady state, this furnace tests at 83% – within manufacturer tolerances

Tools:

1. Combustion analyzer with probe

MH 5.3003.15f - Net stack temperature

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

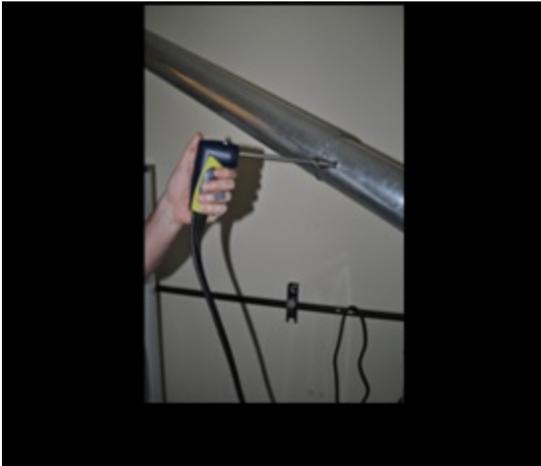
Specification(s):

Net stack temperature will be measured and verified in accordance with manufacturer specifications

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

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.

MH 5.3003.15g - Carbon dioxide (CO₂) and oxygen (O₂)

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

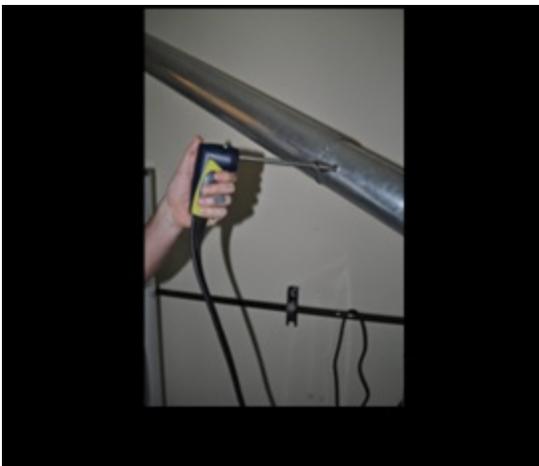
Specification(s):

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



Best Practice

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

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.

MH 5.3003.15h - Excess combustion air

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

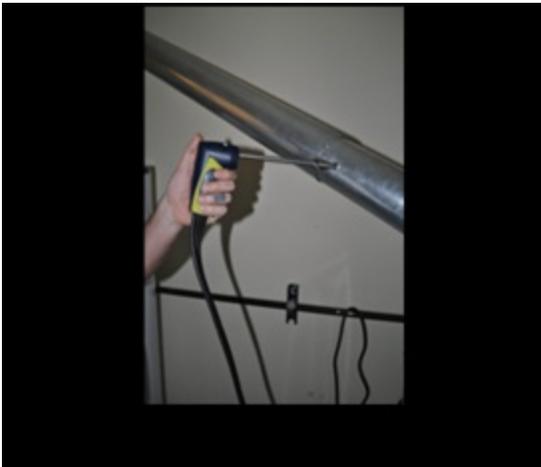
Specification(s):

Excess air will be minimized in accordance with industry best practices

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

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

MH 5.3003.15i - CO in flue gas

Desired Outcome:

Analysis of critical components and operations completed to industry and manufacturer specifications

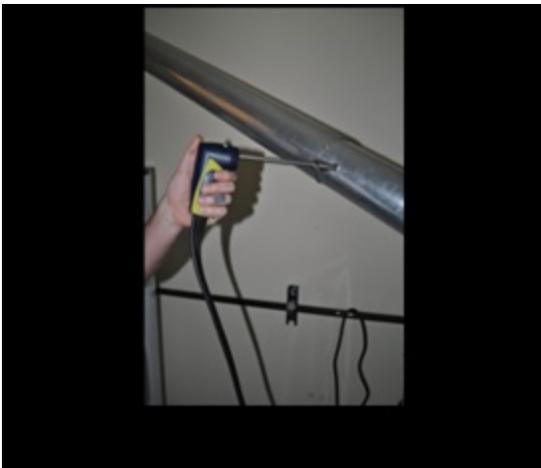
Specification(s):

CO in the undiluted flue gas will be less than 400 ppm air-free

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Best Practice

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

MH 5.3003.15j - Testing/inspection holes**Desired Outcome:**

Analysis of critical components and operations completed to industry and manufacturer specifications

Specification(s):

All testing and inspection holes will be sealed with approved materials

Objective(s):

Ensure equipment:

- operates as designed
- operates safely
- operates efficiently
- is durable



Before

The testing hole was left unsealed.

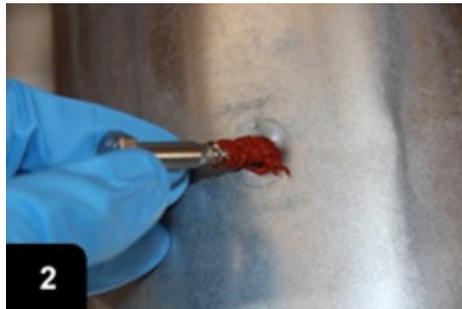


After

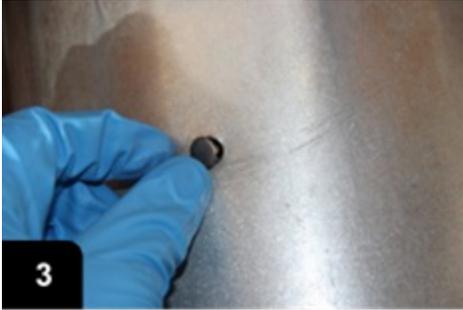
The hole in both walls has been properly sealed with a plug, cap, or other approved method.



1
If using a bolt, apply high temperature sealant to the bolt, so that both holes will be sealed.



2
Screw the bolt into place, ensuring a proper seal on both pipes.



If sealing each wall individually, insert the plug into each hole.



Apply high temperature sealant to the perimeter of the plug.

