

Weatherization Operations Manual

Section 5. Building Standards

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General Policies

Weatherization services shall be provided in a manner that minimizes risk to workers, clients, and dwellings.

Installation of weatherization measures shall comply with the standards in this section.

A written explanation must be in the client file for weatherization measures that do not meet an SIR of 1 per AkWarm or are not 1A on the Priority List.

Additional requirements are provided throughout the Weatherization Operations Manual (**WOM**) and the grant.

AHFC will provide to Grantees a CD of the Energy Outwest *Weatherization Field Guide*, which is referred to in these standards.

1.0 General Requirements

The Grantee shall perform all work or ensure that its contractors perform all work consistent with the provisions of the grant agreement, all applicable laws, ordinances, regulations, industry standards, and other applicable authority as amended from time to time. All work shall be completed consistent with good workmanship performed by craftsmen skilled in their trade. The provisions in this paragraph shall supersede any other provision of this WOM; additional information, if any, provided in subsequent sections of the WOM is intended to complement, not contradict, other authority. Whenever the information provided in this WOM may not be consistent with comparable standards imposed by other law, ordinance, regulation, industry standard or other applicable authority, the provisions that are more restrictive or that impose higher standards or requirements shall govern.

1.1 Subcontractors

The following requirements apply to Subcontractors (Service Dealers) who work in units that are to be weatherized.

1.1.1 Subcontractor License and Insurance Requirement

All Subcontractors must be licensed, bonded, and insured in accordance with state law. Copies or printouts of individual contractor license, insurance, and bonding information must be kept on file for all contractors and updated, at a minimum, annually.

1.1.2 Competency

It is important that installers and technicians be qualified to do the work required under this program. The Grantee should be aware that there are many trades for which the State of Alaska does not require workers to have a professional license.

Therefore, the competence of the installer or repair technician must be determined by other means such as the general reputation of the business, competency certifications provided by equipment manufacturers, or by technical schools with Heating Ventilation and Air Conditioning (HVAC) or other programs.

1.2 Warranties

The Grantee and all Subcontractors shall provide warranties against any defect in the material, manufacture, design, or installation of all materials, equipment, or products that is found within one (1) year from the date of completion of installation. The defects found within the warranty period shall be remedied without charge to the client and within a reasonable period of time.

1.3 Code Compliance

All materials, equipment, or products installed will comply with applicable federal, state, and local laws and code regulations.

1.4 Asbestos

When the presence of asbestos is suspected and likely to be disturbed during the installation, modification or replacement of any materials, equipment or products, all health and building regulations and codes requirements shall be followed.

1.5 Materials

All materials used shall meet the specifications found in Section 8, *Materials Standards* (i.e., *10 CFR 440 Appendix A—Standards for Weatherization Materials*).

1.5.1 Alternate Materials

The Grantee shall get written approval to use alternate materials from the Alaska Housing Finance Corporation Weatherization Manager.

1.6 Manufacturer's Requirements

The Grantee and Subcontractors shall conform to all manufacturers' requirements regarding installation, use and maintenance of all materials, equipment, or products installed or supplied through the Weatherization program.

1.7 Certificate of Insulation

The certificate of insulation shall contain the following information, and shall be completed in ink and signed by the installer:

- a. Address of residence.
- b. Date of installation.
- c. Name, address, and phone number of installer.
- d. Amount (number and size of bags).
- e. Final R-value of insulation.
- f. Area of space in square feet that was insulated.

1.7.1 Posting of Certificate

Upon completion of the installation of the insulation, the completed certificate shall be posted in the interior of the area insulated in a location nearby, and visible, from the access to the area. A copy of the certificate shall also be kept in the client file of the Grantee.

1.7.2 Posting Empty Bag/Wrapper

Upon completion of the installation of the insulation, the Grantee or Subcontractor shall post near the Certificate of Insulation an empty bag or wrapper from the insulating material that was installed.

1.7.3 Delivery of Certificate

The completed certificate shall be kept in the permanent file of the Grantee. A copy of the certificate will also be given to the client.

1.8 Savings to Investment Ratio (SIR)

The Grantee shall install those individual conservation measures that have a savings to investment ratio of 1.0 or greater.

Exception(s):

- a. A measure with an SIR of 1 or greater can be deferred if the Grantee does not have adequate funding to install the measure

2.0 Health and Safety

During the course of performing energy assessments and/or weatherization work, the work in progress at each dwelling must be monitored in order to identify potential or existing hazards to either weatherization workers or dwelling occupants. All work

must be completed consistent with the provisions of the grant agreement, all applicable laws, ordinances, regulations, industry standards, and other applicable authority as amended from time to time. Strict compliance with OSHA or other safety standards is mandatory. The provisions in this paragraph shall supersede any other health and safety provision referenced in Section 5, *Building Standards* of this WOM; additional information, if any, provided in subsequent sections of Section 5, *Building Standards* is intended to complement, not contradict, other authority. Whenever the information provided in Section 5, *Building Standards* may be inconsistent with comparable standards imposed by other law, ordinance, regulation, industry standard or other applicable authority, the provisions that are more restrictive or that impose higher standards or requirements shall govern.

2.1 Worker Safety

Each worker is responsible for working in a safe manner so as to not endanger either himself or others. Individuals who continue to demonstrate that they are unable to work in a safe, workmanlike manner shall undergo additional safety training. Worksite supervisors are responsible for insuring the safety of all workers and client on the worksite.

All weatherization workers, whether employees or subcontractors, are required to abide by the State of Alaska Occupational Safety and Health Standards, Volumes I & II, (8 AAC 05) published by and available through the Alaska Department of Labor, Division of Labor Standards and Safety. Additionally, weatherization workers are required to abide by all regulations adopted by reference in 8 AAC 05 "State of Alaska Occupational Safety and Health Standards, Lead in Construction (8 AAC beginning 05.265) and the Construction Code for Asbestos (8 AAC beginning 05.045).

Agencies should inform workers of potentially hazardous sanitation conditions and possible exposure to disease.

Workers in rural area should be advised that they may be exposed to and immunizations are available for communicable diseases such as tuberculosis, hepatitis and others as may be identified. Immunization for these workers is an allowable program expense.

The Alaska Housing Finance Corporation Weatherization Assistance Program allows a waiver for non-performance of assessments, installations, or any portion of these functions, if such action will expose workers to conditions regarded as unsafe or unhealthy as determined by OSHA Construction Industry Standards.

2.2 Housekeeping Activities

All scrap lumber, waste material and debris will be removed from the immediate area as work progresses. An area outside the home should be designated for storing such material and removed from the premises at the end of each work day or when the job is completed.

Equipment (i.e., blower hose, power tools, extension cords, etc.) will be removed from the immediate work area and properly stored when no longer required or when each phase of the weatherization process is completed.

2.3 Client Safety

Grantees and their representatives are required to take all reasonable precautions against performing work on homes that will subject clients to health and safety risks. During the initial assessment, the assessor will make an evaluation of conditions existing within the home. In cases where a person's health is fragile and/or crew work activities would constitute a health or safety hazard, special arrangements shall be required to ensure occupants are protected.

2.4 Walk-Away Policy

If conditions exist where repairs are required that are beyond the scope of the WAP, health and safety conditions are such that weatherization workers or materials would be jeopardized, or weatherization activities may aggravate an unsafe situation or the durability of the home, the Grantee may choose to not weatherize that home until such conditions are remedied. If that choice is made, a written notification to the client and/or homeowner will be issued, clearly explaining the conditions and that work may commence when the conditions are remedied. Such notice may specify a timeframe for resolving the condition that is reasonable for the client and the program. See also WOM Section 1, *Walk-Away Policy* on pg. 1-33.

3.0 Home Energy Assessments

All homes receiving weatherization services shall receive an on-site assessment.

3.1 Scope of Assessment

The Grantee shall evaluate the dwelling for the following:

- a. Cost-effective energy efficiency improvements.
- b. Comfort issues.
- c. Health and safety issues.
- d. Building issues that may negatively affect or prohibit installation of energy efficiency measures.

3.2 Assessment Requirements

3.2.1 In-Home Safety

The Energy Assessor should be aware of unsafe conditions encountered in the course of the energy assessment. Specific precautions will be exercised to protect both occupants and crew workers. Complications that may arise from existing unsafe

conditions will be documented before any work begins on a home. If conditions exist that could pose a hazard to clients or crews, the assessor may decide to delay weatherization work until those conditions are remedied.

Potentially unsafe conditions may include but not be limited to:

Carbon Monoxide/Indoor Air Quality: Workers shall not be exposed to carbon monoxide (CO) levels greater than 200 ppm ambient. Clients shall be notified of the potential dangers of CO exposure.

Awareness of CO; the knowledge that for all pollutants, the level of pollution increases if there is an increase at the source or a decrease in dilution air; and attention on the part of weatherization personnel to the level of air-tightening measures performed on a home will aid in the prevention of making a bad situation worse. The energy assessor should be attentive to client's lifestyle, hobbies (i.e., thinners, varnishes, glue, tobacco smoke etc.), that may attribute to poor indoor air quality. When applicable, provide client education pertaining to proper ventilation, by opening windows, using exhaust fans (when such materials are used) and properly sealing containers when not in use. If possible, such materials should be used and stored outside the living area. If conditions where lifestyle causes or contributes to poor indoor air quality, air sealing work may be limited to the discretion of the assessor. The client should be informed in writing when air sealing work has been limited due to lifestyle.

Sanitation: No worker shall be required to work in surroundings or working conditions which are unsanitary, hazardous, or dangerous to one's health and safety. Such conditions should be documented and remedied prior to commencing or as a part of weatherization activities.

Electrical: The condition of wiring may be affected by weatherization activities. Precautions will be taken when working around wiring throughout the home. When necessary, specific instructions will be documented.

Address problems that will interact with weatherization (i.e., shielding combustible materials from heat producing sources; minor repair of connections; fuse/circuit breaker replacement, etc.) or obvious hazards to workers or clients. Notify the client/property owner of other issues that are beyond the scope of the Weatherization program, (i.e., replacement of unsafe service panel; extensive replacement of unsafe wiring, etc.).

Structural: Weatherization materials (i.e., cellulose, fiberglass, etc.) will be shielded from both indoor and the outdoor environments. Shielding protects both the weatherization materials, and more importantly, the occupants from exposure to the insulation fibers.

Structural repair measures include replacement of a damaged or missing section of the building envelopment (i.e., drywall, plywood or other sheathing material). Another measure may include repairing damaged or leaking components to protect insulation.

Notify the client/property owner of other issues that are beyond the scope of the Weatherization program, (i.e., extensive roof repair, major portions of the interior

surface area requiring drywall, and major portions of the exterior surface area requiring sheathing material, etc.). The intent of the WAP is energy conservation and not housing rehabilitation.

3.2.2 All assessments will include:

- a. Diagnostic testing (blower door testing). See Section 4, *Diagnostic Testing*.
- b. Combustion safety diagnostic testing when combustion appliances are present. See example in WOM Section 6, *Combustion Safety Maximum Depressurization Data Sheet*.
- c. Mold Disclosure report. See example in WOM Section 7.
- d. Health and Safety notification.
- e. Visual inspection, which shall include inspecting all accessible areas as follows:
 1. Attics.
 2. Crawlspace.
 3. Building envelope.
 4. Roofs.
 5. Insulation levels.
 6. Heating systems.
 7. Ventilation systems.
 8. Interior surfaces.
 9. Appliances.
 10. Home energy bills.
 11. Plumbing and electrical (only where insulation may be installed).
 12. Smoke alarms and CO detectors.

3.3 Review of Assessment with Client

The Grantee shall review the findings of the assessment and anticipated scope of work with the occupants of the dwelling. Documentation of the assessment findings and anticipated scope of work shall be retained in the client file.

3.4 Client Authorization

The Grantee shall obtain a signature from the client (occupant of the dwelling unit) and the landlord (if it is a rental dwelling), authorizing installation of the measures to be performed on the eligible dwelling prior to work commencing. A copy of the signed authorization shall be retained in the client file.

Exception(s):

- a. Low-cost/No-cost measures may be installed before assessment findings are reviewed with the occupants and landlord.

3.5 Assessment Documentation

The Grantee shall document the findings of all assessments in the client file. These findings shall describe the condition of the home at the time of the assessment, the work performed, and the final condition of the home.

3.5.1 Photographic Record

The Grantee shall record the condition of the home by taking a minimum of 2 photographs of the home's exterior elevation that capture the essence of the dwelling unit. These photographs shall be dated and retained in the client file.

3.6 Computerized Assessment Tool

The Grantee shall evaluate 95% of homes using an AkWarm computerized energy assessment. A copy of the assessment must be retained in the client file. The use of the Priority List is allowed for the remaining 5%. See Section 3.7, *Priority List*.

3.6.1 Savings to Investment Ratio (SIR)

The Grantee shall install those individual conservation measures that have a savings to investment ratio of 1.0 or greater.

Exception(s):

- a. A measure with an SIR of 1 or greater can be deferred if the Grantee does not have adequate funding to install the measure

3.6.2 Computerized Assessment Program Maintenance

The Grantee is required to maintain the following areas and data related to the computerized assessment:

- a. Update new versions of software as required.
- b. All assessors shall be trained to perform a computerized energy assessment.

3.6.3 Calculation of Installed Measure Cost

The Grantee shall calculate installed measure costs. Only conservation measures shall be included in the calculation. Measure costs shall be calculated using one of the following methods:

1. Installed measure costs are equal to verifiable contractor costs.
2. Local crew-based agencies may calculate and document their construction costs including materials, labor costs, and associated overhead.

3. Local crew-based agencies may calculate and document their construction costs including the actual materials and labor costs and then use a 20% multiplier (20% of the materials and labor) for an estimated associated overhead.

Associated Overhead Costs are those overhead costs associated with a particular installed measure, including, but not limited to: benefits/fringe, rent, telephone, utilities, insurance, vehicle costs (purchase, operating, insurance, depreciation, repair and maintenance), and tool costs (purchase, amortization/depreciation, storage, and repair and maintenance).

3.7 Priority List

When computerized assessment is not used, the Grantee shall utilize the approved Priority List...

3.8 Analysis of Base Load Costs

The Grantee shall analyze base load costs for each dwelling unit when fuel histories are available. Base load cost data shall be used to determine cost-effective energy conservation and energy education opportunities.

4.0 Diagnostic Testing

The Grantee shall perform diagnostic testing on all dwelling units prior to weatherization measures being installed and upon completion of each project.

4.1 Diagnostic Testing Equipment

The Grantee shall:

- a. Use a digital manometer to perform all pressure diagnostic testing measurements.
- b. Have blower door(s) maintained and digital manometer(s) calibrated as recommended by the manufacturer.
- c. Keep on file a record of maintenance and calibration for all diagnostic equipment.
- d. Document and have the client sign any measure that is recommended for health and safety that is refused by the client.

4.2 Single Point Blower Door Test

The Grantee shall perform a single point depressurized blower door test before any weatherization measures are installed, and at the conclusion of any project. Results of pre and post weatherization blower door testing must be documented in the client file. If unable to complete pre or post blower door, provide documentation in client file to justify.

Exception(s):

- a. A pressurized single point blower door test is acceptable to avoid the possibility of pulling known pollutants into the building during the test procedure (e.g. mold from walls or crawlspaces). If it is required to complete a positive test, then post weatherization test will also be positive pressure test.

