

# Weatherization Operations Manual

## Section 5. Building Standards

<b>Table of Contents .....</b>	<b>5-1</b>
<b>General Policies.....</b>	<b>5-10</b>
<b>Guiding Principles of the Alaska Weatherization Assistance Program .....</b>	<b>5-10</b>
<b>Mandatory Health-and-Safety Measures .....</b>	<b>5-11</b>
<b>1.0 General Requirements .....</b>	<b>5-11</b>
<b>1.1 Subcontractors .....</b>	<b>5-12</b>
1.1.1 Subcontractor License and Insurance Requirement.....	5-12
1.1.2 Competency .....	5-12
<b>1.2 Warranties .....</b>	<b>5-12</b>
<b>1.3 Code Compliance .....</b>	<b>5-12</b>
<b>1.4 Materials .....</b>	<b>5-12</b>
1.4.1 Alternate Materials.....	5-12
<b>1.5 Manufacturers' Requirements .....</b>	<b>5-13</b>
<b>1.6 Certificate of Insulation—All Forms of Insulation.....</b>	<b>5-13</b>
1.6.1 Posting of Certificate .....	5-13
1.6.2 Posting Empty Bag/Wrapper—Loose Fill .....	5-13
<b>1.7 Savings to Investment Ratio (SIR) .....</b>	<b>5-13</b>
<b>1.8 Level of Finish Required .....</b>	<b>5-14</b>
<b>2.0 Health and Safety .....</b>	<b>5-15</b>
<b>2.1 Worker Safety .....</b>	<b>5-15</b>
<b>2.2 Housekeeping Activities .....</b>	<b>5-16</b>
<b>2.3 Client Safety.....</b>	<b>5-16</b>
<b>2.4 Health-and-Safety Limitations .....</b>	<b>5-16</b>
<b>2.5 Walk-Away Policy .....</b>	<b>5-16</b>
<b>3.0 Home Energy Assessments .....</b>	<b>5-17</b>
<b>3.1 Scope of Assessment .....</b>	<b>5-17</b>
<b>3.2 Assessment Requirements.....</b>	<b>5-17</b>
3.2.1 In-Home Safety.....	5-17

3.2.2	All assessments will include:.....	5-18
<b>3.3</b>	<b>Review of Assessment with Client .....</b>	<b>5-18</b>
<b>3.4</b>	<b>Client Authorization .....</b>	<b>5-18</b>
<b>3.5</b>	<b>Assessment Documentation.....</b>	<b>5-19</b>
3.5.1	Photographic Record .....	5-19
<b>3.6</b>	<b>AkWarm .....</b>	<b>5-19</b>
3.6.1	AkWarm Updates and Training.....	5-19
3.6.2	Calculation of Installed Measure Cost.....	5-19
<b>4.0</b>	<b>Diagnostic Testing.....</b>	<b>5-20</b>
<b>4.1</b>	<b>Diagnostic Testing Equipment .....</b>	<b>5-20</b>
<b>4.2</b>	<b>Blower Door Test .....</b>	<b>5-20</b>
4.2.1	Building Set-Up to Test Thermal Boundary (AkWarm) .....	5-21
4.2.2	Building Set-Up to Test Living Space (For Ventilation ASHRAE.....	5-21
4.2.3	Blower Door Set-Up and Test Procedure.....	5-22
4.2.4	Baseline Data .....	5-22
4.2.5	Pre and Post Test Home Set-Up .....	5-22
<b>4.3</b>	<b>Blower Door Tests in Multi-Unit Buildings .....</b>	<b>5-23</b>
4.3.1	In buildings with 12 or more units, blower door testing is.....	5-23
4.3.2	When weatherizing buildings of less than 12 units, .....	5-23
4.3.3	In townhome-style (shared walls but no shared floor/ceiling.....	5-23
4.3.4	In townhome-style (shared walls but no shared floor/ceiling.....	5-23
4.3.5	In townhome-style condominium buildings (where each unit .....	5-23
4.3.6	In townhome-style condominium buildings where the entire.....	5-23
4.3.7	In multi-level condominium buildings where only an individual .....	5-24
4.3.8	In multi-level apartment and condominium buildings where.....	5-24
<b>4.4</b>	<b>Zonal Pressure Testing .....</b>	<b>5-24</b>
4.4.1	Duct System Testing.....	5-25
<b>4.5</b>	<b>Dominant Duct Leak Testing.....</b>	<b>5-25</b>
<b>4.6</b>	<b>Room-to-Room Pressure Differential Testing .....</b>	<b>5-25</b>
<b>5.0</b>	<b>Combustion Appliance Zone Depressurization.....</b>	<b>5-26</b>
5.0.1	Combustion Safety Testing.....	5-26
5.0.2	Post Weatherization Combustion Safety Testing.....	5-27
<b>5.1</b>	<b>Heat Rise.....</b>	<b>5-27</b>
<b>5.2</b>	<b>Draft and Spillage Tests .....</b>	<b>5-27</b>
5.2.1	Single Chimney with Multiple Appliances.....	5-27
5.2.2	Multiple Fuel Sources Vented into a Single Chimney .....	5-27
5.2.3	Draft Testing .....	5-27
5.2.4	Spillage .....	5-28
<b>5.3</b>	<b>Carbon Monoxide Tests .....</b>	<b>5-28</b>