MH 5.3003.16 Evaluating Electrical Service

MH 5.3003.16a - Service entrance

Desired Outcome:

Electrical components properly tested

Specification(s):

Homes will have a four-wire service entrance to the panel box to ensure a wiring system that is nominally rated at 120/240 volts and allows for proper grounding

Grounding at the service entrance will be checked to determine proper grounding of the home

Objective(s):

Ensure occupant and worker safety

MH 5.3003.16b - Polarity

Desired Outcome:

Electrical components properly tested

Specification(s):

Polarity of equipment will be verified by a qualified technician if wiring is to be modified or repaired

Objective(s):

- operates as designed
- operates safely

MH 5.3003.16c - Voltage: incoming power

Desired Outcome:

Electrical components properly tested

Specification(s):

Voltage will be in accordance with manufacturer specifications

Objective(s):

Ensure equipment operates as designed

MH 5.3003.16d - Voltage: contactor

Desired Outcome:

Electrical components properly tested

Specification(s):

Voltage drop will be within acceptable range in accordance with manufacturer specifications

Objective(s):

Ensure contactor does not overheat

Ensure equipment operates as designed

MH 5.3003.16e - Grounding

Desired Outcome:

Electrical components properly tested

Specification(s):

Grounding will be connected in compliance with local code requirements, ANSI/NEMA GR 1-2007, and NFPA National Electric Code

Frames of home sections will be bonded with copper wire

Bonding lug will be selected to prevent corrosion due to dissimilar metals

Objective(s):

- operates as designed
- operates safely
- Ensure ground continuity among sections

MH 5.3003.16f - Blower amperage

Desired Outcome:

Electrical components properly tested

Specification(s):

Amperage will not exceed manufacturer full load amperage

Objective(s):

- operates as designed
- operates efficiently
- operates safely

MH 5.3003.16g - Compressor amperage

Desired Outcome:

Electrical components properly tested

Specification(s):

Amperage will not exceed manufacturer full load amperage

Objective(s):

- operates as designed
- operates efficiently
- operates safely

MH 5.3003.16h - Door switch operation

Desired Outcome:

Electrical components properly tested

Specification(s):

Blower compartment safety switch operation will be verified, if present

Objective(s):

Ensure blower:

- Does not operate during service
- Cannot backdraft a flue when the door is off

MH 5.3003.16i - 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

MH 6 Ventilation

MH 6.60 Exhaust

MH 6.6002 Components

MH 6.6002.4 Ducts (Exhaust Fans)

MH 6.6002.4a - Duct design and configuration

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Consideration will be given to:

- Vent termination location
- Amount of space for duct run
- Roof condition, type, and access (e.g., metal, shingle, bow string, flat)
- Duct insulation

When applicable, pitch duct to remove condensation to outdoors

Ducts will be as straight as possible, fully extended, and have the shortest run possible

Turns will be made so the radius at the centerline is no less

than one duct diameter

Duct diameter will be equal to or greater than the exhaust fan outlet

Fan flow will be verified by flow measurement to meet ASHRAE Standard 62.2

Objective(s):

Effectively move the required volume of air

- Kitchen and bathroom exhaust fans **must** be vented to the exterior.
- Horizontal runs and elbows should be avoided.
- If the exhaust vent 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.

MH 6.6002.4b - Duct insulation

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 in accordance with local codes

Objective(s):

Prevent condensation from forming or collecting inside or outside of the ductwork

- Check local codes to see if R-8 is accepted level of insulation.



Before

Existing flex duct that does not meet the requirement of R-8.0 should be removed



After

All new and replacement ducting in *unconditioned spaces* should be R-8.0 minimum

MH 6.6002.4c - Duct support

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Horizontal runs will be supported in accordance with flex duct manufacturer specifications and local codes

Supports with a width of at least 1 1/2" will be used or adequate metal support

Objective(s):

Effectively move the required volume of air

Preserve the integrity of the duct system

- Metal flexible duct for exhaust fan ventilation is limited to 6 foot or less.
- Flexible plastic ducting is not allowed.



Best Practice

Straps should be at least 1.5" wide.



Best Practice

Straps should be spaced in accordance with manufacturer's specification, typically 4 feet.

Materials:

1. 1.5" webbing or strap material

MH 6.6002.4d - Duct connections

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Metal-to-metal or metal-to-PVC connections will be fastened with a minimum of three equally spaced screws

Flexible duct-to-metal or flexible duct-to-PVC connections will be fastened with tie bands using a tie band tensioning tool

PVC-to-PVC connections 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 must be fastened at all connections with sheet metal screws or rivets



In Progress

For flex to metal connections, use zip tie and tensioner to secure liner to connection fitting.

Tools:

1. Drill
2. Tie band tensioner

Materials:

1. Mechanical fastener
2. Tie bands
3. PVC primer and cement



Round metal-to-metal connections require fiberglass mesh tape and 3



PVC-to-PVC connections should use PVC primer and cement.

mechanical fasteners
minimum.

MH 6.6002.4e - Duct materials

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Flexible materials will be UL 181 listed or Air Diffusion Council approved

Rigid, smooth metal of 30-gauge wall thickness or thicker will be used PVC material may be used

Objective(s):

Effectively move the required volume of air

Preserve the integrity of the duct system

- Metal flexible duct for exhaust fan ventilation is limited to 6 foot or less.
- Flexible plastic ducting is not allowed.



Best Practice

This material conforms to UL Standard 181.



Look for the Air Diffusion Council seal.



Flex installed should meet or exceed UL181.



When rigid duct is being used, its wall thickness should be 30 gauge minimum.

MH 6.6002.4f - Total exhaust airflow

Desired Outcome:

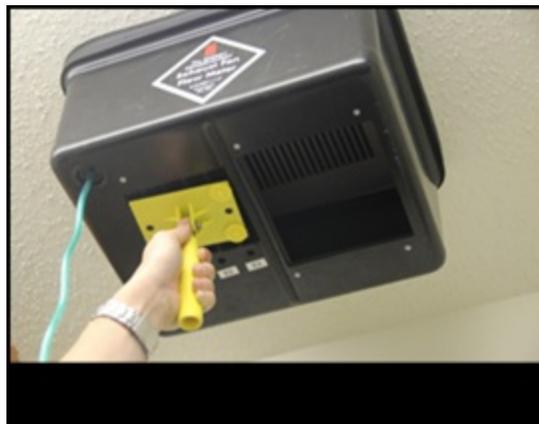
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Total exhaust system ventilation airflow will be measured

Objective(s):

Ensure air flow is as designed



Before

Exhaust fan flow should be measured and compared with the fans rated capacity as well as ASHRAE 62.2 requirements.

Tools:

1. Exhaust fan flow meter
2. Manometer

ASHRAE requires the following flows for bath fans: 50CFM intermittent, or 20CFM continuous.