4.2.1 Building Set-Up

The goal of the setup is to test the thermal boundary of the dwelling. We want to include conditioned crawlspaces and lofts. The exception is conditioned attached garages. Due to the potential for pollutants, the garage will be isolated from the tested volume, and air sealing will be directed toward the dividing wall and door between the home and garage in addition to the thermal boundary. **DO NOT** temporarily seal intentional openings in the building envelope (such as dryer exhaust, ventilation system intake or exhaust; or a chimney for a furnace or water heater). Below is the building set-up:

- Close all exterior windows.
- Close all exterior doors (Doors from the house to unheated arctic entries are considered exterior and shall be closed for the test.)
- Close all doors between house and garage.
- Close exterior garage pedestrian and vehicle doors.
- Close exterior crawlspace hatches.
- Open all interior doors to rooms and basement that are conditioned, including an access hatch to a conditioned crawlspace and doors to conditioned utility/heater rooms. The objective is to treat the entire building as one conditioned space (except for attached garages) and to subject all of the leaks in the building to the same pressure difference.
- Turn off all combustion appliances, so they will not turn on during the test. (**Note:** *If combustion appliances turn on during a depressurization test, it is possible for flames to be sucked out of the combustion air inlet (flame rollout). This is a fire hazard and possibly can result in high CO levels.*)
- If there are attached spaces (e.g., townhouses) that could contain a vented combustion appliance, either adjust those appliances to prevent them from turning on during the test or be sure that the attached spaces are not depressurized or pressurized when the blower door is operating.
- Be sure that fires in fireplaces and woodstoves are completely out. Take precautions to prevent ashes from being sucked into the building during the test.
- Turn off all exhaust fans, vented dryers, air conditioners, ventilation system fans, and air handler fans.

4.2.2 Blower Door Setup and Test Procedure

The Grantee shall reference the blower door Owner's Manual for guidance on blower door set up, manometer set up, and single point test procedure. Buildings will be set

up as detailed above—not per the Owner’s Manual. The blower door test pressure will depressurize (or pressurize depending on the situation) the home by 50 Pascals from the baseline pressure. **Example:** *If the measured building baseline pressure was negative 2 Pascals (-2 Pa), the new target test pressure becomes (-2 + (-50)) or -52. In other words, you will need to depressurize the building to -52 Pascals for your One-Point Test. The main point to remember is that we want to change building pressure by 50 Pascals from the starting point (baseline) pressure.*

4.2.3 Baseline Data

The Grantee shall document baseline information, such as wind speed, temperature, baseline pressure, using a diagnostic test report.

4.2.4 Pre- and Post-Test Home Set-Up

Building configuration including attic vents, garage exterior doors, crawlspace exterior hatches, etc. should be configured the same for both the pre and post test. To acquire reliable numbers, consistent building setup is required.

4.3 Blower Door Tests in Multi-Unit Buildings.

All tests are single point CFM50 unless otherwise noted.

- 4.3.1 In buildings with 12 or more units, blower door testing is not required but may be undertaken at the discretion of the Grantee. If testing is performed, multi-point testing is required. If testing is not performed, the Grantee shall ensure completion of all priority air sealing tasks. Blower door diagnostics must still be used for identifying bypasses.
- 4.3.2 When weatherizing buildings of less than 12 units, blower door testing before and after weatherization must be completed. The appropriate test procedure is dictated by the building type and the size/leakiness of the building. Where the building configuration or Grantee resources make it impossible to complete an accurate blower door test, an explanation of why no test was performed with detailed justification must be filed in the client file. This is expected to occur only on an occasional basis. Blower door diagnostics must be used for identifying bypasses and air sealing.
- 4.3.3 In townhome-style (shared walls, but no shared floor/ceiling assemblies) apartment buildings where only an individual unit is to be weatherized, blower door testing before and after weatherization must be completed. Every effort should be made to have adjacent units at ambient pressure (several windows or exterior doors open to outdoors) when testing the weatherized unit. Document test conditions with the location and size of open windows and doors in the adjacent units. Conduct the post test in the same manner as the pre test.

- 4.3.4 In townhome-style (shared walls, but no shared floor/ceiling assemblies) apartment buildings where the entire building is to be weatherized, a single-point guarded blower door test at -50 pa must be completed on each individual unit before and after weatherization. A guarded blower door test is performed with blower doors in adjacent units operating at the same pressure as the target unit so that walls entirely inside conditioned space have the same blower door pressure on both sides. Where that building includes a conditioned crawlspace, the crawlspace shall be included in blower door tests.
- 4.3.5 In townhome-style condominium buildings (where each unit is individually owned and common walls are property line separations) and where only an individual unit is to be weatherized, blower door testing before and after weatherization must be completed. Conditioned crawlspaces shall be included in the blower door test. Creating conditions where adjacent units are kept at ambient pressure when testing the weatherized unit is not required. The Grantee may choose to create such conditions at the Grantee's discretion. Document test conditions with the location and size of open windows and doors in adjacent units.
- 4.3.6 In townhome-style condominium buildings where the entire building is to be weatherized, a single-point guarded blower door test at -50 pa should be completed on each unit before and after weatherization. Conditioned crawlspaces shall be included in the blower door test.

Where access to the crawlspace cannot be made through a conditioned living space, such as where access is through an opening in the perimeter foundation wall, do not include the crawlspace in the blower door test.

- 4.3.7 In multi-level condominium buildings where only an individual unit is to be weatherized, blower door testing before and after weatherization should be completed. Document test conditions with the location and size of open windows and doors in the adjacent units and make sure the pre and post test are done in the same manner.
- 4.3.8 In multi-level apartment and condominium buildings where the *entire building* is to be weatherized and where there is a common entry and common hallway that make it possible to complete a "whole-building" blower door test, open all units to common hallways and entries to create one test zone. If the crawl space is conditioned, it should be opened to the building during the test.
- a. If the building is small enough or tight enough that it can be tested to -50 pa with one blower door (CFM50 < approximately 5,000), complete a single point test at -50 pa.
 - b. Where -50 pa cannot be reached with a single blower door, use multiple blower doors to complete a multi-point depressurization test. Measure pre- and post-test baselines to calculate baseline corrections. Evaluate the test data with analysis software as recommended by the blower door manufacturer.
 1. The blower door test shall include a minimum of five test pressures from approximately -75 to -25 pa. Use 10-second (or longer) time averaging. The

strongest test pressure should not exceed 80 pa. The weakest test pressure should be greater than three times the most extreme baseline pressure measured. In windy conditions, increase the weakest test pressure to four times the baseline pressure measured, verify that all parts of the building are depressurized equally, with pressure variation of less than ± 10 percent.

2. Collect data and make corrections for indoor/outdoor temperature difference and climate/wind affects, as provided in the analysis software.
3. A test of sufficient accuracy will have a correlation coefficient (R2) of 0.99 or greater, a regression coefficient, n, of 0.5 to 0.99 inclusive, and a CFM50 value with an error of less than ± 2.0 percent.
4. It is common to test at more than five pressures and select no less than five test data points (discard outliers) in evaluating the blower door test.

4.4 Zonal Pressure Testing

The Grantee shall perform zonal pressure testing in all zones (attics, crawlspaces, garages, unconditioned crawlspaces, etc) with more than 50 sq. ft. of common surface with the intended thermal boundary of the dwelling. The test shall be performed prior to the installation of weatherization measures that alter the shell of the dwelling. Zonal pressures shall be recorded with reference to (WRT) the living space of the home. Post zonal pressure testing shall be done before the installation of attic or crawlspace ventilation. Pre and post zonal pressure measurements shall be documented in the client file.

4.4.1 Duct System Testing

The Grantee shall perform pressure pan (or pressure block) testing of all forced air duct systems. Duct system standard for tightness is 1 pa or less at each supply register. The standard for return plenums is 5 pa or less. See Section 15.6, *Duct Sealing*. Post testing of ducts in enclosed cavities, such as wall bays, dropped ceilings, floor joists, mobile home bellies, etc., shall be performed prior to insulating those cavities. Pre and post duct pressure pan measurements shall be recorded in the client file.

Exception(s):

- a. Duct systems that are entirely within the heated building envelope and not connected to any exterior wall, attic or ceiling building component or buffered zone, are not required to be tested.
- b. The Grantee may use a duct tester to perform duct tightness testing. The standard for tightness is 100 cfm leakage to outside at 25 pa.
- c. Duct tightness testing and standards shall take into consideration the homes plumbing system and potential freeze-ups. If duct sealing is not completed and numbers are above the standard, document the reason in the file for not sealing.

4.5 Dominant Duct Leak Testing

The Grantee shall perform dominant duct leakage testing of all homes with ducted forced air heating distribution systems. Pre and post dominant duct leakage measurements shall be recorded in the client file. See *Field Guide, Section 2.7, Duct-Blower Leak-Testing, Dominant duct leakage*. Standard for dominant duct leakage is no more than 1.5pa or 100cfm of leakage to outside.

4.6 Room-to-Room Pressure Differential Testing

The Grantee shall test and record the pressure differential between rooms with supply only ducts and the main body of the dwelling. Pressure differentials of more than 5pa must be corrected. See *Field Guide, Section 2.7, Duct-Blower Leak-Testing, Room pressure imbalance*. Pre and post pressure differential measurements shall be recorded in the client file.

4.7 Diagnostic Testing Equipment

The Grantee shall:

- a. Use a digital manometer to perform all pressure diagnostic testing measurements.
- b. Have blower door(s) maintained and digital manometer(s) calibrated as recommended by the manufacturer.
- c. Keep on file a record of maintenance and calibration for all diagnostic equipment.
- d. Document and have client sign any measure that is recommended for health and safety that is refused by client.

5.0 Combustion Appliance Zone Depressurization

The Grantee shall perform a worst-case depressurization test in each combustion appliance zone. When combustion appliance zone (CAZ) depressurization limits are exceeded under worst-case conditions, the depressurization shall be brought within acceptable limits as detailed in Table 1.

Table 1: CAZ Depressurization Limits¹

Venting Condition	Limit (Pascals)
Natural draft water heater (including outside chimneys) or fireplace	-3
Wood stoves and fireplace inserts, including air tight models with outside combustion air	-10
Individual natural draft boiler or furnace	-5
Toyostove/ Monitor	-20
Power vented or induced draft boiler or furnace	-10
Chimney-top draft inducer; High static pressure flame retention head oil burner; Direct vented appliances; Sealed combustion appliances;	-20

If reasonable efforts cannot meet or reach the CAZ Depressurization Limits standard, the Grantee shall document in the client file the actions taken and the education provided to the client.

5.0.1 Combustion Safety Testing

Combustion Appliances Defined: any liquid, gas and solid fuel burning appliances including water heaters, wood stoves, ranges, ovens or stove tops, furnaces, boilers, space heaters, fireplaces, fireplace inserts, and gas logs.

Wood stoves and fireplaces need not be tested for spillage, draft, or carbon monoxide.

A Combustion Safety Maximum Depressurization Data Sheet (See WOM Section 6.) shall be filled out for each appliance and be present in the client file.

5.0.2 Post Weatherization Combustion Safety Testing

The Grantee shall perform a Combustion Safety Test on every combustion appliance at the conclusion of the Weatherization project.

5.1 Heat Rise

The Grantee shall test all forced air heating systems for heat rise. If the heat rise is greater than 70° or less than 40° the system fails. If the heating unit fails the heat rise test, The Grantee shall have the appropriate repairs made or defer the project until the problem is corrected.

¹ Building Performance Institute Standard

5.2 Draft and Spillage Tests

The Grantee shall perform spillage and draft tests for all natural draft space heating systems and water heaters. Draft and spillage shall first be tested under worst-case conditions, and then repeated for natural conditions if the appliance fails under worst-case.

5.2.1 Single Chimney with Multiple Appliances

When a chimney is shared by multiple appliances, the appliance with the smallest BTU input rating shall be tested first, and remaining appliances shall be tested in order of increasing input rate.

5.2.2 Multiple Fuel Sources Vented into a Single Chimney

Multiple fuel sources vented into a single chimney are cause for deferral of services until the situation is corrected.

5.2.3 Draft Testing

The Grantee shall measure vent draft pressure at steady-state operating conditions of all natural draft heating and hot water appliances. Draft test location should be approximately 1-2 inches downstream of the appliance draft diverter. After the test, the test hole must be sealed with a metal plug or screw that fills and seals the hole. Appliances shall draft at or above (i.e. have more draft) the minimum acceptable draft level detailed in Table 2. If the draft test fails, the Grantee shall make appropriate repairs before proceeding with weatherization services or defer the project until problem is corrected.

Table 2: Minimum Acceptable Draft Test Action Levels²

Outside Temperature (degree F)	Draft Pressure Standard (Pa)	Water Column
<10	-2.5	1" = 249 Pascals
10-90	(Outside temp / 40) – 2.75 *	
>90	-0.5	

* Calculation is as follows: Divide the outside temp by 40; then, subtract 2.75 from this value. The result is the minimum acceptable draft.

5.2.4 Spillage

The Grantee shall test for spillage on all atmospheric draft appliances. The Grantee shall measure and record the amount of time it takes for spillage to stop and draft to be established. Any appliance that continues to spill flue gases beyond the maximum

² Building Performance Institute Standard

established time limits identified in Table 3 fails the spillage test. If the unit fails, the Grantee shall make appropriate repairs or defer the project until the problem is corrected.

Induced draft heating systems shall be checked for spillage at the base of the chimney liner or flue. If a chimney is shared between an induced draft heating system and a natural draft water heater, spillage shall be checked at the water heater draft diverter.

Table 3: Maximum Acceptable Appliance Spillage Periods³

Appliance Type	Spillage Test Period (minutes)
Water Heater, Gravity Furnace, Boiler	1.0
Space Heater	1.0
Forced Air Furnace	1.0

5.3 Carbon Monoxide Tests

The Grantee shall perform a CO test on net ambient air and all combustion appliances. The Grantee shall measure CO in the undiluted flue gasses in the flue of the appliance, using a digital gauge that measures in parts per million (ppm). For all combustion appliances, CO shall be measured at steady-state operating conditions. CO levels must be recorded and appropriate actions taken, as detailed in Tables 4 and 5.

5.3.1 CO Measurement for Power Vented, Direct Vented or Sealed Combustion Units

The Grantee shall not drill holes in flues for power-vented, direct-vented, or sealed combustion units. CO shall be measured at the exterior outlet of the flue.

³ Building Performance Institute Standard

Table 4: Carbon Monoxide Test Action Levels for Gas Appliances⁴

CO Test Result*	Retrofit Action
0 – 25 ppm	Proceed with work
26 – 99 ppm	Recommend cleaning of appliance burner
100 – 200 ppm	Considered unsafe and the problem needs correcting. The unit may be operated minimally if no spillage of flue gas is detected.
200-400 ppm	Considered unsafe and the problem corrected immediately. The unit may be operated minimally if no spillage of flue gas is detected.
More than 400 ppm	Conditions are considered unsafe. The appliance must be disabled and not run (even if no CO is detected in the ambient space) until the condition is corrected.

* CO measurements for undiluted flue gases

5.3.2 Gas Ovens and Range Tops

If a gas stove or range top is present, it must have a properly installed, working range hood exhausted to the outside. If one is not present, then one must be installed. Educate occupant of proper use. If it is not possible to install a range hood, document the reason in file.

Test Protocol:

Range Hood

Measure the CO in the exhaust gases (after 5 minutes of burn time) of the range top burners with a Monoxer. Start with the left front burner (burner #1) and move in a clockwise direction. Record the CO in PPM for each burner, 18" above each burner.

Oven

Then take a reading in the undiluted flue gases of the oven (after 5 minutes of burn time) and record in PPM. Look in the oven for anything that may melt or catch fire before performing the test. Make sure the oven burner is actually on during the test.