<b>5.4 CO Measurement for Power-Vented, Direct-Vented, or Sealed .....</b>	<b>5-28</b>
<b>Combustion Units .....</b>	<b>5-28</b>
5.4.1 Range Tops and Gas Ovens .....	5-29
5.4.2 Ambient Carbon Monoxide .....	5-30
5.4.3 Gas Leak Test .....	5-30
<b>5.5 Documentation.....</b>	<b>5-30</b>
<b>5.6 Un-Vented Fuel Burning Space-Heating Appliances.....</b>	<b>5-31</b>
<b>6.0 Building Envelope Air-Sealing .....</b>	<b>5-31</b>
6.0.1 Air-Sealing Locations.....	5-31
6.0.2 Cost Effective Air-Sealing.....	5-31
6.0.3 Use of Pressure Diagnostics and Blower Door.....	5-32
6.0.4 Air-Sealing Documentation.....	5-32
<b>6.1 Building Airflow Standard (BAS).....</b>	<b>5-32</b>
<b>6.2 Preferred Installation Method .....</b>	<b>5-32</b>
6.2.1 Dirt and Debris Removal .....	5-32
6.2.2 Depth of Sealant.....	5-32
6.2.3 Filler Materials .....	5-32
<b>6.3 Sealing Bypasses Around Chimneys, Flues and Stovepipes.....</b>	<b>5-32</b>
6.3.1 Fireplaces with Broken or Missing Dampers .....	5-33
<b>6.4 Sealing Non-IC-rated Fixtures .....</b>	<b>5-33</b>
<b>7.0 Attic/Ceiling Insulation .....</b>	<b>5-33</b>
7.0.1 Installing Loose Fill—Insulation material shall be installed in .....	5-33
7.0.2 When insulating attic/ceilings, the thermal and pressure.....	5-33
<b>7.1 Ceiling Loading.....</b>	<b>5-33</b>
<b>7.2 Insulating Knee Walls.....</b>	<b>5-33</b>
7.2.1 Cavity under Knee Wall .....	5-33
7.2.2 Vapor Barrier .....	5-33
<b>7.3 Sloped Ceilings.....</b>	<b>5-34</b>
<b>7.4 Attic/Ceiling Damming .....</b>	<b>5-34</b>
7.4.1 Recessed Lighting Fixtures and Other Heat-Producing Fixtures .....	5-34
7.4.2 Exhaust Fans.....	5-34
7.4.3 Flues and Chimneys.....	5-35
7.4.4 Photo Documentation .....	5-35
<b>7.5 Exhaust Ducting in Attics/Ceilings .....</b>	<b>5-35</b>
<b>7.6 Heating and Cooling Ducting in Attics/Ceilings.....</b>	<b>5-35</b>
<b>7.7 Knob and Tube Wiring in Ceilings/Attics .....</b>	<b>5-35</b>
7.7.1 Inspection .....	5-35
7.7.2 Overcurrent Protection .....	5-35
7.7.3 Insulation .....	5-36