The requirements for kitchen range hoods are: 100CFM intermittent, or 5ACH (for kitchen area)

MH 6.6003 Fans

MH 6.6003.1 Surface-Mounted Ducted

MH 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



In Progress

Determine size to cut hole by measuring fan assembly and ducting



After

A snug fit should be ensured to minimize weatherproofing required

Tools:

1. Tape measure
2. Saw
3. Writing utensil



Measure the termination fitting to determine proper hole diameter (in this case, 4")

Hole should be no more than 1/4" larger than assembly diameter



Clear wall surface and mark hole size 1/4" larger than termination fitting



Since opening is larger than most hole saws, precision cutting is important

MH 6.6003.1b - Wiring

Desired Outcome:

Surface-mounted ducted fans installed to specification

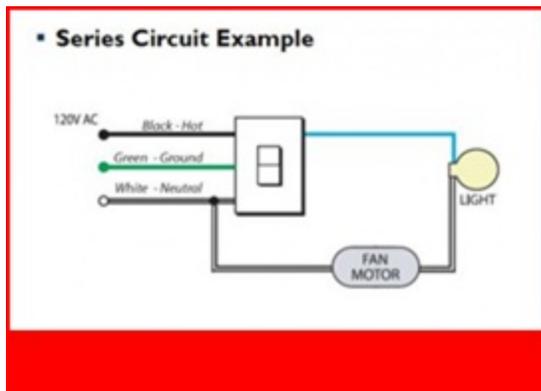
Specification(s):

Wiring will be installed by a properly licensed contractor, as required by the authority having jurisdiction

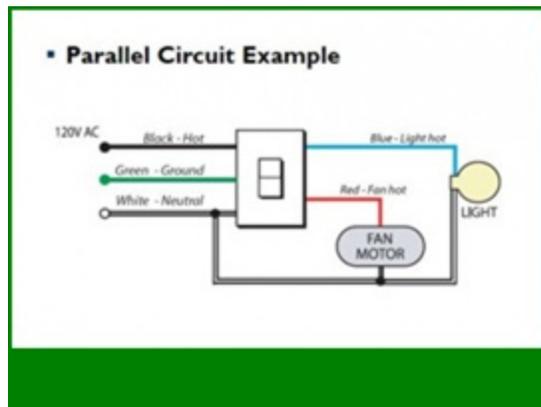
Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard



Before



After

MH 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



Bad Practice



Best Practice

MH 6.6003.1d - *Backdraft damper*

Desired Outcome:

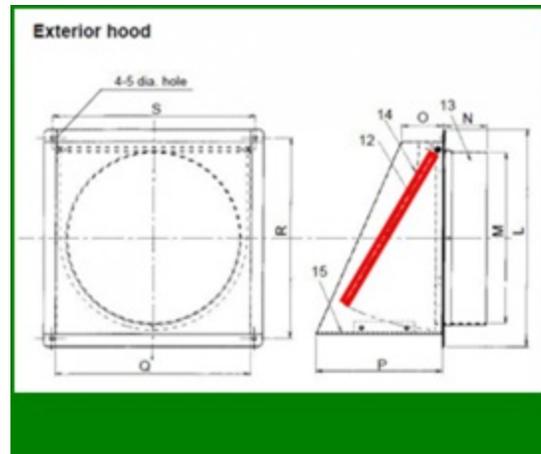
Surface-mounted ducted fans installed to specification

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



Before

Damper should be installed to maintain exterior air barrier

MH 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 connections 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 connections will be fastened with tie bands using a tie band tensioning tool

- PVC-to-PVC connections 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 listed material

Objective(s):

Exhaust to outside



Before

The connection has been sealed with mastic, and is being secured with 3 mechanical fasteners minimum.

Tools:

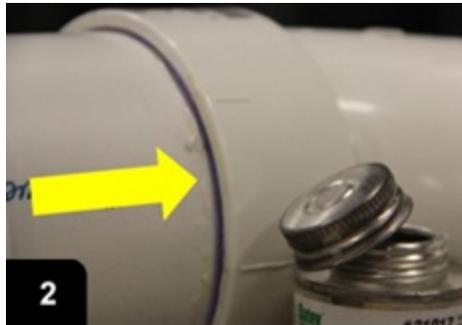
1. Drill
2. Tie band tensioner
3. Brush

Materials:

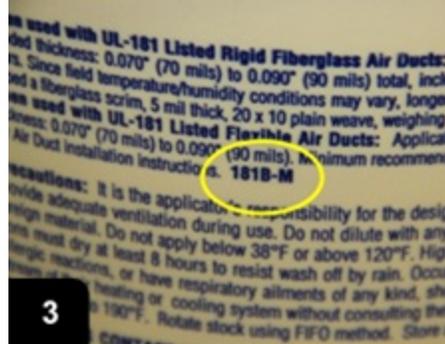
1. Tie bands
2. Mechanical fasteners
3. Mastic
4. PVC primer and cement



Round metal-to-metal connections require fiberglass mesh tape and 3 mechanical fasteners minimum.



PVC-to-PVC connections should use PVC primer and cement.



Sealants should show UL181-M or UL181B-M.

MH 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



Best Practice

Seal openings in the fan housing to ensure that air is exhausted only from the desired location.

Tools:



Best Practice

Sealant should be approved for its intended surfaces.

Materials:

1. Caulk gun

1. Caulk

MH 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



Before

The opening for the fan is unsealed, allowing air



After

The fan to interior surface seal is made using the

leakage into or out of the attic.

proper materials and prevents airflow to and from the attic space.

MH 6.6003.1h - Air flow

Desired Outcome:

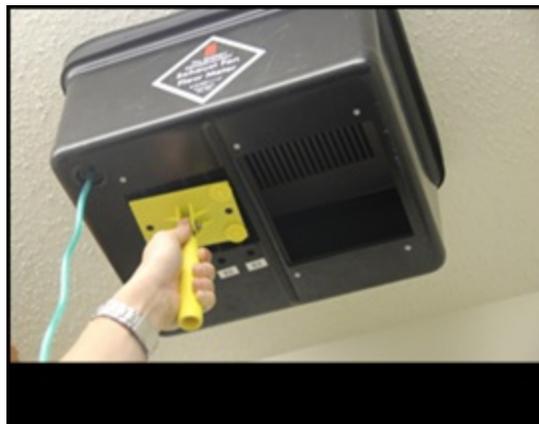
Surface-mounted ducted fans installed to specification

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



In Progress

Exhaust fan flow should be measured and compared with the fans rated capacity as well as ASHRAE 62.2

requirements.