Ambient

Monitor ambient CO levels upon entering the combustion appliance zone and during the test period for all appliances. If ambient levels exceed 10 ppm at any time, turn off the appliance immediately and make appropriate repairs. The maximum allowable ambient CO level in a dwelling where weatherization work has been completed is 10 ppm.

⁴ Building Performance Institute Standard

Table 5: Carbon Monoxide Test Action for Gas Cookstoves

CO Test Result	Retrofit Action
0 – 25 ppm	Proceed with work
26 – 99 ppm	Recommend cleaning of appliance burner
100 – 400 ppm	Write up health and safety notification and educate occupants on proper use of range hood. Ensure that ambient CO is below 10 ppm with range hood operating.
> 400 ppm	Notify owner and occupant in writing. Work may not proceed until the problem is corrected, either by Grantee or owner.

5.3.3 Ambient Carbon Monoxide

The Grantee shall monitor ambient CO levels upon entering the combustion appliance zone and during the test period for all appliances. If ambient levels exceed 35 ppm at any time, turn off the appliance immediately and make appropriate repairs. The maximum allowable ambient CO level in a dwelling where weatherization work has been completed is 10 ppm.

5.4 Documentation

The Grantee shall document in the client file repairs and the actions taken to correct all combustion safety failures.

5.5 Un-Vented Fuel Burning Space-Heating Appliances

The Grantee shall not proceed with weatherization of dwellings that have existing un-vented fuel burning space-heating appliances until they are removed and disposed of. The Grantee shall notify the owners and the occupants of any hazards that exist with un-vented space heaters and of the program requirements that un-vented space heaters be removed before weatherization services can be delivered.

5.6 Required Equipment

The Grantee shall:

- Use a digital manometer to perform all pressure diagnostic-testing measurements.
- Use a digital CO measurement device that is capable of measuring 1 ppm to 1000 ppm
- Have diagnostic testing equipment calibrated and maintained as recommended by the manufacturer.
- Keep on file a record of maintenance and calibration for all diagnostic equipment.

6.0 Building Envelope Air Sealing

The Grantee shall perform air sealing where it is determined by a weatherization assessment to be effective based on one of the following considerations: health, safety, building durability, or cost-effectiveness.

6.0.1 Air Sealing Locations

Air seal the building envelope including the duct system, at the pressure boundary, and align it with the thermal boundary.

6.0.2 Priority Air Sealing

Priority air sealing shall be performed, and shall include air sealing of all large holes, including obvious bypasses, chase ways, and gaps that exist between the unconditioned areas and the conditioned areas.

6.0.3 Determining Cost Effectiveness

Each Grantee will establish a cost-effectiveness guideline. This guideline will reflect the cost to achieve a 100CFM50 reduction as a result of air sealing. Air sealing shall continue until the additional costs of air sealing cannot be justified in terms of the energy savings it will produce. A savings to investment ratio (SIR) of one or greater shall be used when determining the cost-effectiveness of air sealing. Documentation of the air sealing time and efforts must be present in the client file. After all air sealing in an attic/ceiling addressing health, safety, and durability issues is complete, then air sealing should continue until it is determined that further work is not cost effective. Reference materials for establishing a cost-effectiveness guideline can be found in *Residential Energy* by John Krigger, *Appendix A-12, Air Sealing Economic Limits*.

6.0.4 Use of Pressure Diagnostics and Blower Door

The blower door shall be used to assist in determining appropriate air sealing measures.

6.0.5 Target Air-Leakage Reductions

The Grantee shall attempt to air seal homes below 100% of the calculated Building Airflow Standard (BAS) until air sealing is no longer cost-effective. If the final blower door is higher than BAS, the Grantee shall document the reason air sealing was stopped in the client file. Reasons for not reaching BAS could be depressurization issues with gas appliances, inaccessible areas, not cost-effective, budget restraints, client disapproval, etc.

6.1 Building Airflow Standard (BAS)

Calculate the Building Airflow Standard (BAS) using each of the three formulas listed below and select the highest BAS calculated.

Note: Listed below are 3 different names for the same airflow standard.

- The Building Airflow Standard (BAS)
- The Building Tightness Limit (BTL)
- The Minimum Ventilation Level (MVL)

Refer to the Alaska Climate/Building Factors sheet for “n” number.

Formula #1

$$15\text{cfm} \times \text{___} \# \text{ of occupants} \times \text{“n”} = \text{___} \text{cfm50 BAS}$$

This is one of three formulas for calculating the Minimum Ventilation Level (MVL) or Building Tightness Limit (BTL) Building Airflow Standard (BAS) for a given home.

Formula #2

$$15\text{cfm} \times \text{number of bedrooms} \text{___} + 15 \times \text{“n”} = \text{___} \text{cfm50 BAS}$$

This equation is based on potential occupants for a given dwelling. This calculation takes into consideration 1 or 2 people living in a 4-bedroom that is likely to be rented or sold to a family much larger. Also, a home with a small square footage or volume may have few occupants, but the potential occupancy (may have many small bedrooms) may be much higher.

Formula #3

$$\text{Estimated volume of conditioned living space} \times .35 \times \text{“n”} / 60 = \text{___} \text{cfm50 BAS}$$

This equation is based solely on the volume of the conditioned space of the dwelling. Measurements may be the actual interior space including interior walls of the conditioned spaces, but not including attached garages (conditioned crawlspaces would be included in the volume).

Building Airflow Standard = highest number calculated using Formulas 1, 2, and 3

Record the highest CFM50 BAS calculated using Formulas 1, 2 or 3. The number recorded here should be the minimum allowable CFM50 of the conditioned living space unless there are documented factors which result in a decision that would indicate a higher or lower BAS be recommended.

6.2 Preferred Installation Method

The preferred method for installing air-sealing materials is from the attic side, not living space side, of ceilings and attics, from the inside surface of walls, and from the underside of floors.

6.2.1 Dirt and Debris Removal

All loose dirt and debris or other materials that might prevent the adherence of the air-sealing materials to the surface shall be removed prior to installation.

6.2.2 Depth of Sealant

Sealant shall be installed following the manufacturer's recommendations.

6.2.3 Filler Materials

Filler materials that will adequately support the sealant, such as polyurethane foam, backer rod or other suitable materials will be installed in cracks deeper than 1/2 inch to a depth of 3/8 inch below adjacent surfaces to support the sealant when necessary.

6.3 Sealing Bypasses around Chimneys, Flues and Stovepipes

Bypasses around chimneys, flues, and stovepipes shall be sealed using non-combustible materials rated for this use.

6.3.1 Fireplaces with Broken or Missing Dampers

Installation of chimney top dampers or an inflatable draft stopping device is allowable.

6.4 Sealing Non-IC-rated Fixtures

Non-IC-rated fixtures in a closed top dam shall not be air sealed, the box or other method can be air sealed.

Closed Top Dam Defined: A fixture that is dammed with a metal, sheetrock, or other non-combustible material that extends at least 24 inches above the fixture and has a cover over the top that will prevent insulation from entering inside the dammed area.

7.0 Attic/Ceiling Insulation

Attics/Ceilings will be insulated if the cost to insulate is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1 or greater. When insulating, meet BEES for insulating attics/ceilings. If unable to meet BEES, document why in the client file.

Region	R-Value
All Regions except North Slope Borough	38
North Slope Borough	52

7.0.1 Insulation material shall be installed in a uniform manner throughout the attic and cover exterior wall plates with a minimum R-11 of insulation.

7.0.2 When insulating attic/ceilings, the thermal and pressure boundary shall be aligned.

7.1 Ceiling Loading

The Grantee is responsible for ensuring that the ceiling can bear the loads that will be imposed when insulation (new or additional) is installed.

7.2 Insulating Floored Attics

Floored over attic spaces shall be insulated to the highest R-value approaching R-38, without altering the structure.

7.3 Insulating Knee Walls

Knee walls adjoining attic spaces shall be insulated to a minimum of R-11. Insulation shall be permanently fastened. Fastening shall be in accordance with the guidelines for underfloor insulation.

7.3.1 Cavity under Knee Wall

The floor cavity immediately below the knee wall shall be air sealed prior to insulation.

7.3.2 Vapor Barrier

Any vapor barrier that is installed shall be located on the warm side of the cavity being insulated.

7.4 Sloped Ceilings

Sloped ceiling cavities shall be insulated using one of the following methods:

- a. Dense pack the sloped ceiling area. Seal all penetrations and bypasses along slope to prevent any moisture migration. Refer to *Field Guide Section 5.4, Attic Insulation*.
- b. Sloped cavities may be insulated with loose fill, batt, or rigid insulation while maintaining a ventilated one-inch air space between the insulation and the roof sheathing. Refer to *Field Guide Section 5.4, Attic Insulation*.

7.5 Attic/Ceiling Damming

Attic/ceiling damming requirements are detailed below.

7.5.1 Recessed Lighting Fixtures and Other Heat-Producing Fixtures

A solid, flame-resistant enclosure shall be securely attached over or around all recessed lighting fixtures or other heat-producing fixtures (including door bell transformers) that are not listed for insulation cover (IC). Such enclosures shall:

- a. Keep insulation at least 3 inches but not more than 4 inches from the sides of the fixture.
- b. Be made from metal or sheetrock, or other material with a flame spread rating of 25 or less, in accordance with ASTM E-84.
- c. Be securely attached to the ceiling structure to prevent their displacement during and after the installation of insulation.
- d. Extend at least 24 inches above the top of the fixture if it is a closed-top enclosure.

Exception(s):

- a. If a closed-top enclosure is impractical, an open-top enclosure can be used. An open-top enclosure shall extend at least four inches above the final level of insulation. There shall be 1 inch or more air space above the dam. All other requirements listed above still apply.
- b. Type IC-rated metal recessed lighting fixtures and other heat-producing fixtures that are certified by an independent laboratory as being capable of dissipating fixture heat can be covered with insulation. These fixtures shall be marked as UL listed "Recessed fixture Type IC."

7.5.2 Exhaust Fans

Exhaust fans in attics and/or dropped ceilings are not considered heat-producing fixtures.

7.5.3 Soffits and Dropped Ceilings

Damming shall be installed in soffits with heat-producing, non-IC-rated fixtures prior to installation of insulation. If damming cannot be installed, no insulation shall be installed in the soffit. Refer to Section 25, *Lighting Retrofit*.

7.5.4 Flues and Chimneys

If insulation is added, these conditions apply:

- a. All combustible insulation materials shall be kept at least three inches and no more than five inches from masonry chimneys
- b. All combustible insulation materials shall be kept at least manufacturer's required minimum distance from masonry chimneys
- c. Any combustible insulation that is found within clearance area of a flue or chimney shall be removed.
- d. A retaining wall of either solid, non-combustible material or fire rated material with a flame spread of 25 or less, extending a minimum of four inches above the level of loose-fill insulation shall be installed around metal flues or chimneys.
- e. Non-combustible batt insulation shall not require a shield but shall maintain a 3-inch clearance from chimney or flue.

7.6 Exhaust Ducting in Attics/Ceilings

Refer to Section 12, *Mechanical Ventilation*.

7.7 Heating and Cooling Ducting in Attics/Ceilings

Refer to Section 15, *Heating and Cooling Ducts*.

7.8 Knob and Tube Wiring in Ceilings/Attics

Insulation may be installed over knob and tube wiring found in attics or ceilings when the following procedures are followed.

7.8.1 Inspection

The wiring shall be surveyed by a licensed electrical contractor who shall certify in writing that the wiring is in good condition with no evidence of improper overcurrent protection, conductor insulation failure or deterioration, and with no improper connections or splices. Repairs, alterations or extensions of or to the electrical system shall be inspected by an electrical inspector as defined in *WAC 296-46B-394 Wiring methods and materials -- Concealed knob-and-tube wiring*. (<http://apps.leg.wa.gov/WAC/default.aspx?cite=296-46B-394>). A copy of the electrician's certification shall be present in the client file.

7.8.2 Overcurrent Protection

All knob and tube wiring that is to be covered with insulation shall have overcurrent protection in compliance with the *National Electrical Code, Table 310-16, 60°C column*. Overcurrent protection shall be either circuit breakers or Type S fuses. Type S fuse adaptors shall not accept a fuse of an ampacity greater than is permitted in the abovereferenced National Electric Code.

7.8.3 Insulation

After inspection and any subsequent repairs and corrections are made, or over current protection installed, fiberglass or cellulose insulation may be installed. Loose or rolled thermal insulating materials may be installed over knob and tube wiring as long as the insulation meets the National Fire Protection Association (NFPA) 101 Life Safety Code, as identified with a flame spread factor of 25 or less as tested using *ASTM E-84 Flame Spread*. (See WOM Section 6.) Foam insulation is not allowed for use with knob and tube wiring. If repairs or overcurrent protection are not made or provided, then no insulation shall be installed in contact with the knob and tube wiring, and the owner of the building will be notified in writing of the areas needing repair, or circuits needing overcurrent protection.

7.9 Wiring (Other than Knob and Tube)

Insulation may be installed over wiring (other than knob and tube wiring) found in attics or ceilings when the following procedures are followed.

7.9.1 Splices and Connections

All splices and connections shall be in UL approved junction boxes that have covers that are attached with screws prior to insulating the attic.

7.10 Attic Access

Access shall be provided into attic spaces wherever it is practical for a person to reasonably work. Access shall be from the exterior when possible. Exterior access shall be sized to allow for entry into the attic. All installed attic access shall be easily movable, such as on hinges or screwed. Nails shall not be used to secure attic access covers. If interior access is required, access covers and doors that open to conditioned living spaces shall be airtight and insulated.

7.10.1 Framing Access Openings

Attic entry access shall be framed to prevent loose-fill insulation from falling or sloughing through the opening. If interior access is to be installed, it shall have an opening of least 14.5 inches by 24 inches, and be installed in a workmanlike manner. In all cases, a rigid dam around the opening shall extend at least four inches above the level of the insulation and made of a minimum ½" plywood or equivalent.

7.10.2 Knee-Wall Access Openings

If attic access is provided through a knee wall, the access shall be at least 14.5 x 24 inches and be insulated to R-11. All installed knee-wall access shall be airtight and easily movable, such as on hinges or screwed. No nails can be used to secure knee-wall access covers.

7.10.3 Insulating Access Openings

Attic access covers shall be insulated to the same level as the surrounding area whenever possible.

7.11 Retractable Ladders

Attic access doors that incorporate retractable ladders or similar devices shall be insulated to at least R-10 by installing an insulating cover over the opening of the attic. This cover shall be designed and installed in a fashion that will allow it to be easily removed and reinstalled by the homeowner when the attic access is used.

7.12 Passive Ventilation

Installation of ventilation is allowable. The installation of additional ventilation is not required.

7.12.1 Roof Top Vent Locations

Roof top vents (i.e., roof jacks) shall not be installed in the lower portion of a roof. Roof top vents installed on cedar shake roofs shall be of a type designed for that purpose.

7.12.2 Ventilation Baffling

Baffling shall be installed for those eave/soffit vents that are necessary to meet minimum ventilation requirements. Baffling shall be installed in a fashion that will permanently maintain the airflow from the vent. Baffling shall be installed in a fashion that allows the maximum amount of insulation to be installed over the top plates of outside walls. Baffling shall extend a minimum of four inches vertically above the level of insulation and be stapled on the inside. Baffles will extend down to top plate and direct airflow from soffit venting up and over insulation.

7.13 Certificate of Insulation

A certificate of insulation will be completed and posted as per Section 1, *General Requirements*.