<b>7.8 Wiring (Other than Knob and Tube)</b> .....	<b>5-36</b>
7.8.1 Splices and Connections .....	5-36
<b>7.9 Attic Access</b> .....	<b>5-36</b>
7.9.1 Framing Access Openings .....	5-36
7.9.2 Knee-Wall Access Openings .....	5-36
7.9.3 Insulating Access Openings.....	5-37
<b>7.10 Retractable Ladders</b> .....	<b>5-37</b>
<b>7.11 Passive Ventilation</b> .....	<b>5-37</b>
7.11.1 Ventilation Baffling .....	5-37
<b>8.0 Wall Insulation</b> .....	<b>5-37</b>
<b>8.1 Dense Pack Wall Insulation</b> .....	<b>5-38</b>
8.1.1 Fill Tube Method .....	5-38
8.1.2 Interior/Exterior Installation .....	5-38
8.1.3 Water Column (WC) Pressure .....	5-38
8.1.4 Balloon-Framed Walls.....	5-38
<b>8.2 Treatment of Interior and Exterior Surfaces</b> .....	<b>5-38</b>
8.2.1 Lead-Based Paint .....	5-39
8.2.2 Removing Exterior Siding .....	5-39
8.2.3 Drilling Exterior Siding.....	5-39
<b>8.3 Open Wall Cavities</b> .....	<b>5-39</b>
8.3.1 Insulating Open Cavities .....	5-39
<b>8.4 Interior Applied Insulation</b> .....	<b>5-39</b>
<b>9.0 Crawlspace/Under-Floor/Perimeter Insulation</b> .....	<b>5-39</b>
9.0.1 Installation Standard .....	5-40
<b>9.1 Insulation Support</b> .....	<b>5-40</b>
<b>9.2 Ground Cover</b> .....	<b>5-40</b>
<b>9.3 Crawlspace Access</b> .....	<b>5-41</b>
9.3.1 Exterior Access.....	5-41
9.3.2 Interior Access .....	5-41
<b>9.4 Passive Ventilation in Crawlspace</b> .....	<b>5-41</b>
9.4.1 Closeable Vents.....	5-41
9.4.2 Vent Opening Location .....	5-42
9.4.3 Vent Screening and Framing .....	5-42
9.4.4 Rigid Foam Plug .....	5-42
<b>9.5 Sealed Crawlspace and Mechanical Ventilation</b> .....	<b>5-42</b>
9.5.1 Combustion appliances in crawlspaces must have combustion .....	5-42
<b>9.6 Crawlspace/Unconditioned Basement Combination</b> .....	<b>5-42</b>
9.6.1 Crawlspace/Unconditioned Basement Combination, Option 1 .....	5-42
9.6.2 Crawlspace/Unconditioned Basement Combination, Option 2.....	5-42