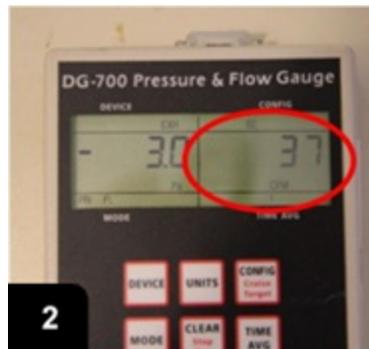
Tools:

1. Digital manometer
2. Exhaust fan flow measuring device
3. Fan speed controller

Minimum Credit (per unit)		
CFM50 / N-Value		
3200	41.8	76.5
F		
Continuous Ventilation to (Needed - Credit)		
		30.0
		G
		cfm

1

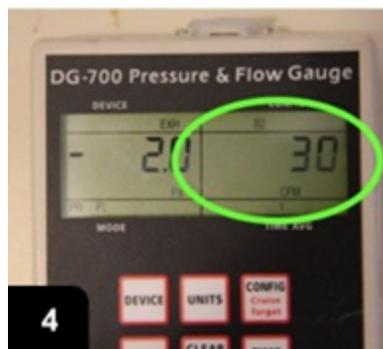
Perform the ASHRAE calculation to determine the Q_{fan} or *continuous ventilation* needed.



Measure the fan flow to see how much adjustment is needed.



Adjust the fan speed using



Re-measure the fan flow,

the chosen fan control device.

and continue making adjustments until desired flow is achieved.

MH 6.6003.1i - Preventing air leakage caused by exhaust fans

Desired Outcome:

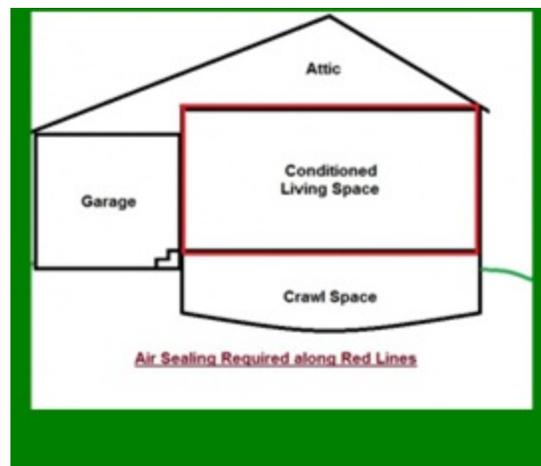
Surface-mounted ducted fans installed to specification

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



Best Practice

The barrier between *conditioned* and

unconditioned spaces should be sealed

MH 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



Before

Installing new ventilation can cause imbalances within the house

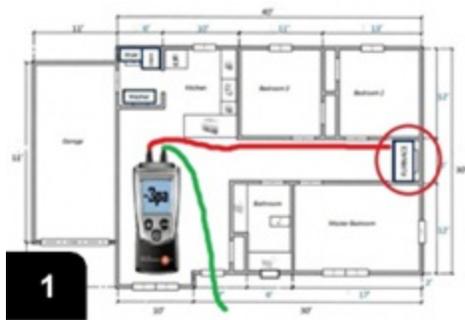


After

Test that depressurization limit is not being exceeded by new ventilation

Tools:

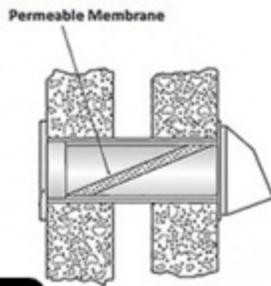
1. Manometer



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



After mitigation, verify that depressurization limits are not being exceeded

MH 6.6003.2 Inline

MH 6.6003.2a - Wiring

Desired Outcome:

Inline fans installed to specification

Specification(s):

Wiring will be installed by a properly licensed contractor, as required by the authority having jurisdiction

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

MH 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 National Electric Code or local authority having jurisdiction

Objective(s):

Fan and service switch will be accessible for maintenance

MH 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

MH 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

MH 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 connections 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 connections will be fastened with tie bands using a tie band tensioning tool
- PVC-to-PVC connections 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 listed material

Objective(s):

Exhaust from desired location to outside

Preserve integrity of the duct system and *building envelope*

MH 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

MH 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



In Progress

Exhaust fan flow should be measured and compared with the fans rated capacity as well as ASHRAE 62.2 requirements.

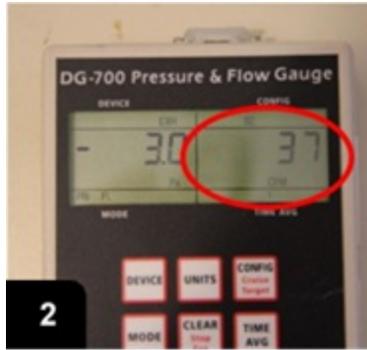
Tools:

1. Digital manometer
2. Exhaust fan flow measuring device
3. Fan speed controller

CFM50 / N-Value		F
3200	41.8	76.5
Continuous Ventilation to (Needed - Credit)		G
30.0		cfm

1

Perform the ASHRAE calculation to determine the Q_{fan} or *continuous ventilation* needed.



2

Measure the fan flow to see how much adjustment is needed.



3

Adjust the fan speed using the chosen fan control device.



4

Re-measure the fan flow, and continue making adjustments until desired flow is achieved.

MH 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

MH 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



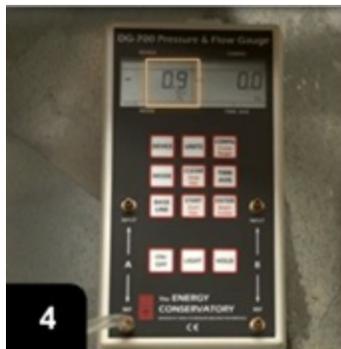
1 Set the house to natural conditions. With the manometer measuring CAZ WRT outside, perform the baseline procedure.



2 Turn on all exhausting appliances (vented outdoors), including the dryer, kitchen fan, and bath fans.



3 Close all doors. With your back to the CAZ, smoke doors with fans behind them. Smoke in: open door, smoke out: close it.



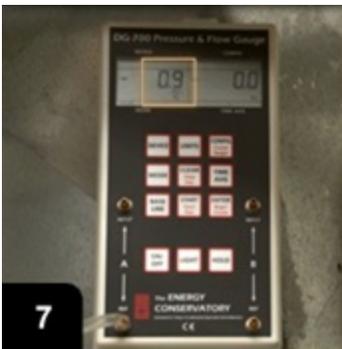
4 Measure CAZ pressure with the door open and record the reading. Close the door and record the reading.



5 Turn on the air handler fan.



6 Recheck all door positions for worst case depressurization. Smoke hits your toes, leave the door closed.



7 Measure CAZ pressure with the door open then closed. Record the readings. Recreate the WCD, or the most negative seen.



8 Fire the unit and check draft pressure using the manometer or combustion analyzer.



Measure flue gases at steady state and record readings. Turn off the unit being tested per manufacturer's instructions.