8.0 Wall Insulation

Walls shall be insulated if the cost to insulate is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1 or greater. When installing wall insulation, meet BEES. If unable to meet BEES, document why in the client file.

Wall Insulation

Region	Fuel Type	R-value
Southeast	All Fuels	21
Southcentral	Natural Gas	18
Southcentral , Aleutians, Kodiak	All Others	25
Interior, Southwest	All Fuels	25
Northwest	All Fuels	30
Arctic slope	All Fuels	35

Existing Wall Cavities

If any of the following conditions exist, then the wall cavity should not be insulated:

- a. Knob and Tube Wiring: Wall cavities that contain knob and tube wiring that cannot be certified.
- b. Insulated Cavity: Cavities that are fully insulated.
- c. Cavities Containing Ducts/Heaters: Any part of the cavity that is used as, or contains, an HVAC duct, contains a gas wall furnace, or contains an electric wall heater or other heat-producing device.
- d. Uninsulated Soffit Next to Cavity: Cavity is open to an uninsulated soffit with a recessed light fixture or other heat-producing device that cannot be properly dammed.
- e. Cavities Next to Fireplace or Chimney: Cavity is next to a masonry fireplace or chimney with less than three-inch clearance between cellulose and masonry.
- f. Cavity Next to Pocket Door: Wall cavity is connected to an unprotected pocket door cavity.
- g. Repairs Needed: Interior or exterior repair is needed and will not be performed as part of the weatherization package of the dwelling, water leaks are present, or substandard interior or exterior sheathing is present.
- h. Solid Walls: Walls are solid masonry, concrete, concrete block, wood, or adobe.

8.1 Timing of Wall Insulation

Wall insulation shall be installed after the following activities have taken place:

- a. Knob and tube wiring inspection.
- b. Correct electrical hazards the insulation will cover-up.
- c. Required damming and/or blocking is installed.

8.2 Dense Pack Wall Insulation

All closed wall cavities that can be insulated shall be insulated by means of dense-packing insulation methods at a density of 3.5 to 4 pounds per cubic foot.

Exception(s):

- a. If the home's pre-insulation cfm50 is less than 100% of the calculated Building Airflow Standard (See WOM Section 6.), the wall cavities do not have to be insulated using the dense pack method.
- b. On a project-by-project basis, products other than cellulose may be used, with reasons documented in client file.
- c. Voltage drop is greater than 5 volts at any outlets or lights before insulating.

8.2.1 Fill Tube Method

Insulation will be installed using the fill-tube method.

8.2.2 Interior/Exterior Installation

Contractors shall get a signed authorization prior to drilling from the homeowner or landlord allowing the Contractor to drill holes in the home. Dense pack insulation may be installed from the exterior or interior.

8.2.3 Water Column (WC) Pressure

Insulation blowing machines shall be tested and perform at a minimum of 80 inches WC on the date of installation. This measurement shall be recorded on the certificate of insulation.

8.2.4 Balloon-Framed Walls

Walls that do not have a top and/or bottom plate (balloon-framed) shall have stops installed in the top and/or bottom of the cavity before insulating. The stops shall be installed in a manner that will withstand dense-pack insulation installation.

8.3 Treatment of Interior and Exterior Surfaces

The following procedures should be followed when treating exterior or interior surfaces for insulation purposes

8.3.1 Lead-Based Paint

Exterior and interior siding shall be inspected prior to any work. Siding surfaces that may be coated with lead-based paint shall be tested, or presumed to be coated with lead-based paint. Work shall follow procedures in Section 23, *Lead-Safe Weatherization (LSW)*.

8.3.2 Removing Exterior Siding

Exterior siding shall be removed or lifted to gain access to the exterior wall for drilling. Siding shall be replaced after insulation is installed. Any siding that is damaged shall be repaired or replaced with matching siding that is primed and painted to match existing siding.

8.3.3 Drilling Exterior Siding

Exterior siding not containing asbestos that cannot be removed or lifted before drilling walls may be drilled through with the owner's permission. Holes shall be drilled in a level line, and all holes will be filled with a tight-fitting, wooden plug that is installed using an exterior grade, non-silicone-based adhesive, and then filled and smoothed with exterior-grade spackle, textured to match existing surface(s), primed, and painted to match existing siding.

8.4 Open Wall Cavities

The following procedures shall be followed when insulating open wall cavities.

8.4.1 Insulating Open Cavities

Batt insulation shall be tight fitting, but not compressed. Insulation installed on the interior of home shall be installed per the manufacturer's specifications.

8.4.2 Fire Rating

All insulation shall be installed as per fire protected manufacturer's specification and applicable code.

8.4.3 Open Garage Walls

When wall insulation is installed in open wall cavities the insulation shall have a covering with a flame spread index of 25 or less and smoke developed index of not greater than 450 when tested in accordance with ASTM - E84-01. If the insulation does not meet this standard, a covering may be applied that does meet the standard.

8.5 Exterior Wall Insulation

- a. Establish an air/vapor retarder on warm side of wall before proceeding. Vapor retarder placement rule of thumb needs to be no more than 1/3 of insulation r-value into warm side of wall. This is to prevent the potential of water vapor reaching dew point.
- b. Exterior insulation should be attached securely as per manufacturer specs and be appropriate for exterior weather conditions.
- c. Establish a drainage plane that moves water away from wall assembly and doesn't allow the trapping of bulk water.

- d. Insulation shall be covered with a weatherproof covering.
- e. All exterior penetrations will be treated with a weatherproof seal.

8.6 Interior Applied Insulation

- a. An appropriate air/vapor barrier shall be established (as per 8.5a).
- b. Insulation shall be covered to meet applicable manufacturer specs and fire code.

8.7 Certificate of insulation

A certificate of insulation will be completed and posted as per Section 1, *General Requirements*.

9.0 Crawlspace/Under-Floor/Perimeter Insulation

Floors over unconditioned crawlspaces and basements or walls of crawlspaces or basements shall be insulated if the cost to insulate is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1.0 or greater. When installing insulation, meet BEES. If unable to meet BEES, document why in the client file.

Floors

Region	Fuel Type	R-Value
Southeast	All Fuels	30
Southcentral	Natural Gas	19
Southcentral, Aleutians, Kodiak	All Other Fuels	30
Interior, Southwest	All Fuels	38
Northwest	All Fuels	38
Arctic Slope	All Fuels	43

Below Grade Walls

Region	Fuel Type	R-Value
Southeast	All Fuels	15
Southcentral	Natural Gas	10
Southcentral, Aleutians, Kodiak	All Other Fuels	15
Interior, Southwest	All Fuels	19
Northwest	All Fuels	19
Arctic Slope	All Fuels	-

Exception(s):

- a. Clearance between ground and structural framing of sub floor is less than 24 inches.
- b. Floor contains knob and tube wiring that cannot be certified safe by a licensed electrician or inspector.
- c. There is sewage waste on the ground, or any other condition is present that poses a health or safety hazard that cannot be corrected with available repair funds.
- d. The sub-floor, floor, or structural members are wet, rotten, or unsound and the problem cannot be corrected with available repair funds.
- e. Insect or rodent infestation is present that cannot be eliminated prior to insulating.
- f. Extensive debris or household goods or personal belongings are present.

9.0.1 Installation Standard

Insulation shall be installed as follows:

- a. Be in substantial contact with the sub-floor or wall with no voids or gaps.
- b. Insulation batts shall not be compressed more than 10% of rated thickness.
- c. Insulation shall be cut to fit each joist space.
- d. All ends shall fit tight without overlapping.
- e. Insulation shall fit tight against structural members, rim joist, foundation walls, and pipes.
- f. Insulation shall not be installed between conditioned space and water/heat pipes unless it can be assured that water pipes stay above freezing such as in an insulated utilidor.

9.1 Ducts in Crawlspace

Ducts in crawlspaces shall be treated in accordance with Section 15, *Heating and Cooling Ducts*.

9.2 Insulation Support

Insulation shall be properly fastened as to not sag or fall out.

9.3 Ground Cover

Ground cover moisture barrier shall be installed in accordance with the following:

- a. Shall be installed in a crawl space when no ground cover exists or when an existing ground cover has been extensively damaged.
- b. All wood or other cellulose fiber-based debris, where practical, shall be removed before new ground cover is put in place.
- c. The ground cover shall be 6 mil polyethylene, or its equivalent in perm-rating, strength, and resistance to soil-chemical degradation.
- d. All joints shall be lapped a minimum of 12 inches and taped with polyethylene rated tape rated for polyethylene, or sealed with a compatible poly sealant.
- e. The poly cover shall extend at least 6 inches up the foundation wall or pier blocks, but shall not contact any untreated wood members.
- f. New ground cover may be installed over existing ground cover that is deteriorated or incomplete.

Exception(s):

- a. When under-floor insulation is installed over an unconditioned basement and the basement has no exposed soil (has a concrete floor and walls), ground cover is not required.

9.4 Crawlspace Access

If adding a crawlspace access the minimum access opening size shall be 18 x 24 inches.

Exception(s):

- a. Smaller access is allowable when dictated by existing framing.

9.4.1 Exterior Access

Exterior access to the crawlspace shall have a cover or door that fills the opening, is tight fitting, and can be securely attached using hand-operable mechanical fasteners. Nails shall not be used to secure access covers to framing. Cover and framing material exposed to weather, or in contact with soil or concrete, shall be pressure treated or cedar. Other types of wood may be used if they are primed and painted with exterior grade paint. Nails, screws, fasteners or other hardware used shall be made of galvanized metal, stainless steel, or similar corrosion resistant material.

9.4.2 Interior Access

Interior access to the crawl space shall have a cover or door that fills the opening and is reasonably tight fitting. Horizontal access covers shall provide structural support equivalent to that of 3/4 inch plywood. Access covers adjacent to a conditioned space

shall be insulated to a minimum of R-19 for horizontal openings and to a minimum of R-11 for vertical openings. The insulation shall be permanently attached to access covers. Interior access covers shall be weatherstripped if used as the envelope boundary.

9.5 Passive Ventilation in Crawlspace

9.5.1 Closeable Vents

Closeable vents are allowable. Use caution during installation. Foundation vents can be a source of heat loss and air infiltration.

9.5.2 Vent Opening Location

New vent openings shall not be located within 48 inches of existing water pipes.

9.5.3 Vent Screening and Framing

All new and existing vents shall be screened with 1/4 inch corrosion resistant wire mesh, secured on all four sides, and trimmed so that no exposed edges of the wire mesh are showing from the outside. Expanded metal covers may be used. Wood framing in contact with concrete or ground shall be pressure treated or cedar.

9.5.4 Rigid Foam Plug

If insulating an existing vent, use a removable rigid foam plug that is clearly marked.

9.6 Sealed Crawlspace and Mechanical Ventilation

If installing an exhaust fan in crawlspace, the exhaust fan shall be rated for continuous operation, sized to provide a minimum of 1 CFM exhaust for every 50 square foot of crawl space floor area, AND create a minimum -2 Pascal and a maximum -5 Pascal, pressure differential with respect to (WRT) the conditioned space. Exhaust termination shall be a minimum of 5 feet (measured on the horizontal) from any operable door or window fresh air inlet. Refer to Section 12, *Mechanical Ventilation*. Ground cover is required as detailed in Section 9.3, *Ground Cover*.

9.6.1 Combustion appliances in crawlspace must have combustion air to code.

9.7 Crawlspace/Unconditioned Basement Combination

In instances where an unconditioned basement and crawl space are found in the same structure, two treatment options are acceptable and shall be evaluated for cost effectiveness:

9.7.1 Crawlspace/Unconditioned Basement Combination, Option 1

Treat the entire area as a crawl space and insulate accordingly.

9.7.2 Crawlspace/Unconditioned Basement Combination, Option 2

Construct a permanent wall dividing the two areas. Treat each area according to relevant specifications.

9.8 Rim Joist Area

Rim joist and sill areas shall be air sealed and insulated to a minimum R-10 using rigid foam, or 2 part urethane.

Inspect existing rim joist for moisture or rot. Correct problems before proceeding with insulation.

9.9 Exterior Perimeter Insulation

Exterior perimeter insulation shall be an acceptable alternative to under-floor insulation at the discretion of the Grantee. When exterior perimeter insulation is installed the Grantee or Subcontractor shall follow the specifications detailed below.

9.9.1 Minimum R-Value for Walls

Insulation installed shall have a minimum thermal resistance of R-10.

9.9.2 Insulation Installation

Insulation shall be installed from the bottom edge of the siding to a depth equal to the local "frost line" (as determined from local building or water utility officials) or two feet below grade.

Exception(s):

- a. Insulation shall not be installed, nor excavation take place, below the level of any foundation footing.

9.9.3 Excavation in Preparation for Insulation

Prior to any excavation, the Grantee or Subcontractor shall reach an agreement with the client regarding protection or removal and replacement of any plants or other items which will be disturbed and damaged by the excavation. Any required excavations shall be promptly backfilled after work is completed, and all plants or other items replaced in their original locations, unless released, in writing, from this obligation by the client.

9.9.4 Utility Locating

The Contractor/installer shall be responsible to locate, protect, and if damaged, repair any underground cables, pipes, utility lines or other obstructions during excavation.

9.9.5 Surface Preparation and Attachment of Insulation

The foundation surface shall be cleaned and prepared in accordance with the insulation manufacturer's recommendation. Insulation shall be attached to the foundation according to manufacturer's specifications.

9.9.6 Protection and Flashing of Insulation

Insulation material shall be protected and flashed to prevent water intrusion, rated for ground contact where required, and be acceptable to the owner.

9.10 Interior Perimeter Insulation

When interior perimeter insulation is installed the Contractor/Installer shall follow the specifications detailed below.

9.10.1 Minimum R-Value

Insulation installed shall have a minimum thermal resistance of R-10.

9.10.2 Batt or Blanket Insulation Installation

Batt or blanket insulation shall extend from the bottom surface of the sub-flooring (including band joists) downward to the crawl space floor. All seams between adjacent batts, blankets, or sheets shall be either continuously taped or stapled (on no more than 6-inch spacing) along their entire length.

9.10.3 Rigid Insulation

The insulation shall start at the bottom of the sill and extend to the crawl space floor. The insulation shall be mechanically fastened every 22 inches and adhered to the foundation according to manufacturer's specifications. If code dictates insulation shall be covered with appropriate fireproofing to meet code.

9.10.4 Spray Foam Insulation

The insulation shall start at the bottom of sill plate and extend to the crawl space floor. If code dictates insulation shall be covered with appropriate fireproofing to meet code.

9.11 Cantilevered Floors

Cantilevered floors shall be insulated using one of the following methods.

9.11.1 Insulate Cantilever, Open Through Rim

When the floor joists extend beyond the foundation wall and the rim area is open, extend the insulation batt into the cantilevered area from the crawl space. The thickness of the batt insulation shall be thick enough to satisfy the requirement that insulation be in substantial contact with the under-floor. Install rigid foam into rim cavities and airseal so no air movement is occurring from cantilevered area to crawlspace. If there are plumbing and heating in the cantilevered area, Minimum R-10 rigid foam insulation will be installed to the exterior of pipes or ducting and air-sealed to effectively bring the plumbing and heating to within the thermal and pressure boundary.

Exception(s):

- a. Plumbing and ducting may be situated so insulation can not be installed, do not insulate and document in folder

9.11.2 Insulate Cantilever, Open Under Floor

Installer/Contractor shall install insulation batt that is the full thickness of the floor joist from the exterior. A cover of 3/8 inch exterior grade sheathing or similar material shall protect the insulation installed. If subjected to intermittent moisture (i.e., splashback, etc.), wood sheathing shall be primed on all exposed sides or pressure treated plywood used. Air seal penetrations through sheathing or sub floor.

9.11.3 Insulate Cantilever, No Access

Installer/Contractor shall drill through existing interior or exterior cover, blow insulation into all joist cavities until full, plug holes using plugs and glue recommended for the surfaces being glued. Fiberglass insulation shall be blown at a density of 1.5 pounds per cubic foot and cellulose insulation shall be blown at a density of 3.5 pounds per cubic foot. Air seal penetrations through sheathing or sub floor.

9.12 Floor over Unheated Attached Garage, No Access

Installer/Contractor shall drill through existing interior or exterior cover, blow insulation into all joist cavities until full, plug holes using plugs and glue recommended for the surfaces being glued. Cellulose insulation shall be blown at a density of 3.5 pounds per cubic foot. If the ceiling being drilled for access is drywall or plaster, the holes shall be plugged and skim coated with joint compound ready for light sand.

9.12.1 Floor over Attached Garage, Open Joists

Under-floor insulation installed in open floor joists over a garage shall be covered with material having a flame spread index of 25 or less, and a smoke developed index of not greater than 450 when tested in accordance with *ASTM E84-01 Flamespread*. See WOM Section 6.

10.0 Skirting—Insulated and Un-insulated

Foundation perimeters of buildings exposed to weather can be skirted. When conditions don't allow for insulating floors, such as too little clearance or plumbing that needs to remain within the heated envelope, a well-sealed insulated skirt is an effective measure.

Uninsulated skirting can be an effective measure in high wind areas where wind washing can cause extensive heat loss even though a floor might be insulated.

Skirting can prevent wind washing, which can be the cause of plumbing freezing.

Exception(s):

- a. Where permafrost exists, skirting can cause ground to melt and possibly cause frost heaving.
- b. When there is sewage waste on the ground or any other condition is present that poses a health or safety hazard that cannot be corrected with available repair funds.
- c. The sub-floor, floor, or structural members are wet, rotten, or unsound, and the problem cannot be corrected with available repair funds.
- d. Insect or rodent infestation is present that cannot be eliminated prior to skirting.
- e. Extensive debris or household goods or personal belongings are present.

10.1 Installation Standard

All materials that are in contact with ground should be moisture tolerant and rot resistant such as AWW.

When installing insulated skirting it is advisable to have a sealed ground vapor retarder. See 8.3 if this is not possible, the use of an exhaust fan that keeps the crawl space at negative pressure is required. See 11.6.

Skirting shall be:

- a. Securely fastened to existing structure.
- b. Capable to withstand wind loading.
- c. Able to shed bulk water and prevent water intrusion.
- d. All joints sealed with exterior grade caulk.

- e. At least one access door provided.
- f. Fastened with exterior grade fasteners and compatible with AWW materials.

10.2 Skirting Insulation

- a. Insulation should be minimum R-Value of R-10. 2" rigid board foam is recommended.
- b. Insulation shall be applied to interior side of skirting directly against the sheathing.
- c. Attach insulation using appropriate fasteners and/or adhesive.
- d. Avoid insulation voids.

10.3 Access Door

- a. Shall be provided with easy opening hardware.
- b. Access doors may not be closed and opened by use of screws.

11.0 Moisture Control

Moisture Problem Defined: Any condition, which, if left un-attended, will allow moisture in any state (liquid, vapor, or ice) to damage the dwelling structure. Evidence of moisture problems includes, but is not limited to, visible rot, mold, peeling paint, swollen/bulged/soft building materials and/or discoloration of building component surfaces.

11.1 Plumbing

Prior to completion of weatherization services the Grantee or Property Owner shall repair any plumbing leak found to be wetting insulation.

11.2 Roof

The Grantee shall inspect the roof, flashing details, and penetrations for indications of leaks prior to insulating. Attics or ceiling cavities may be insulated when, in the judgment of the Grantee, the roof in its current or repaired condition following a weatherization repair is expected to last, without leaking, a minimum of 5 years. Attics covered by roofs that do not meet this standard shall not be insulated. Refer to Section 7, *Attic/Ceiling Insulation*.

11.3 Gutters and Downspouts

Gutter repair and/or installation are allowable if necessary to prevent rainwater from entering the crawlspace or basement.

11.4 Below Grade Vents and Penetrations in Foundation Walls

When crawlspace vents and other penetrations are found to be installed below grade they shall be assessed to determine whether water from outside is entering the crawlspace through the vents or penetrations. The path of water into crawlspace shall be eliminated before weatherization work is completed in the crawlspace.

11.5 Ground Cover

All crawlspaces shall have ground cover installed as outlined in Section 9.3, *Ground Cover*.

11.6 Sump Pumps

A sump pump may be replaced, repaired, or installed to prevent water from accumulating under a dwelling.

11.7 Mechanical Crawlspace Ventilation

In crawlspaces with seasonal standing water an exhaust fan may be installed above the high water mark that allows for continuous ventilation of the crawlspace directly to the outdoors.

11.8 Source-Specific Ventilation

A working exhaust fan may be installed at the source of moisture to alleviate high moisture conditions. Refer to Section 12, *Mechanical Ventilation*.

11.9 Whole House Ventilation

A whole house ventilation system may be installed to alleviate high moisture conditions. Refer to Section 12, *Mechanical Ventilation*.

11.10 Dehumidifiers

A dehumidifier may be replaced, repaired, or installed to prevent water damage to a dwelling unit having persistent and unresolved high moisture levels. The installation shall comply with specifications detailed in Section 13, *Dehumidifiers*.

11.11 Client-Controlled Conditions

The Grantee shall inform the client of any observed client controlled conditions contributing to high moisture levels in the dwelling. The Grantee shall document in the client file those recommendations that would help lower moisture levels.

11.12 Mold

The Weatherization Assistance Program is not a mold remediation program. Funds should not be used to test, abate, remediate, or purchase mold insurance. Abatement/remediation is defined as disturbing more than 10 square feet of mold area. Funds may be used to correct energy-related conditions to allow for effective weatherization work and/or to ensure the immediate health of workers and clients. The Grantee should ensure that regular weatherization work is performed in a manner that does not contribute to mold problems.

11.12.1 Observed Pre-Existing Mold

The initial home weatherization assessment shall include an item to identify if mold is observed. At a minimum, document unusual odors in the house, moisture (or signs of past moisture) on windows and/or doors, visible mold, gutter, or grade problems around the home, wet crawlspaces and unusually high humidity levels. If mold is observed, the location and an estimate of the area in square feet as well as photographs shall be documented in the client file.

11.12.2 Pre-Work Notification

If mold is observed, the Grantee shall provide to the client (and owner if rental situation) notification to inform the client of the observation of mold in the home. The notification will include specific work done on the home that should minimize the mold problem. The notification needs to be discussed with and signed by the client and owner if rental situation. A copy of the signed statement shall be documented in the client file.

11.12.3 EPA Mold Pamphlet

In dwelling units where moisture and/or mold conditions are observed, the Grantee shall provide to the client the EPA pamphlet "A Brief Guide to Mold, Moisture, and Your Home." Client shall sign a document acknowledging receipt of the pamphlet and copy shall be kept in client file (acknowledgment of receipt of pamphlet can be part of notification listed above 11.12.2).

11.12.4 Personnel Training

Grantees are required to provide assessor AND crew training on identification and assessment of moisture and mold hazards, methods to alleviate conditions which promote mold growth, prevention of mold, and protocols for client notification. DOE developed a recommended mold training curriculum which can be used for training purposes; a copy of the presentation is available at the weatherization assistance program technical assistance center website (<http://www.waptac.org>).

11.12.5 Deferral of Weatherization Work due to Mold

- Weatherization in dwelling units with mold conditions greater than 30 contiguous square feet must be deferred until the mold conditions are remediated by the owner or a company licensed and insured to provide mold abatement.
- If the Grantee deems regular weatherization work would contribute to mold growth, then the work should be deferred until the mold conditions are remediated by the owner or a company licensed and insured to provide mold abatement.
If weatherization work is deferred due to observation of mold, then the client should be referred to the appropriate public or non-profit agency for remedial action.

11.12.6 Moisture control and ventilation

In situations where mold conditions are observed and it is not a deferral, regular weatherization work shall assess for ways to minimize moisture sources, condensation problems, and ensure an operational ventilation system is installed per Section 12, *Mechanical Ventilation*.

11.12.7 Worker Protection

Procedures for worker protection found in U.S. Department of Labor Occupational Safety and Health (OSHA) "*A Brief Guide to Mold in the Workplace*" (<http://www.epa.gov/mold/moldresources.html>) shall be followed when alleviating or working in the area of mold.

11.12.8 Occupant Protection

Procedures for occupant protection found in U.S. Department of Labor Occupational Safety and Health (OSHA) "*A Brief Guide to Mold in the Workplace*" (<http://www.epa.gov/mold/moldresources.html>) shall be followed when alleviating or working in the area of mold.

12.0 Mechanical Ventilation

The Grantee shall assure mechanical ventilation is available to alleviate excess moisture and the buildup of indoor pollutants. Whole house and spot ventilation shall minimally meet the following standards, higher flow rates may be deemed necessary dependent on pollutant sources, moisture, occupants, etc.

12.1 Whole House Mechanical Ventilation

Mechanical whole house ventilation is required if the final CFM50 as measured using a blower door is less than 100% of the calculated BAS. The Grantee may select Option 1 or Option 2 in order to meet this requirement.

Option 1:

Determine ventilation requirement using the table below. Install a fan that is rated at .1 inches of water column to meet or exceed flow requirement.

WHOLE BUILDING VENTILATION REQUIREMENTS

Number of Bedrooms:	0-1	2-3	4-5	6-7	>7
<1500 square feet	35	55	75	95	115
1501-3000	50	70	90	110	125
3001-4500	65	85	105	125	145
4501-6000	80	100	120	140	160
6001-7500	95	115	135	155	175
>7500 square feet	110	130	150	170	190

Different occupant density: The table assumes two persons in a studio or one-bedroom dwelling unit and an additional person for each additional bedroom. Where higher occupant densities are known, the rate shall be increased by 10cfm for each additional person.

Option 2:

Determine ventilation requirement using the steps below.

1. Determine Building Airflow Standard (BAS) per Section 6.1, *Building Airflow Standard (BAS)*.
2. Divide BAS ____ by n factor.
3. Record $BAS \div n =$ ____ CFM required.
4. Determine final (post wx work) CFM 50 using a blower door.
5. Divide final CFM50 by n factor used in BAS calculation.
6. Record $CFM50/n =$ ____ CFM natural estimate.
7. Subtract CFM natural estimate from CFM required.
8. $CFM_{req.} - CFM_{nat} =$ _____ mechanical ventilation flow requirement.
9. Install a fan that is rated at .1 inches of water column to meet or exceed flow requirement.

12.1.1 Whole House Ventilation Systems

The following types of whole house ventilation systems may be installed to meet the whole house ventilation requirement.

- a. Exhaust fan rated at .1 inches of water column to meet the minimum air flow requirement each hour home is occupied without occupant intervention.
- b. Energy or Heat Recovery Ventilator rated at .1 inches of water column to meet the minimum air flow requirement each hour home is occupied without occupant intervention.

12.1.2 Whole House Fan Requirements

- a. Have a sone rating of 1 or less.
- b. Motors shall be rated for continuous use.
- c. Equipped with a back draft damper located at either the fan outlet or the vent termination.
- d. Have an operating watt draw of 50 watts or less.

Exception(s):

- a. Vibration isolated, remote mounted fans are exempt from sone rating requirements.
- b. Fans designed and wired to operate constantly do not require a damper.

12.1.3 Verification of Fan Performance

Exhaust fan will be performance tested using an approved method to assure ventilation rate meets whole house ventilation required CFM flow. Document in file.

12.2 Source-Specific Exhaust in Kitchens

A working exhaust fan sized for the home shall be present where a gas combustion range, cook top, or oven is present.

Exception(s):

- a. A home without electricity.

12.2.1 Ventilation level

A kitchen exhaust shall be rated to meet or exceed 100 cfm at .1 inches of water column.

12.2.2 Fan Rating

Exhaust fans installed directly over a range or oven must be rated for installation in this location.

12.2.3 Kitchen Fan Control

Kitchen fans shall be controlled by the manufacturer's switch or a wall mounted switch.

12.2.4 Kitchen Fan Exhaust Ducting Shall:

- a. Be constructed of galvanized metal, stainless steel or copper with a wall thickness of not less than 26 gauge.
- b. Be air tight, with smooth interior finish and ducted to the outside.
- c. Be connected to a collar of termination cap. Collar shall pass through the wall or roof sheathing.
- d. Be mechanically fastened at each joint using screws, and taped using aluminum butyl tape in heated spaces, to the fan outlet and to the collar of termination cap.
- e. Have terminal cap with opening size at least equivalent to the net free area of the duct.
- f. Have no more than the equivalent of two 90 degree elbows in the run.

12.3 Source-Specific Exhaust in Bathrooms

Each bathroom where a tub or shower is present shall have an operable fan that is rated to deliver 50cfm at .1 inches water column. When replacing fan with light, replacement must also have light.

Exception(s):

- a. Bath exhaust may not be required where occupancy and usage patterns indicate infrequent use and there is no evidence of moisture problems. The reason for not installing the fan must be documented in the client file.
- b. Bath exhaust may not be required when whole house ventilation is functioning as designed.
- c. Mechanical exhaust is not required in water closets, laundry rooms, lavatories, and utility rooms.

12.3.1 Sone Rating

Exhaust fans installed to provide local bathroom exhaust shall have sone rating of 1 or less.

12.3.2 Energy Use

Exhaust fans installed to provide local bathroom exhaust shall have an operating watt draw of 50 watts or less.

12.3.3 Bathroom Ducting Requirements

- a. Ducts will be smooth, will have the shortest run possible, and will have no more than two 90 degree elbows.
- b. Duct diameter will be equal to or greater than the exhaust fan outlet.
- c. Up to 2' of flexible duct will be permitted to accommodate tight spaces and reduce noise.
- d. Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8.
- e. Shall be air tight and ducted to the outside.
- f. Duct shall be connected to a collar of the termination cap. Collar shall pass through the roof sheathing.
- g. Shall be mechanically fastened at each joint using a minimum of 2 screws, and taped using aluminum butyl tape, to the fan outlet and to the collar of termination cap.
- h. Terminal elements shall have at least the equivalent net free area of the duct work.
- i. Horizontal duct runs shall be supported using nylon, plastic, or metal strapping with a minimum width of 1/2 inch. Support strapping or hangers shall not compress the insulation. Support strapping or hangers shall be installed within 1 foot of a joint or connection and a minimum of every 4 feet thereafter, or per manufacturer's recommendation.
- j. Insulated flex duct may be used if diameter is 50% more than outlet of fan.

12.4 Crawlspace and Garage Ventilation

Exhaust fans may be installed for operation in crawlspaces or garages to exhaust pollutants and maintain a pressure boundary relative to the dwelling unit. Fan installed shall meet the following requirements.

12.4.1 Sizing Fans

Exhaust fan shall be sized to provide a minimum -2 Pascal and a maximum -5 Pascal pressure differential with respect to (WRT) the conditioned space.

12.4.2 Controls

Exhaust fans shall be wired to exhaust continuously with a switch to allow shut down for maintenance.

12.4.3 Verification of Fan Performance

The Grantee shall verify that fan performance during normal operating conditions creates a negative pressure with reference to the dwelling unit of 2 to 5 Pascals.