MH 6.6003.5 Garage Exhaust Fan

MH 6.6003.5b - Air leakage

Desired Outcome:

Contaminants properly removed from house

Specification(s):

Air leakage between the house and garages will be prevented by sealing and weather-stripping

Objective(s):

Ensure occupant health and safety

Reduce *conditioned* air being drawn from the house

Reduce contaminant migration from garage to house



Before

The reading is zero indicating strong connection with the garage.



After

The reading is closer to 50, indicating the garage is connected to the outside.

Tools:

1. Blower door assembly
2. Manometer



Depressurize the house to 50 pascals.



The reading of 50 pascals indicates the zone is more closely connected to the outside.

MH 6.6003.5c - Combustion safety

Desired Outcome:

Contaminants properly removed from house

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

Ensure occupant health and safety



In Progress

Pressure should be measured in the CAZ to verify combustion appliances operate safely.



Best Practice

If depressurization in the CAZ exceeds acceptable limits, return air pathways or make up air may be needed.

Tools:

1. Digital manometer
2. Static pressure probe
3. 1/4" hoses
4. Smoke stick or equivalent
5. Combustion analyzer



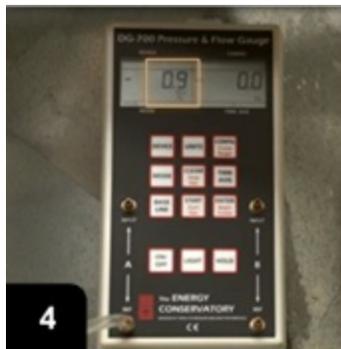
Set the house to natural conditions. With the manometer measuring CAZ WRT outside, perform the baseline procedure.



Turn on all exhausting appliances (vented outdoors), including the dryer, kitchen fan, and bath fans.



Close all doors. With your back to the CAZ, smoke



Measure CAZ pressure with the door open and record

doors with fans behind them. Smoke in: open door, smoke out: close it.

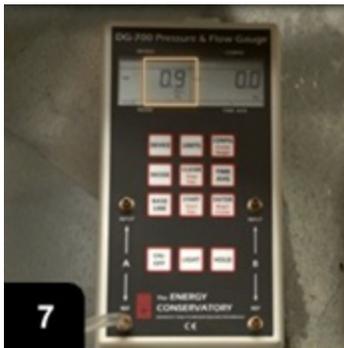


Turn on the air handler fan.

the reading. Close the door and record the reading.



Recheck all door positions for worst case depressurization. Smoke hits your toes, leave the door closed.



Measure CAZ pressure with the door open then closed. Record the readings. Recreate the WCD, or the most negative seen.



Fire the unit and check draft pressure using the manometer or combustion analyzer.



Measure flue gases at steady state and record readings. Turn off the unit being tested per manufacturer's instructions.

MH 6.6003.6 Fan Placement (Whole House/Common Space Exhaust Only)

MH 6.6003.6a - Clearance

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Clearance for size of the fan recommended will be determined

Consideration will be given for adequate head clearance

Objective(s):

Ensure access for installation, operation, and maintenance

Ensure occupant safety

MH 6.6003.6b - Power source

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Power source load will be determined as adequate

Consideration will be given to power source location

Objective(s):

Provide accessible and adequate power source

MH 6.6003.6c - Location

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

No resistance greater than 3 pascals will exist between fan intake location with reference to the common area

Objective(s):

Allow fresh air distribution to common areas

MH 6.6003.6d - Duct/vent

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Consideration will be given to:

- Vent termination location
- Amount of space for duct run
- Roof condition and type (e.g., metal, shingle, bow string, flat)
- Duct insulation

When applicable, pitch duct to remove condensation to outdoors

Ducts will be as straight as possible, fully extended, and have the shortest run possible

To the extent possible, turns will be made so that the radius at the centerline is no less than one duct diameter

Duct diameter will be equal to or greater than the exhaust fan outlet

Fan flow will be verified by flow measurement to meet ASHRAE standard 62.2

Objective(s):

Effectively move the required volume of air

MH 6.6003.6e - Attachment

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Fan will be secured to a structural component

Structural integrity of the *manufactured home* will be maintained (e.g., roof trusses, walls, floor joists)

Objective(s):

Maintain structural integrity Maintain fan attachment

MH 6.6003.6f - Total exhaust airflow

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Total exhaust system airflow will be measured

Objective(s):

Ensure exhaust airflow is as designed



In Progress

Measure the fan flow with the flow meter.

ASHRAE requires the following flows for bath fans: 50CFM intermittent, or 20CFM continuous.

The requirements for kitchen range hoods are: 100CFM intermittent, or 5ACH (for kitchen area) continuous.



Attach hose to the fan meter.



Attach hose to the manometer set to PR/PR.



Adjust gate on the flow meter as needed.



With the flow meter in place, read the resulting pressure on the manometer.