12.4.4 Fan Rating

Fans installed for the purpose of maintaining a pressure boundary shall be rated for continuous operation.

12.4.5 Fan Termination Point

Fans installed for the purpose of maintaining a pressure boundary shall not terminate within 5 feet of a door, window, combustion appliance air-intakes, or fresh air intakes.

12.5 Dryer Ducting

Clothes dryers shall be vented directly to the outside in accordance with the following procedures.

Exception(s):

- a. Electric Dryer: If location prevents ducting from being installed per code, notify client and document in client file. Assure home has other means of mechanical ventilation and instruct owner to use while the dryer is operating.
- b. Gas Dryer: If location of dryer prevents code compliant ducting to the outside, all weatherization work shall be deferred until situation is resolved.

12.5.1 Dryer ducting

Dryer vent ducts shall conform to the following:

- a. Extend directly to the outside of the structure.
- b. Have a smooth interior finish.
- c. Vent shall terminate in a non-screened vent cap with a damper.
- d. Not exceed 25 feet in length from dryer location to outlet terminal, the maximum length shall be reduced 2.5 feet for every 45 degree elbow and 5 feet for each 90 degree elbow.
- e. Extension material in excess of 6 feet must be metal with a non-ribbed interior and must be mounted in such fashion that no traps or reversing horizontal runs are present. Horizontal runs shall be sloped toward the vent discharge. Discharge will not place moisture on building materials or walkways.
- f. Screws shall not be used to connect dryer ducting.
- g. A rated flex duct may be used for extensions of 6 feet or less.
- h. Shall be insulated to minimum R-4 if duct is more than 6 feet in length, and passes through unconditioned space.

12.6 Outdoor Air Inlets

Install outdoor air inlets if house fan performance during normal operating conditions creates a negative pressure with reference to the dwelling unit of more than 5 Pascals.

Outdoor air inlets for individual rooms when installed shall:

- a. Have a controllable and secure opening.
- b. Be sleeved and flashed or otherwise designed so as not to compromise the properties of the wall or window in which they are placed.
- c. Be screened or otherwise protected to prevent entry of leaves, debris or pests.
- d. Not be located within 10 feet of hazardous or unsanitary locations.
- e. Shall not be placed in closets
- f. Shall not be placed within 6' of a sitting/sleeping area.

13.0 Dehumidifiers

The installation of a dehumidifier is allowable, provided it is determined to be the most effective and cost-efficient method of reducing moisture problems or high moisture buildup in a home. Dehumidifiers shall be installed only after other measures with less of an energy penalty have been found ineffective at reducing moisture problems.

Moisture Problem Defined: Any condition, which, if left un-attended, will allow moisture in any state (liquid, vapor, or ice) to damage the dwelling structure. Evidence of moisture problems includes, but is not limited to, visible rot, mold, peeling paint, swollen/bulged/soft building materials and/or discoloration of building component surfaces.

13.1 EnergyStar-Rated and AHAM-Certified

The dehumidifier installed shall be EnergyStar-rated and certified by the Association of Home Appliance Manufacturers (AHAM) Specification DH-1 (www.AHAM.org).

13.2 Sizing

The Grantee shall size dehumidifiers for installation according to the general guidelines below, and shall be controlled by a humidistat to automatically maintain the desired humidity level. Dehumidifier capacity shall be determined by the rated capacity test contained in AHAM Specification DH-1 (www.AHAM.org).

Floor Area of House (sq. ft.)	Dehumidifier Capacity (Pints/24 hours)
Up to 1,000	25
1,000-2,000	30
2,000-3,000	35

13.3 Low Temperature Location

When the dehumidifier is to be located in a basement or other area where the normal operating temperatures are expected to be below 65 degrees Fahrenheit, the Grantee shall install a dehumidifier rated to operate in “low temperature” conditions.

13.4 Electrical Safety

The Grantee shall observe all manufacturer warnings regarding electrical safety. The Grantee shall not allow drain hoses, water drainage, or disposal near electrical circuits, cords, or devices.

13.5 Hose to Drain Required

The Grantee shall install a hose to drain the dehumidifier's water bucket. Hose shall be mechanically attached to the water bucket outlet and terminate at a drain or sump. Hose installed shall not create a tripping hazard.

14.0 Heating Systems

Contractors should ensure that upon completion of weatherization services all dwelling units have a safe, operable, permanently installed, and adequate heating system.

Heating System Defined: Heating system is any component of a residential space heating system which:

- a. Distributes heat (duct work, air handler, baseboard, pipes, or radiators).
- b. Generates heat or controls combustion (furnace, boiler, space heater, or safety controls).
- c. Ventilates products of combustion (flue, vent pipe, and chimney).

- d. Stores and supplies fuel for the heating system (tank or fuel line).

Adequate Heat Defined: Heating facilities are considered adequate if they are capable of maintaining a room temperature of 65 degrees F in all habitable rooms and bathrooms when the outside design temperature is reached.

14.1 Inspection and Testing of Heating Systems

The Grantee shall inspect and test the heating system(s) in each dwelling unit for safe operation prior to delivering weatherization services. The Grantee shall document in the client file the condition of heating system prior to weatherization.

Proper clearances shall exist between combustible material and the heating unit. The client will be notified if any flammable material is stored next to a heating unit (i.e., rags, paper, etc.) All flammable materials stored near heating units should be immediately removed.

Provide and or check for proper ventilation for combustion systems, a clean chimney for wood stoves and adequate air space/shielding of combustible materials and insulation near heat producing sources. Weatherization activities will not be performed on homes with unvented combustion appliances (except for gas ranges), unless that appliance is removed or vented during the course of weatherization activities.

Provide repair of fuel leaks. If major gas leaks are encountered, ventilate the area, advise client to vacate the premises and immediately contact the local utility (call from neighbors phone in order to eliminate risk).

14.1.1 Inspection of Electric Heating Systems

The minimum requirement for electrically heated dwelling units is:

- a. Visual inspection of the electrical system.
- b. Visual inspection of heating system clearances to combustibles,
- c. Visual inspection of air handler (if present).
- d. Verification that the system is permanently installed and securely attached to the floor, wall, or ceiling.

14.1.2 Inspection and Safety Testing of Gas and Oil Heating Systems

The Grantee shall ensure that dwelling units with combustion appliances are tested in accordance with approved *Combustion Safety Test Maximum Depressurization Data Sheet*. (See WOM Section 6.) Refer to Section 5, *Combustion Appliance Zone Depressurization*.

14.2 Electric Heating System Service

Electric heating systems shall be serviced to:

- a. Correct hazards identified during initial inspection.
- b. Complete system checks and repairs detailed in the work order form.
- c. Improve distribution efficiency.

14.2.1 Minimum Service, No Hazards

- a. Fan blades and cabinet of the air handler cleaned free of all visible dirt.
- b. Check and change furnace filter if necessary.

14.3 Gas and Oil Heating System Service

Gas and Oil fired heating systems shall be serviced to:

- a. Correct hazards identified during combustion safety inspection and testing.
- b. Improve combustion or distribution efficiency.

14.3.1 The minimum service for a gas or oil heating system where no hazards have been identified:

- a. Check and change furnace filter if necessary.

14.4 Heating System Replacement

Heating system replacement is allowable when the Grantee determines that it is more cost effective to replace the heating system than it is to repair or replace inefficient, non-operable, unsafe components. Estimated repair costs, usable life, and efficiency considerations used to justify the decision to replace shall be documented in the client file.

14.4.1 Replacement for Efficiency

Replacement of a gas or oil fired heating system is allowable to improve efficiency when justified using a Savings to Investment Ratio (SIR) greater than 1.0 as calculated by the computerized assessment tool. AkWarm

The Annual Fuel Utilization Efficiency (AFUE) rating of the existing heating system shall be determined either from the manufacturer's information or by the type and age of the unit.

- a. The replacement cost shall be determined by the Grantee.
- b. Generate SIR using AkWarm software.

14.4.2 Permit Required

Necessary permits shall be obtained prior to the replacement of the heating system. All applicable code regulations must be met as described in Section 1, *General Requirements*.

14.4.3 Minimum Efficiency of New System

All new oil or gas heating systems installed shall have a minimum AFUE rating of 80%.

14.5 Wood and Pellet Stoves

The Grantee shall assess solid fuel burning stoves for safety hazards. Assessor shall list recommended corrections, and corrections made, if any in client file.

14.5.1 Information on Clean Burning Practices

The Grantee shall provide all clients with solid fuel burning information pamphlet on clean and efficient burning techniques.

15.0 Heating and Cooling Ducts

All heating and cooling ducts located outside the heated envelope of the dwelling unit should be insulated to a minimum of R-8. Where determined necessary by diagnostic testing, leakage in ducts will be reduced to lowest practical level. When ducts are insulated or sealed they must meet the requirements detailed in this section.

15.1 Duct Survey, Inspection and Testing

The Grantee shall conduct diagnostic testing and visually inspect all accessible ducting in the heat distribution system including the plenums, trunk and branch lines. Refer to Section 4, *Diagnostic Testing*.

15.2 Duct Testing Required

Pressure pan testing of duct systems is required. Refer to Section 4.4.1, *Duct System Testing*.

Exception(s):

- a. The Grantee may elect to have ducts tested using a duct testing device and the associated procedures outlined by the manufacturer as an alternative to pressure pan testing.
- b. The entire distribution system is located within the envelope's conditioned space.

15.3 Dominant Duct Leak Test Required.

Dominant duct leak test is required. Refer to Section 4.5, *Dominant Duct Leak Testing*.

15.4 Ducts, Duct Sealing and Duct Insulating Materials

Materials used for replacement, repair and sealing of ducts shall be approved and listed in Section 8. *Materials Standards* (i.e., *10 CFR 440 Appendix A—Standards for Weatherization Materials*).

15.5 Ducts to be Repaired or Replaced

The Grantee or Subcontractor shall reconnect all serviceable ductwork found disconnected from boots, trunks or plenums. Method used for reconnection shall be permanent and appropriate to the materials being connected. All ductwork that is torn, crushed, or severely deteriorated shall be replaced or repaired.

15.6 Duct Sealing

When determined necessary by diagnostic testing or visual inspection, ducts shall be sealed to the following standard:

- a. All accessible connections to the air handler cabinet and plenums both inside and outside shall be sealed to provide permanent, air tight connections using mastic, mastic and fiber mesh.
- b. All accessible ductwork-to-ductwork connections both inside and outside shall be sealed to provide permanent, air tight connections using mastic, mastic and fiber mesh tape.
- c. All accessible elbows, holes, joints, seams, including lateral seams shall be sealed to provide permanent, air tight connections using mastic, mastic and fiber mesh tape.

15.6.1 Gaps

Gaps greater than 1/8 inch shall be sealed with a 2-inch wide fiber mesh tape embedded in mastic.

15.6.2 Timing

Ducts shall be sealed prior to insulating.

15.7 Flex Duct Requirements

- a. Flex duct, existing or installed, shall be insulated to a minimum, effective R-8.
- b. Flex duct shall be of the proper length for connection between two points without excessive bends or sag.
- c. Horizontal and vertical runs of flex duct shall be supported using nylon, plastic or metal strapping having a minimum width of ½ inch. Support strapping or hangers shall not compress the insulation.
- d. Support strapping or hangers shall be installed within 1 foot of a joint or connection with a maximum of 4 feet between supports.
- e. Flex duct shall not be installed in a manner allowing direct contact with the ground.
- f. Flex duct shall be connected to metal collars or boots using a layer of mastic between the metal and inner layer of the flex duct. The inner layer of the flex shall be secured using a compression strap. The outer layer of insulation shall also be secured using a compression strap.

15.8 Metal Duct

- a. Metal duct, existing or installed, in unconditioned spaces shall be insulated to a minimum, effective R-8.
- b. Metal ducts shall be of proper length without unnecessary elbows or changes in direction.
- c. Sections shall be securely connected to each other using a minimum of 3 screws for round ducts and 4 for rectangular.
- d. Insulation shall be permanently secured with rot and stretch proof twine or rust-proof wire, without unduly compressing the insulation.
- e. Horizontal and vertical duct runs shall be supported using nylon, plastic or metal strapping having a minimum width of 1/2 inch. Support strapping or hangers shall not unduly compress the insulation.
- f. Support strapping or hangers shall be installed within 1 foot of a joint or connection with a maximum of 4 feet between supports.
- g. Metal ducts shall not be installed in a manner allowing direct contact with the ground.

15.9 Rigid Fiberglass Duct Board

Rigid fiberglass duct board shall not be used to fabricate ducts.

15.10 Perimeter Wall Insulation

Where perimeter insulation, R -10 or greater, has been installed on the walls surrounding a basement or sealed crawlspace containing heating or cooling ducts, the ducts shall not be insulated unless a SIR greater than 1 is demonstrated.

Note: If exhaust fan is installed for continuous ventilation then ducts should be sealed.

16.0 Thermostats

Installation of a thermostat or replacement of an existing thermostat is allowable.

16.1 Determining Type of Thermostat to Install

The Grantee shall determine if a standard or a programmable thermostat should be installed, and install the appropriate thermostat. All thermostats shall have a dead-band range of less than two degrees.

16.1.1 Operating Instructions for Programmable Thermostats

The Grantee shall ensure that the dwelling unit occupants fully understand the benefits of a programmable thermostat and can demonstrate how to program the thermostat for optimal use, and how to change the back-up battery.

16.2 Thermostat Power Source

Thermostats shall be source powered. Programmable thermostats shall also have a battery backup.

16.3 Required Thermostat Features

Thermostats shall have a built in anti-short-cycle feature and include a positive on-off switch that is easily accessible. Programmable thermostats shall also have a 7-day cycle, or a 5 day-2 day cycle, a set-back capability of at least 10 degrees, and provide at least 4 program periods per day.

16.4 Location

All installed thermostats shall be reachable and readable by the primary occupant(s).

16.5 Placement

The top of the thermostat shall be 60 inches from the floor (+-6"). When an occupant uses a wheelchair, thermostat top shall be 48 (+-6") inches from floor.

17.0 Domestic Water Pipe Insulation in Unconditioned Spaces

The Grantee shall install insulation on accessible hot and cold water lines in unconditioned spaces.

Exception(s):

- a. Water pipes shall not be insulated if any of these conditions are present:
 - Water pipes or valves are leaking or are improperly supported.
 - When electric heat tape is being used to prevent freezing of pipes.

17.1 Pipe Insulation R-Value

Water pipe insulation installed by the Grantee shall have a minimum effective insulation value of R-5.

17.2 Installation Standard for Foam Insulation

Insulation shall be installed to these standards:

- a. Insulation with a lengthwise slit shall be positioned on horizontal pipe so that the slit is on the bottom side of the pipe.
- b. Insulation shall be sized to fit and firmly secured to the pipe. Products that are glued shall use the manufacturer's recommended adhesive and all slits in the material shall be sealed.
- c. Products that are not glued shall be taped in place or held in place with wire or plastic ties.
- d. Tape shall be applied along every slit and around each joint between separate pieces of material.
- e. If ties are used, they must be made of either galvanized wire or non-slipping plastic.
- f. The ties shall be spaced at one inch from each end of the material and thereafter every nine inches on center.
- g. Insulation material shall be cut and folded, or otherwise molded, to completely cover all elbows or curved pipe without compressing the insulation or allowing gaps to occur in the insulation.

17.3 Insulation of Pipes Exposed to Weather

If insulation is installed on pipes exposed to the weather, then such insulation shall be resistant to degradation from moisture, ultraviolet light, and extremes in temperature, or a jacket or facing shall be installed that protects the insulation from these conditions.