	Meter Pressure (Pa)	Flow (CFM)		
E3		E1	E2	E3
8	4.4	92	43	21
9	4.5	94	44	22
10	4.8	95	45	23
11	5.0	98	46	24
12	5.2	100	47	25
13	5.4	102	48	26
14	5.6	103	49	27
15	5.8	105	50	28
16	6.0	107	51	29
17	6.2		52	30
18	6.4		53	31
19	6.6		54	32
20	6.8		55	33
21	7.0		56	34
22	7.2		57	35
23	7.4		58	36
24	7.6		59	37
25	7.8		60	38
26	8.0		61	39
27	8.2		62	40
28	8.4		63	41
29	8.6		64	42
30	8.8		65	43
31	9.0		66	44
32	9.2		67	45
33	9.4		68	46
34	9.6		69	47
35	9.8		70	48
36	10.0		71	49
37	10.2		72	50
38	10.4		73	51
39	10.6		74	52
40	10.8		75	53
41	11.0		76	54
42	11.2		77	55
43	11.4		78	56
44	11.6		79	57
45	11.8		80	58
46	12.0		81	59
47	12.2		82	60
48	12.4		83	61
49	12.6		84	62
50	12.8		85	63
51	13.0		86	64
52	13.2		87	65
53	13.4		88	66
54	13.6		89	67
55	13.8		90	68
56	14.0		91	69
57	14.2		92	70
58	14.4		93	71
59	14.6		94	72
60	14.8		95	73
61	15.0		96	74
62	15.2		97	75
63	15.4		98	76
64	15.6		99	77
65	15.8		100	78
66	16.0		101	79
67	16.2		102	80
68	16.4		103	81
69	16.6		104	82
70	16.8		105	83
71	17.0		106	84
72	17.2		107	85
73	17.4		108	86
74	17.6		109	87
75	17.8		110	88
76	18.0		111	89
77	18.2		112	90
78	18.4		113	91
79	18.6		114	92
80	18.8		115	93
81	19.0		116	94
82	19.2		117	95
83	19.4		118	96
84	19.6		119	97
85	19.8		120	98
86	20.0		121	99
87	20.2		122	100
88	20.4		123	101
89	20.6		124	102
90	20.8		125	103
91	21.0		126	104
92	21.2		127	105
93	21.4		128	106
94	21.6		129	107
95	21.8		130	108
96	22.0		131	109
97	22.2		132	110
98	22.4		133	111
99	22.6		134	112
100	22.8		135	113
101	23.0		136	114
102	23.2		137	115
103	23.4		138	116
104	23.6		139	117
105	23.8		140	118
106	24.0		141	119
107	24.2		142	120
108	24.4		143	121
109	24.6		144	122
110	24.8		145	123
111	25.0		146	124
112	25.2		147	125
113	25.4		148	126
114	25.6		149	127
115	25.8		150	128
116	26.0		151	129
117	26.2		152	130
118	26.4		153	131
119	26.6		154	132
120	26.8		155	133
121	27.0		156	134
122	27.2		157	135
123	27.4		158	136
124	27.6		159	137
125	27.8		160	138
126	28.0		161	139
127	28.2		162	140
128	28.4		163	141
129	28.6		164	142
130	28.8		165	143
131	29.0		166	144
132	29.2		167	145
133	29.4		168	146
134	29.6		169	147
135	29.8		170	148
136	30.0		171	149
137	30.2		172	150
138	30.4		173	151
139	30.6		174	152
140	30.8		175	153
141	31.0		176	154
142	31.2		177	155
143	31.4		178	156
144	31.6		179	157
145	31.8		180	158
146	32.0		181	159
147	32.2		182	160
148	32.4		183	161
149	32.6		184	162
150	32.8		185	163
151	33.0		186	164
152	33.2		187	165
153	33.4		188	166
154	33.6		189	167
155	33.8		190	168
156	34.0		191	169
157	34.2		192	170
158	34.4		193	171
159	34.6		194	172
160	34.8		195	173
161	35.0		196	174
162	35.2		197	175
163	35.4		198	176
164	35.6		199	177
165	35.8		200	178
166	36.0		201	179
167	36.2		202	180
168	36.4		203	181
169	36.6		204	182
170	36.8		205	183
171	37.0		206	184
172	37.2		207	185
173	37.4		208	186
174	37.6		209	187
175	37.8		210	188
176	38.0		211	189
177	38.2		212	190
178	38.4		213	191
179	38.6		214	192
180	38.8		215	193
181	39.0		216	194
182	39.2		217	195
183	39.4		218	196
184	39.6		219	197
185	39.8		220	198
186	40.0		221	199
187	40.2		222	200
188	40.4		223	201
189	40.6		224	202
190	40.8		225	203
191	41.0		226	204
192	41.2		227	205
193	41.4		228	206
194	41.6		229	207
195	41.8		230	208
196	42.0		231	209
197	42.2		232	210
198	42.4		233	211
199	42.6		234	212
200	42.8		235	213
201	43.0		236	214
202	43.2		237	215
203	43.4		238	216
204	43.6		239	217
205	43.8		240	218
206	44.0		241	219
207	44.2		242	220
208	44.4		243	221
209	44.6		244	222
210	44.8		245	223
211	45.0		246	224
212	45.2		247	225
213	45.4		248	226
214	45.6		249	227
215	45.8		250	228
216	46.0		251	229
217	46.2		252	230
218	46.4		253	231
219	46.6		254	232
220	46.8		255	233
221	47.0		256	234
222	47.2		257	235
223	47.4		258	236
224	47.6		259	237
225	47.8		260	238
226	48.0		261	239
227	48.2		262	240
228	48.4		263	241
229	48.6		264	242
230	48.8		265	243
231	49.0		266	244
232	49.2		267	245
233	49.4		268	246
234	49.6		269	247
235	49.8		270	248
236	50.0		271	249
237	50.2		272	250
238	50.4		273	251
239	50.6		274	252
240	50.8		275	253
241	51.0		276	254
242	51.2		277	255
243	51.4		278	256
244	51.6		279	257
245	51.8		280	258
246	52.0		281	259
247	52.2		282	260
248	52.4		283	261
249	52.6		284	262
250	52.8		285	263
251	53.0		286	264
252	53.2		287	265
253	53.4		288	266
254	53.6		289	267
255	53.8		290	268
256	54.0		291	269
257	54.2		292	270
258	54.4		293	271
259	54.6		294	272
260	54.8		295	273
261	55.0		296	274
262	55.2		297	275
263	55.4		298	276
264	55.6		299	277
265	55.8		300	278
266	56.0		301	279
267	56.2		302	280
268	56.4		303	281
269	56.6		304	282
270	56.8		305	283
271	57.0		306	284
272	57.2		307	285
273	57.4		308	286
274	57.6		309	287
275	57.8		310	288
276	58.0		311	289
277	58.2		312	290
278	58.4		313	291
279	58.6		314	292
280	58.8		315	293
281	59.0		316	294
282	59.2		317	295
283	59.4		318	296
284	59.6		319	297
285	59.8		320	298
286	60.0		321	299
287	60.2		322	300
288	60.4		323	301
289	60.6		324	302
290	60.8		325	303
291	61.0		326	304
292	61.2		327	305
293	61.4		328	306
294	61.6		329	307
295	61.8		330	308
296	62.0		331	309
297	62.2		332	310
298	62.4		333	311
299	62.6		334	312
300	62.8		335	313
301	63.0		336	314
302	63.2		337	315

MH 6.61 Supply

MH 6.6102 Components

MH 6.6102.4 Intake for Ventilation Air to Forced Air System Used for Heating or Cooling

MH 6.6102.4a - 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 the outside will be less than 10% of the air handler flow when measured at 25 pascals with reference to the outside

Any portion of the return located inside the *combustion appliance zone* will be air sealed

Objective(s):

Reduce migration of pollutants

MH 6.6102.4b - Wiring

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Wiring will be installed by a properly licensed contractor, as required by the authority having jurisdiction

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

MH 6.6102.4c - 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

MH 6.6102.4d - 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 reaching the thermal conditioning components

Filtration will be accessible and serviceable

Duct will be connected to intake fitting

Connection and seal will be performed in accordance with supply duct detail

Objective(s):