18.0 Water Heater Insulation

Water heaters in unconditioned spaces shall be insulated.

Unconditioned Space (in relation to water heaters) **Defined:** The areas of a dwelling unit that are not intentionally heated.

Exception(s):

- a. A tank shall not be insulated if any of the following conditions exist and cannot be corrected with available funding:
 - Internal insulation is R-12 or greater.
 - There is evidence of leaks or other impending failure.
 - External insulation is prohibited by the manufacturer.
 - There is evidence of improper combustion for a gas-fired unit.
 - Vent pipe or draft hood is improperly installed.
 - There is improper or inadequate venting for a gas fired unit.
 - Combustion air supply is improper or inadequate.
 - A temperature and pressure relief valve is not present or is located more than 6 inches from the tank or is capped or plugged.
 - Hazardous or improper electrical connections are present.
 - Thermostat cover plate is not present.
 - Burner access doors are not present.
 - Adequate clearances cannot be maintained.

18.1 Insulation Wrap R-Value

Insulating wraps shall have an insulation value of R-10 or greater.

18.2 Minimum Clearances for Heat Producing Appliances and Venting

Clearances between the surface of the wrap and adjacent heat producing appliances, including vent connectors, shall be maintained according to state and local codes.

18.3 Enclosure Wall Clearances

Water heaters shall meet the manufacturer's clearance requirements when installed in closets and enclosed spaces.

18.4 Temperature Setting

Prior to the installation of an insulating wrap, the hot water temperature shall be measured at a sink and adjusted so that the temperature does not exceed 120 degrees F.

Exception(s):

- a. If the client requests a higher temperature in writing, the temperature can be set to 130 degrees Fahrenheit or less. The Grantee shall document this request in writing in the client file.

18.5 Installation Procedures

Insulation wraps shall be installed according to the methods and procedures in the *Field Guide Section 4.2, Domestic Hot Water Systems, water heater blankets*.

19.0 Window Replacements and Repairs

Window replacement or repair is allowable for the following reasons:

19.0.1 Energy Efficiency

Windows and storm windows may be replaced or repaired for energy efficiency reasons if the total cost is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1 or greater. If replacing window, meet BEES.

Windows

Region	Fuel Type	U-Value	R-Value
All Regions	All Fuels	.33	3.0

19.0.2 Health and Safety Reasons

Windows may be replaced or repaired if the window's condition is compromising the health and safety of the dwelling unit occupants, this includes egress in bedrooms. If the cost to replace the window is less than the cost to repair the window, then the window may be replaced.

19.0.3 Security Reasons

Windows may be replaced or repaired for security reasons. If the cost to replace the window is less than the cost to repair or replace components of the window that will reasonably assure that the window is secure, then the window shall be replaced.

19.0.4 Durability Reasons

Windows may be replaced or repaired for durability reasons if any window components have failed or are deteriorated and they have compromised the structural integrity of the window or of the wall framing around the window. If the cost to replace the window is less than the cost to repair the window, then the window shall be replaced.

19.1 Lead-Based Paint

The Grantee shall address painted window components in houses built before 1978 using lead safe work practices unless testing indicates no lead-based paint is present. See Section 23, *Lead-Safe Weatherization (LSW)*.

19.2 Replacement Windows

Replacement windows shall meet BEES for climate zone location. (See chart above.) The replacement window shall have a label from the National Fenestration Rating Council (<http://www.nfc.org/label.aspx>) that indicates the U-factor rating and the air leakage rating.

19.2.1 Photo Documentation

A photo that clearly shows the window before it is replaced shall be kept in the client file.

19.2.2 Screens

All replacement windows that are openable shall have a removable insect screen.

19.2.3 Exterior and Interior Trim

All replacement windows shall be trimmed in a workmanlike manner and shall match the existing trim as much as is reasonably practical. Exterior trim, for replacement windows, whether existing or new, shall have any bare wood surfaces primed with an exterior grade primer.

Exception(s):

- a. If cedar trim is used in an exterior application, then no primer or sealer is required.

19.3 Storm Windows

A storm window may only be installed over a prime window that is structurally sound. The prime window shall be free of decay; broken windowpanes; worn or damaged rollers; missing, deteriorated, or broken glazing; and broken sashes. The Grantee shall evaluate the costs to replace a window unit with the costs associated with

repairing a prime window and installing a storm window to ensure that the most cost-effective treatment is applied. The interior window, whether the prime or storm, needs to be as airtight as possible.

19.3.1 Operable Storm Windows

Operable storm windows shall be installed over existing operable prime windows, and the storm window shall not interfere with the operation of the prime window. If the operation of the prime window is impeded by paint buildup, mechanical fasteners, or other reasons, a storm window can be installed if the window is restored to an operating condition or if the Grantee and homeowner agree in writing that the nonopening window is not required for egress or ventilation.

19.3.2 Storm Window Removal

All storm window installations shall provide an easy method of removing the storm sashes so that both the storm and prime windows can be washed.

19.3.3 Jalousie Prime Windows

Jalousie windows may be replaced.

19.4 Safety Glass

Safety glass shall be used in replacement window units or replacement glazing in locations where required by building codes.

19.4.1 Safety Glass Requirements

Safety glass shall conform to the Safety Glazing Certification Council (SGCC) labeling requirements. Installed safety glass shall have a permanently affixed manufacturer's label or etching.

19.5 Replacement Glazing

Replacement glazing shall meet the specifications found in Section 8. *Materials Standards* (i.e., 10 CFR 440 Appendix A—Standards for Weatherization Materials).

19.6 Obscure Glass

Obscure glass shall be installed in windows where privacy is important. The Grantee shall make the owner aware of locations where obscure glass is to be installed.

19.7 Egress Window

If replacing a window in a bedroom, at least one window must meet egress.

Definition of Egress: 20' minimum opening width
 24" minimum opening height
 44" maximum height from interior floor
 Unobstructed opening must equal 5.7 sq ft.

20.0 Door Replacement and Repairs

Door replacement or repair is allowable for the following reasons:

20.0.1 Energy Efficiency

Doors can be replaced or repaired for energy efficiency reasons if the total cost to install is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1 or greater. If replacing door, meet BEES.

Doors

Region	Fuel Type	R-Value
Southeast	All Fuels	7
Southcentral, Aleutians, Kodiak	All Fuels	7
Interior, Southwest	All Fuels	7
Northwest	All Fuels	7

20.0.2 Health and Safety Reasons

Doors can be replaced or repaired for health and/or safety reasons if the door's condition is compromising the health and/or safety of the dwelling unit occupants. If the cost to replace the door is less than the cost to reasonably repair the door, then the door shall be replaced.

20.0.3 Security Reasons

Doors can be replaced or repaired for security reasons. If the cost to replace the door is less than the cost to repair or replace components of the door that will reasonably assure that the door is secure, then the door shall be replaced.

20.0.4 Durability Reasons

Doors can be replaced or repaired for durability reasons if any door components have failed or have been damaged and they have compromised the structural integrity of the door. If the cost of replacement is less than the cost to reasonably repair the door, then the door shall be replaced.

20.1 Lead-Based Paint on Door Components

The Grantee shall address painted door components in houses built before 1978 using lead safe work practices, unless testing indicates that no lead is present. See Section 23, *Lead-Safe Weatherization (LSW)*.

20.2 Replacement doors

Replacement doors shall be metal or fiberglass, insulated, and shall be hinged. If a new exterior door and jamb is being installed, the door shall have three hinges. All exterior door replacements shall be exterior grade. All replacement doors shall have an insulated core with a minimum R7 insulation value.

Exception(s):

- a. Wood, or composite doors are allowable if a metal or fiberglass door cannot be used. Wood doors shall be solid core. Veneers on wood doors shall be a minimum of 1/8 inch thick hardwood.

20.2.1 Photo Documentation

A photo that clearly shows the door before it is replaced shall be kept in the client file.

20.2.2 Exterior and Interior Trim

Trim shall be installed in a workmanlike manner and shall match the existing trim as is reasonably practical. Exterior trim for replacement doors and doorframes, whether existing or new, shall have any bare wood surfaces primed with an exterior grade primer.

Exception(s):

- a. If cedar trim is used, then no primer or sealer is required.

20.3 Replacement Door Jambs

Replacement doorjambs shall have a width that is no greater than the finished wall thickness, and not less than 1/4 inch of the finished wall thickness.

20.4 Door Finishes

Replacement wood doors will be primed and painted or sealed on both sides and on all four edges with an exterior grade paint. Metal doors shall have a factory primer.

20.5 Locksets and Deadbolts

New replacement doors lockset and deadbolt shall match existing door configuration if installing the lockset and deadbolt shall be keyed alike. The Grantee will provide two keys to the owner or occupant of the dwelling unit. When multiple locksets are installed in the same dwelling unit they shall have matching keys.

20.6 Other Attached Items

Address numbers that were present on the existing front door or trim shall be reinstalled on the new door. Peepholes can be installed on solid doors and shall be no more than 60" from the bottom of the door. If an existing door had a mail slot or mechanical doorbell, the Grantee shall provide alternatives that do not require penetration of the door. If a glass lite is installed it can be no larger than 12 x 12. The glass must be a double pane thermal.

Exception(s):

- a. Peepholes are only required if original door had a peephole.

21.0 Carbon Monoxide Detectors

Carbon Monoxide detectors are required outside of each sleeping area in the immediate vicinity of the bedrooms and on each additional story of the dwelling including basement, but not including crawlspaces and uninhabitable attics.

21.1 Detector Standards

Detectors shall have:

- a. A minimum five year operating life.
- b. A digital display that indicates CO levels in Parts Per Million (ppm).
- c. UL approval

21.2 Detector Power Options

- a. Hardwired Detectors: Hardwired detectors are allowable. Hardwired detectors shall have a 9-volt, battery backup.
- b. Battery-Operated Detectors: Battery operated detectors shall make an audible noise when the battery is at the end of its life cycle.
- c. Plug-In Detectors: Plug-in detectors shall have a tamper-resistant connection to a continuously energized 120-v AC power source. They shall not be on a switched plug or on a GFCI protected circuit. Plug-in detectors shall have a battery backup.

21.3 Labeling Devices

All installed detectors shall be labeled in a permanent fashion with all of the following: (This information need not be visible while detector is mounted on the wall.)

- a. Local emergency phone number (most places 911).
- b. Date of installation.

21.4 Manufacturer's Instructions

The manufacturer's instructions shall be left with the occupant of the dwelling unit.

21.5 Education of Dwelling Unit Occupants

The Grantee shall provide the occupant(s) of the dwelling unit with verbal and written information regarding the dangers of CO, how to read the CO detector, instructions on how to respond to CO levels, and how to change the batteries.

21.6 Installation for CO Detectors

All CO detectors will be installed per manufacturer's instructions.

21.7 Installation in Sleeping Areas

A CO detector shall be installed inside any closable sleeping room that:

- a. Contains a combustion appliance
- b. Has a door that directly enters a garage

21.8 Testing

The Grantee shall test each detector for proper operation after installation as per test procedures in the owner's manual provided by the manufacturer.

22.0 Smoke Detectors

Smoke detectors are required in all sleeping rooms, outside of each sleeping area in the immediate vicinity of the bedrooms, on each additional story of the dwelling, including basements but not including crawlspaces and uninhabitable attics.

22.1 Detector Standards

Detectors installed shall be UL approved.

22.2 Detector Power Options

Detector shall be powered by one of the following methods:

- a. Hardwired: Hardwired detectors shall have a battery backup.
- b. Battery-Operated: Battery-operated detectors shall have a lithium battery. They shall make an audible alarm when the battery is at the end of its life cycle.

22.3 Manufacturer's Instructions

The manufacturer's instructions shall be left with the occupant of the dwelling unit.

22.4 Education of Dwelling Unit Occupants

The Grantee shall provide the occupant(s) of the dwelling unit with verbal and written information regarding the operation of the smoke detector(s), the importance of testing and battery replacement.

22.5 Installation Location(s) for Smoke Detectors

Smoke detectors shall be installed on walls and/or ceilings per manufacturer's requirements.

22.6 Hearing Impaired

Hard-wired smoke alarms with a visual alarm for hearing impaired individuals is an allowable weatherization expense when current occupants would benefit from a specialized detector.

22.7 Testing

The Grantee shall test each detector for proper operation after installation.

23.0 Lead-Safe Weatherization (LSW)

Lead Safe Weatherization (LSW) must be applied to all pre-1978 housing.

Follow EPA's Lead, Renovation, Repair and Painting Program (RRP). In addition to RRP, Weatherization requires all weatherization crews working in pre-1978 housing to be trained in Lead Safe Weatherization (LSW). Deferral is required when the extent and condition of lead-based paint in the home would potentially create further health and safety hazards.

- 23.0.1 No Lead-Based Paint will be disturbed without following current EPA / DOE Repair, Renovate and Paint (RRP) and Certified Renovator regulations. LSW must be applied to all pre-1978 housing unless there is existing evidence that the home has been

certified as being lead-free or below the lead threshold limit (e.g., for paint containing lead below the regulated level, 1.0 mg/cm² or 0.5% by weight). One of the following methods must be used to determine the paint to be disturbed is not lead-based paint:

- Written determination by a certified lead inspector or risk assessor; **OR**
- Proper use of an EPA-recognized test kit provided agencies (documenting manufacturer and model of test kit used, description and location of components tested, and test kit results)

Note: Beginning in 2010, tests must be performed by a Certified Renovator, per EPA final rule. Test kits are currently being evaluated, but none have been approved to date. Updates and approved kits will be posted at <http://www.epa.gov/lead/pubs/renovation.htm>; **OR**

- A State-approved lead-based paint test protocol (e.g., XRF scans verifying absence of lead paint).

Copies of all tests must be in the client file.

23.0.2 Mobile Homes. Often, interiors of mobile homes were not painted, but rather, paneling was applied to the surfaces. Therefore, pre-1978 mobile homes that were not painted by the manufacturer, occupant, landlord, or past owner of the unit before 1978, may be exempt from LSW. However, Weatherization Programs must verify the areas receiving weatherization services have never been painted or were painted for the first time after 1978. If this is not verifiable, then LSW protocols must be followed. Painted exterior surfaces on pre-1978 units should not be drilled, scraped, sanded, or receive any other work that disturbs the paint.

23.1 Minimum Standards for LSW

Safe Work Practices must be implemented to minimize exposure to hazards for residents and workers, while allowing Weatherization to occur in a cost-effective manner and without hindering production. The effort required will be based on the hazard, the work specifications, and client health issues.

To meet the LSW minimum standards, crews and contractors **MUST** follow the general principles of working in a lead-safe manner. Best practices for working in a lead-safe manner are available in the benchmark LSW procedures and curriculum and should be reviewed and consistently enforced on LSW jobs.

23.2 Client Protection and Notification

The EPA pamphlet, “Renovate Right: Important Lead Hazard Information for Families, Child Care Providers, and Schools,” (herein referred to as “the pamphlet”) **MUST** be distributed to clients occupying pre-1978 housing.

- a. For occupied homes, the Weatherization staff, crew, or contractor must have an adult tenant or homeowner sign an acknowledgement after receiving the pamphlet. The pamphlet also can be sent by certified mail with a signed return receipt to be placed in the customer file.