Ensure short duct run to achieve optimum air flow

Preserve integrity of the duct system and *building envelope*

MH 6.6102.4e - 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

MH 6.6102.4f - 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

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*

MH 6.6102.4g - 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):

Ensure occupant health and safety

Preserve integrity of the *building envelope*

MH 6.6102.4h - Intake ventilation airflow

Desired Outcome:

Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability

Specification(s):

Total intake ventilation airflow will be measured

Objective(s):

Ensure airflow is as designed

MH 6.6188 Special Considerations

MH 6.6188.2 Removing Supply Vents from Garages

MH 6.6188.2a - Removal of supply/return in garage

Desired Outcome:

Safe removal of garage supply 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, the supply run will be truncated at the plenum

If connected to a Y or T branch system, the supply run 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 duct leakage

MH 6.6188.2b - Patching of the hole in the duct system created by removal

Desired Outcome:

Safe removal of garage supply 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

MH 6.6188.2c - Sealing of the patch

Desired Outcome:

Safe removal of garage supply vents

Specification(s):

All patches will be sealed with mastic meeting UL 181 and in accordance with manufacturer specifications

Objective(s):

Ensure an airtight patch

MH 6.6188.2d - Removal of discarded ducts

Desired Outcome:

Safe removal of garage supply vents

Specification(s):

All abandoned ductwork will be removed from work area

Objective(s):

Provide a clean work site

MH 6.6188.2e - Patching of the register hole in garage

Desired Outcome:

Safe removal of garage supply vents

Specification(s):

Holes 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

MH 6.6188.2f - External static pressure testing

Desired Outcome:

Safe removal of garage supply 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

MH 6.6188.2g - CAZ testing

Desired Outcome:

Safe removal of garage supply vents

Specification(s):

CAZ testing will be performed where combustion appliances

are utilized

Objective(s):

Identify possible conditions that can cause unsafe equipment operating conditions



See
[SWS 2.0101.1a -](#)
[2.0201.1e](#)
for CAZ testing

Best Practice

Complete *combustion appliance zone* testing to ensure a healthy, safe environment

Tools:

1. Manometer
2. Mirror
3. Chemical smoke pencil
4. Stopwatch or watch with second hand
5. Combustion analyzer
6. 1/4" air line tubing
7. Gas leak detector

At the end of each day in which duct sealing or repair is performed, conduct *combustion appliance zone* (CAZ) testing in accordance with the NREL Standard Work Specifications, details [2.0201.1a through 2.0201.1e](#).

MH 6.62 Whole Building Ventilation

MH 6.6205 Exhaust-Only System

MH 6.6205.1 *Manufactured Housing* Exhaust-Only Strategies

MH 6.6205.1a - Assessment

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Assessment will be done using ASHRAE 62.2 standard:

- Blower door test
- Fan flow measurements
- Calculations

Objective(s):

Determine the ventilation needs of the whole house

Provide primary ventilation for common spaces

Specification(s):

Fan type will be capable of continuous operation and selected in accordance with ASHRAE 62.2 for:

- Sizing
- Climate considerations
- Control strategy
- Sone rating
- Durability

Fan will be ENERGY STAR[®] qualified

Objective(s):

Determine proper fan selection

Minimize energy consumption during fan operation



Best Practice

Fans should be marked with the ENERGY STAR[®] logo.

Sone Rating Limits of 62.2

	Local Exhaust [SPOT] INTERMITTENT	Local Exhaust [SPOT] CONTINUOUS	WHOLE BUILDING
New Fans	3.0	1.0	1.0
Existing Fans	N/A	N/A	1.0

No sone requirement when.....

- Using an existing fan with a timer
- Remote mounted fans (i.e. inline fan in the attic)

Best Practice

MH 6.6205.1c - Location

Desired Outcome:

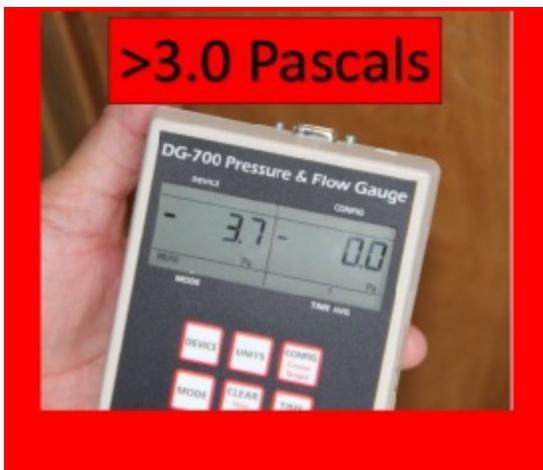
Provide primary ventilation for common spaces

Specification(s):

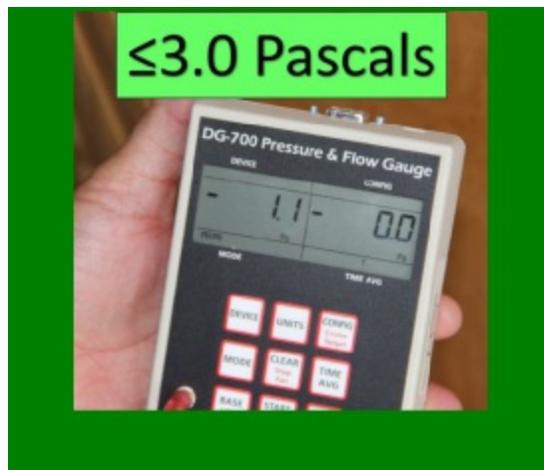
No resistance greater than 3 pascals will exist between fan intake location with reference to the common area

Objective(s):

Ensure fresh air distribution to common areas



Before



After

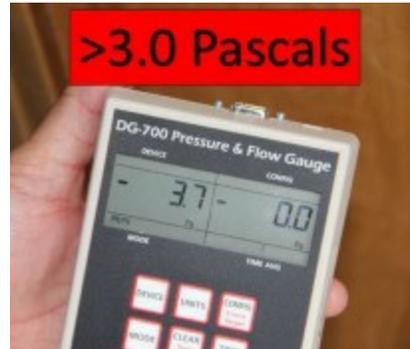


Locate the fan in question.



Turn on the exhaust fan.

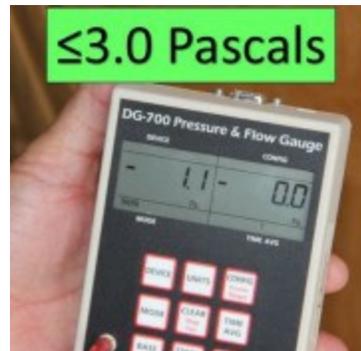
Connect a hose, and turn the manometer on to PR/PR.