- b. For multi-unit housing, the Grantee must:
- Provide written notice to each affected unit (The notice must describe the general nature and location(s) of the planned renovation activities, the expected starting and ending dates, and how the occupant can receive the pamphlet at no charge.); **OR**
 - Post informational signs (The signs must describe the general nature and location(s) of the renovation, and the anticipated completion date.) and post the pamphlet. (If the pamphlet is not posted, then the Grantee is required to provide information about how interested occupants can review a copy of the pamphlet or obtain a copy at no cost from the Weatherization Program.); **OR**
 - Deliver the pamphlet to the homeowner/occupant and obtain the homeowner's and/or occupant's signature with acknowledgment or certificate of mailing. The homeowner/occupant must acknowledge receipt of the pamphlet prior to start of renovation. The acknowledgment must contain the address of the unit undergoing renovation, the name and signature of owner or occupant, and the date of the signature. It must be in same language as "contract for renovation" for owner-occupied (or the same language as the lease for an occupant of non-owner occupied) target housing.
- If the Weatherization Program cannot obtain a signed acknowledgment (e.g., the occupant is not home or refuses to sign it), then the self-certification section of the form must be signed to prove delivery.

The acknowledgement form must be filed and remain with the client file for three years from date of signature. In addition to providing the pamphlet to owners and occupants, designated local agency staff (e.g., an intake specialist, assessor, or crew chief) must discuss the hazards associated with lead-based paint and lead dust and describe how workers will conduct LSW in the home.

23.3 Weatherization Worker Protection

LSW includes these procedures and safety precautions:

- a. Wear personal protective gear specifically suited for the particular LSW measure. Use the National Institute for Occupational Safety and Health (NIOSH) approved respirators (at least ½ face) with HEPA filters, rated at N-100, R-100, or P-100. Nothing with less rating allowed!
- b. Use disposable overalls (with hood or a disposable painter's cap), gloves (cloth, plastic, or rubber as appropriate), goggles, and disposable shoe/boot covers.
- c. Keep dust to a minimum and properly contain dust and paint chips to the work area.
- d. Clean up the area during and after work.
- e. During Weatherization, wash hands and face frequently, particularly when leaving the work area and especially before leaving the area for the purpose of eating, drinking, or smoking.
- f. Before leaving a confined work area, remove protective clothing and protective shoe/boot covers to avoid exposing others.

- g. Before leaving a confined work area and before returning tools and equipment to vehicles, clean all tools to avoid exposing others and to create a lead-hazard for the next Weatherization job.
- h. Get annual medical exams to check blood lead levels. Do non-lead-related work if blood lead level gets too high.
- i. Inform your employer if you develop signs of lead poisoning.

23.4 General LSW Practice Standards

- a. Crews and contractors must take steps to protect occupants from lead-based paint hazards while the work is in progress, using appropriate containment strategies.
- b. Occupants, especially young children or pregnant women, may not enter the work site. Occupants are allowed to return only after the work is done, and the home has passed a visual inspection.
- c. Occupants' belongings must be protected from lead contamination. This can be done by removing them from the work area or covering them in protective bags and sealing them to prevent dust from getting on the items.
- d. The work site must be set up to prevent the spread of leaded dust and debris.
- e. Warning signs must be posted at entrances to the work site when occupants are present; at the main and secondary entrances to the building and at exterior work sites. The signs must be readable from 20 feet from the edge of the work site. Signs should be in the occupants' primary language, when practical.
- f. The work area must be contained. If containment cannot be achieved with occupants in the unit (e.g., work will take several days and involves the kitchen, bathrooms, or bedrooms that cannot be sealed-off from use), occupants must move out of the unit, or the work must be deferred until containment can be achieved.
- g. Ensure containment does not interfere with occupant and worker egress in an emergency.

23.5 Prohibited Work Activities

- a. NEVER use reusable cloth or fabric, such as a painter's drop cloth, as protective containment sheeting. Polyethylene and—in some cases when working in an exterior garden—fabric are the only acceptable protective containment sheeting and must never be reused.
- b. NEVER use brooms and shop vacuums for clean-up. Wet cleaning and HEPA vacuums are the only acceptable methods for clean-up.
- c. NEVER use a conventional shop vacuum with HEPA filters—only HEPA-designed vacuums are acceptable for LSW.
- d. NEVER turn leaded paint into leaded dust by dry scraping or sanding (unless as needed around electrical outlets), grinding, abrasive blasting, or planing.

- e. NEVER use an open-flame torch or heat gun (above 1100°F) to remove paint or window glazing. Open flame/high heat methods to remove paint create fumes that are dangerous for workers to breathe. Small lead particles created by burning and heating also settle on surrounding surfaces and are very hard to clean up.
- f. NEVER ALLOW RESIDENTS AND PETS TO ACCESS THE WORK AREA.
- g. NEVER open windows and doors, allowing lead dust to float into other parts of the building or outside.
- h. NEVER allow furniture and other objects to remain in the Weatherization work area while Weatherization work is being performed unless they are covered and sealed in polyethylene sheeting or bags.

23.6 Containment

Containment is anything that stops any dust or debris from spreading beyond the work area to non-work areas. The level of containment must be determined by the assessor/inspector or supervisor before work is assigned to a crew or contractor. To comply with EPA's LRRPP Rule requirements, a Certified Renovator is required to be at the job site to assess and set up the containment site.

Every home and every specific Weatherization measure is unique. Therefore, the level of containment required will be based on the hazards present, the age of the home, the scope of work activities, and any client health issues. Although Weatherization jobs require individual assessments, LSW work generally falls into two levels of containment. The related standards are outlined below.

23.6.1 Level 1 Containment

Level 1 Containment is required in pre-1978 homes when less than 6 ft² of interior painted surface per room or 20 ft² of exterior painted surface will be disturbed. If HUD funded money is leveraged, more restrictive rules are to be followed.

Level 1 Containment consists of methods that prevent dust generation and contains all debris generated during the work process. The containment establishes the work area which must be kept secure.

Measures that may fall within this guideline include:

- a. Installing or replacing a thermostat
- b. Drilling and patching test holes
- c. Replacing HEPA filters and cleaning HEPA vacuums
- d. Changing Furnace Filter
- e. Removing caulk or window putty (interior)
- f. Removing caulk or window putty (exterior)
- g. Removing weather-stripping

23.6.2 Level 2 Containment

Level 2 Containment is required when Weatherization activities will disturb more than 6 ft² of interior surface per room or 20 ft² of exterior surfaces in homes built prior to 1978. Level 2 Containment consists of methods that define a work area that will not allow any dust or debris from the work area to spread. Level 2 Containment requires the covering of all horizontal surfaces, constructing barrier walls, sealing doorways, covering HVAC registers with approved materials, and closing windows to prevent the spread of dust and debris.

Measures requiring Level 2 containment may include:

- a. Drilling holes in interior walls
- b. Drilling holes in exterior walls, removing painted siding
- c. Cutting attic access into ceiling or knee walls
- d. Planing a door in place
- e. Replacing door jambs and thresholds
- f. Replacing windows or doors
- g. Furnace replacements

Additionally, Level 2 containment must ALWAYS be used where any of the following work is conducted (even if the activities will disturb less than the hazard de minimis levels within the Level 1 category):

- a. Window replacement
- b. Demolition of painted surface areas
- c. Using any of the following:
 - Open-flame burning or torching;
 - Machines to remove paint through high-speed operation without HEPA exhaust control; or
 - Operating a heat gun at temperatures at or above 1100 degrees Fahrenheit.

23.7 Proper LSW Clean-Up and Debris Disposal

Following the containment standards in the previous section will minimize the level of effort required to properly clean up the job site. All dust, dirt, material scraps, containers, wrappers, and work-related debris must be removed from the client's home. A HEPA vacuum should be used to clean up the work areas. Further cleaning may be necessary based on the hazard.

At the conclusion of the job, once all workers have "cleaned" the work areas thoroughly, Weatherization workers must adhere to the following practices:

23.7.1 Safe and Secure Disposal

- a. Bag and gooseneck-seal all waste in 6-mil plastic bags
- b. Safely dispose of all waste in accordance with federal, state, and local regulations

23.7.2 Visual Inspection Verification

Checking the quality of work site cleanliness is a two-phase process:

Phase 1: Worker visual inspection during the cleaning process, looking for any visible paint chips, dust, or debris while using proper cleaning techniques.

Phase 2: Certified Renovator visual inspection after clean-up. There should be no evidence of settled dust following a clean-up effort. If dust is observed, the Weatherization crew is required to repeat the cleaning.

If work is done outside the house, the grounds around the dwelling and all exterior horizontal surfaces also should be examined visually to ensure that all waste and debris have been removed and that paint chips were not left behind.

23.8 Deferrals

It is prudent to defer certain Weatherization work in homes that have either tested positive or are assumed to have lead-based painted surfaces.

First, the Grantee should assess the following factors:

1. Is the Grantee prepared to work with lead-based paint? (i.e., have workers/contractors received training in LSW work practices; is the necessary equipment, such as HEPA vacuum cleaners, available; and does the Grantee's liability insurance cover work with lead-based paint?);
2. What is the condition of the painted surfaces in the home that might be specifically disturbed during the course of an allowable weatherization measure? (i.e., are the surfaces seriously deteriorated?);
3. To what extent will the specific energy efficiency measures determined by the assessment disturb painted surfaces? (i.e., will the disturbance likely generate dust in excess of OSHA minimums?); and
4. Will the cost of doing LSW work represent a large portion of the total cost, so as to exceed the amount allowed by the state's health and safety plan (which could be the case if large amounts of lead-based paint surfaces will be disturbed)?

Second, the Grantee should determine, based on consideration of the above factors, whether to:

1. Proceed with all the weatherization work, following LSW work practices; or
2. Do some of the weatherization tasks and defer others; or

3. Defer all of the weatherization work.

Deferral would mean postponing the work either until the Grantee is prepared to work with lead-based paint or until another funding source has been identified that can finance corrections to the problem LBP area so that Weatherization can be safely performed.

In cases where extensive LSW would be necessary, Grantees are encouraged to coordinate with other organizations that are funded to do lead-based paint hazard control to perform some of the more costly activities, such as risk assessment or clearance testing.

In areas where there are no organizations performing such work, Grantees may choose to develop their capabilities (e.g., purchase of equipment and advanced training for Grantee work crews) for lead-based paint hazard control work. [DOE Weatherization funds may not be used for this purpose.] For a home in an area where lead-based paint hazard control is not available, regular Weatherization work that does not disturb painted surfaces can be done.

23.9 Training

When disturbance of painted surfaces meets minimum EPA standards, Weatherization workers must use LSW practices.

AHFC may provide or recognize prior participation in the following training opportunities to Grantees as required, taking into consideration each Grantee's mix of action items and allowable measures:

- LSW workshops provided by trainers who are certified in The HUD Lead Safe Work Practices
- Peer-to-Peer training
- Individual Grantee training on an as-needed basis.

Training programs in Alaska will be coordinated between AHFC and other training organizations.

24.0 Low-Cost No-Cost Measures

The purchase and installation of Low-cost No-cost energy conservation measures is allowable.

24.1 Types of Measures

Installation of any of the following Low-cost No-cost measures is allowable:

- a. Water flow restrictors.

- b. Furnace or cooling filters, up to one-year supply.
- c. Items that are primarily directed at reducing infiltration, such as weather-stripping, caulking, and glass repairs.
- d. Brochures and other written information concerning the potential savings from installation of Low-cost No-cost measures.
- e. Compact fluorescent light bulbs.
- f. Replacement lamps for energy-efficient fixtures.

24.2 Compact Fluorescent Lamps

The Grantee shall replace incandescent screw-in light bulbs with compact fluorescent screw-in bulbs (CFLs) in each dwelling unit receiving weatherization services.

Exception(s):

CFLs should not be installed if any of the following conditions exist:

- a. Socket or fixture is nonfunctional, damaged, or unsafe.
- b. Circuit is controlled by a solid-state timer.
- c. Circuit is controlled by a non-CFL compatible dimmer.
- d. Fixture is located in a storage room, closet, or other seldom-used room.
- e. Fixture is controlled by an occupancy sensor.
- f. The client refuses to have CFLs installed.

24.2.1 Types of Compact Fluorescent Lamps

CFLs that are installed shall be EnergyStar compliant and be warranted for one year from the date of purchase.

24.2.2 Light Output

CFLs must provide light output levels that meet or exceed the level of the bulbs that they are replacing.

24.2.3 Outdoor Locations

CFLs may be installed in outdoor locations attached to the dwelling provided they are installed in a fixture that protects the lamp from the weather.

24.2.4 Testing

The installer shall test all installed fixtures before leaving the dwelling unit and shall ask the client if the lighting level is adequate, if the client is available.

25.0 Lighting Retrofit

Retrofit of lighting fixtures is allowable if the cost is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is one or greater.

25.1 Type of Fixtures

Fixtures that are installed shall be hard-wired fluorescent fixtures that meet all of the following:

- a. UL listed.
- b. EnergyStar compliant.
- c. Fully warranted for one year after the date of installation.
- d. T-8 or T-5 type lamp that is easily replaceable.
- e. Interior fixtures shall be with electronic ballast only.
- f. Installed according to local electrical code and manufacturers specifications.

25.2 Light Output

Fixtures must provide light output levels that meet or exceed the level of light needed for the task they are illuminating.

25.3 Exterior Fixtures

Exterior fixtures shall be constructed of UV resistant materials and rated for installation in damp or wet locations. Magnetic ballast fixtures are allowed.

25.4 Testing

The installer shall test all installed fixtures before leaving the dwelling unit, and shall ask the client if the lighting level is adequate, if the client is available.

26.0 Refrigerator Replacement

Refrigerators shall be replaced when the replacement is justified using a State approved evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1.0 or greater.

26.1 Document Cost-Effectiveness

The Grantee shall document in the client file that the replacement is cost-effective with an SIR of 1.0 or greater, and the method used to determine the SIR. Use approved calculator from www.energytools.com

26.2 Allowable Methods to Determine SIR

The Grantee shall use the following methods to determine the SIR before replacing a refrigerator:

Weatherization program online tool: www.energytools.com

26.2.1 Data Logging and Databases

The Grantee shall use a minimum of 2 hours of data logging information, or data base referrals to determine energy usage of existing refrigerators. Link to refrigerator database www.kouba-cavallo.com/refmods.htm

26.3 Replacement Refrigerators

Replacement refrigerators shall have the EnergyStar rating.

Replacement refrigerators shall not have extra features such as door ice, through-the-door water dispensing, or automatic icemakers.

Exception(s):

- a. A non-EnergyStar refrigerator may be installed provided the SIR for the non-EnergyStar model is demonstrated to be higher than the SIR for the EnergyStar model.

26.4 Refrigerator Sizing

The smallest size refrigerator that is practical for each household should be installed. The following guidelines shall be used:

Family of 1-2	15 cubic foot
Family of 3-5	18 cubic foot
Family of 5 or more	21 cubic foot

26.5 Client Agreement

The Grantee and client shall have a written agreement that is documented in the client file that the refrigerator being replaced will be removed by the Grantee. Additional refrigerators or freezers, whether working or not, may be removed upon written agreement between the owner and the Grantee.

26.6 Establishment of Ownership

If the refrigerator is installed in a rental unit, the ownership of the existing and the replacement refrigerator shall be established, and documented in the client file. This shall be done before the replacement refrigerator is installed.

26.7 Disposal of Removed Refrigerators

The Grantee shall remove the old refrigerator from the property and dispose of it at an EPA-approved disposal site that reclaims the refrigerant. The client file will contain documentation of the proper disposal from the disposal facility, or a statement signed by a commercial vendor indicating that the vendor will dispose of the refrigerator at an approved disposal site that reclaims the refrigerant.