If the pressure difference is greater than 3.0 pascals, pressure relief is needed.



If pressure relief is needed, it can be provided by a through the door transfer grille.



After pressure relief has been provided recheck the numbers, ensuring a reading within range.

Tools:

1. Digital manometer

MH 6.6205.1d - Climate considerations

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

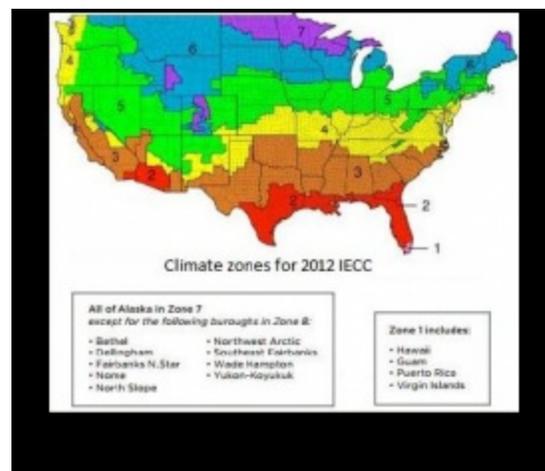
ASHRAE 62.2 will be referenced for climate considerations

Whole house mechanical net exhaust flow for hot-humid climate will not exceed 7.5 cubic feet per minute/100 square feet

Objective(s):

Maintain building durability

Protect occupant health



Best Practice

Climate should be considered when selecting a ventilation strategy. Hot humid climate zones require special attention.

MH 6.6205.1e - Combustion Appliance Zone (CAZ) testing

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

CAZ testing will be performed where combustion appliances are utilized, where applicable

Objective(s):

Identify possible conditions that can cause unsafe equipment operating conditions



See [SWS 2.0101.1a - 2.0201.1e](#)
for CAZ testing

Best Practice

Complete *combustion appliance zone* testing to ensure a healthy, safe environment

Tools:

1. Manometer
2. Mirror
3. Chemical smoke pencil
4. Stopwatch or watch with second hand
5. Combustion analyzer
6. 1/4" air line tubing
7. Gas leak detector

At the end of each day in which duct sealing or repair is performed, conduct *combustion appliance zone* (CAZ) testing in accordance with the NREL Standard Work Specifications, details [2.0201.1a through 2.0201.1e](#).

MH 6.6205.1f - Occupant education

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Occupant will be educated on:

- Purpose of the ventilation system
- Proper operation and use of controls
- Cost and benefit of system
- Manual shut off

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

Operation guide or label will be permanently attached and in full sight

Objective(s):

Ensure occupant is educated on the safe and efficient operation of the system

Deliver intended air exchange



Before

Clients should be educated on the purpose and operation of their new ventilation system.



After

Whole house ventilation should be clearly labeled.

MH 6.6205.1g - Total exhaust airflow

Desired Outcome:

Provide primary ventilation for common spaces

Specification(s):

Total exhaust system airflow will be measured

Objective(s):

Ensure exhaust airflow is as designed



In Progress

Measure the fan flow with the flow meter.



Attach hose to the fan meter.



Attach hose to the manometer set to PR/PR.



Adjust gate on the flow meter as needed.



With the flow meter in place, read the resulting pressure on the manometer.

E3	Meter Pressure (Pa)	Flow (CFM)		
		E1	E2	E3
8	4.4	92	43	21
9	4.5	94	44	22
10	4.8	96	45	23
11	5.0	98	46	24
12	5.2	100	48	25
13	5.4	102	49	26
14	5.6	104	50	27
15	5.8	106	51	28
16	6.0	108	52	29
17	6.2	110	53	30
18	6.4	112	54	31

Match the pressure reading to the gate selection and read the final *CFM* flow.

Tools:

1. Exhaust fan flow meter
2. Manometer

MH 6.6288 Special Considerations

MH 6.6288.2 Sound Ratings - New Fan Installation

MH 6.6288.2a - Primary ventilation system/continuously operating fan

Desired Outcome:

Systems operate as quietly as possible

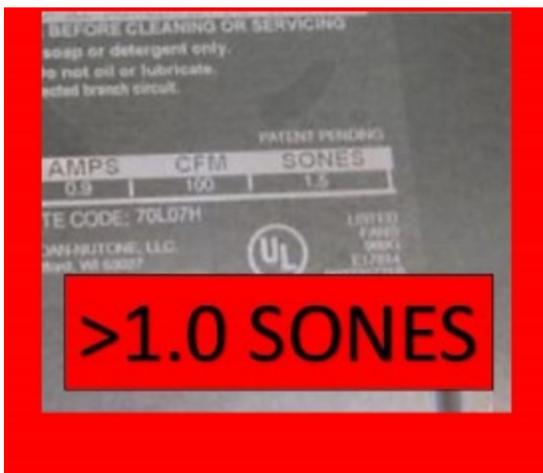
Specification(s):

System will be rated at a sound no greater than 1.0 sone

Objective(s):

Minimize noise

Maximize fan use



Bad Practice

This fan is rated at 1.5 SONES and is NOT acceptable for continuous use.



Best Practice

This fan is rated at 1.0 sones and is acceptable for continuous use.

MH 6.6288.2b - Intermittent spot ventilation system

Desired Outcome:

Systems operate as quietly as possible

Specification(s):

Spot ventilation (local mechanical exhaust systems operated as needed by the occupant; e.g., range hood, bath fans) will be rated at a sound no greater than 3.0 sone

Objective(s):

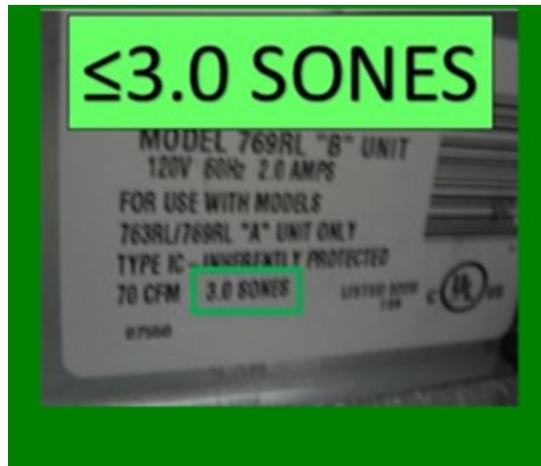
Minimize noise

Maximize fan use



Bad Practice

This fan is rated at 3.5 SONES and is NOT acceptable for intermittent use.



Best Practice

This fan is rated at 3.0 sones and is acceptable for intermittent use.