<b>9.7 Rim Joist Area.....</b>	<b>5-42</b>
<b>9.8 Exterior Foundation Insulation.....</b>	<b>5-43</b>
9.8.1 Minimum R-Value for Walls .....	5-43
9.8.2 Insulation Installation .....	5-43
9.8.3 Excavation in Preparation for Insulation .....	5-43
9.8.4 Utility Locating .....	5-43
9.8.5 Surface Preparation and Attachment of Insulation .....	5-43
9.8.6 Protection and Flashing of Insulation.....	5-43
<b>9.9 Interior Foundation Insulation .....</b>	<b>5-44</b>
9.9.1 Minimum R-Value .....	5-44
9.9.2 Batt or Blanket Insulation Installation.....	5-44
9.9.3 Rigid Insulation and/or Spray Foam .....	5-44
<b>9.10 Cantilevered Floors.....</b>	<b>5-44</b>
9.10.1 Insulate Cantilever, Open Through Rim .....	5-44
9.10.2 Insulate Cantilever, Open Under Floor .....	5-44
9.10.3 Insulate Cantilever, No Access.....	5-45
<b>9.11 Floor over Unheated Attached Garage, No Access .....</b>	<b>5-45</b>
9.11.1 Floor over Attached Garage, Open Joists .....	5-45
<b>10.0 Skirting—Insulated and Un-insulated.....</b>	<b>5-45</b>
<b>10.1 Installation Standard.....</b>	<b>5-46</b>
<b>10.2 Skirting Insulation.....</b>	<b>5-46</b>
<b>10.3 Access Door .....</b>	<b>5-46</b>
<b>11.0 Moisture Control .....</b>	<b>5-46</b>
<b>11.1 Roof/Plumbing Leak .....</b>	<b>5-47</b>
<b>11.2 Gutters and Downspouts .....</b>	<b>5-47</b>
<b>11.3 Below Grade Vents and Penetrations in Foundation Walls.....</b>	<b>5-47</b>
<b>11.4 Ground Cover .....</b>	<b>5-47</b>
<b>11.5 Sump Pumps .....</b>	<b>5-47</b>
<b>11.6 Mechanical Crawlspace Ventilation for Moisture Control .....</b>	<b>5-47</b>
<b>11.7 Dehumidifiers .....</b>	<b>5-47</b>
<b>11.8 Client-Controlled Conditions .....</b>	<b>5-47</b>
<b>11.9 Mold.....</b>	<b>5-48</b>
11.9.1 Observed Pre-Existing Mold .....	5-48
11.9.2 Pre-Work Notification.....	5-48
11.9.3 EPA Mold Pamphlet .....	5-48
11.9.4 Personnel Training .....	5-48
11.9.5 Deferral of Weatherization Work due to Mold.....	5-49
11.9.6 Moisture Control and Ventilation.....	5-49

11.9.7 Worker Protection .....	5-49
11.9.8 Occupant Protection .....	5-49
<b>12.0 Mechanical Ventilation .....</b>	<b>5-49</b>
<b>12.1 Whole House Mechanical Ventilation .....</b>	<b>5-50</b>
12.1.1 Whole House Ventilation Systems .....	5-50
12.1.2 Whole House Fan Requirements .....	5-51
12.1.3 Verification of Fan Performance .....	5-51
<b>12.2 Source-Specific Exhaust in Kitchens .....</b>	<b>5-51</b>
12.2.1 Kitchen Range Hood Ducting Shall:.....	5-51
<b>12.3 Source-Specific Exhaust in Bathrooms .....</b>	<b>5-52</b>
12.3.1 Sone Rating .....	5-52
12.3.2 Energy Use .....	5-52
12.3.3 Bathroom Ducting Requirements .....	5-52
<b>12.4 Crawlspace and Garage Ventilation .....</b>	<b>5-53</b>
12.4.1 Fan Rating .....	5-53
12.4.2 Fan Termination Point.....	5-53
<b>12.5 Dryer Ducting.....</b>	<b>5-53</b>
12.5.1 Dryer ducting .....	5-53
<b>12.6 Outdoor Air Inlets .....</b>	<b>5-54</b>
<b>13.0 Dehumidifiers.....</b>	<b>5-54</b>
<b>13.1 EnergyStar-Rated and AHAM-Certified .....</b>	<b>5-55</b>
<b>13.2 Sizing.....</b>	<b>5-55</b>
<b>13.3 Low Temperature Location.....</b>	<b>5-55</b>
<b>13.4 Electrical Safety.....</b>	<b>5-55</b>
<b>13.5 Hose to Drain Required.....</b>	<b>5-55</b>
<b>14.0 Heating Systems.....</b>	<b>5-56</b>
<b>14.1 Inspection and Testing of Heating Systems .....</b>	<b>5-56</b>
14.1.1 Inspection of Electric Heating Systems.....	5-57
<b>14.2 Electric Heating System Service.....</b>	<b>5-57</b>
14.2.1 Minimum Service, No Hazards .....	5-57
<b>14.3 Gas and Oil Heating System Service .....</b>	<b>5-57</b>
14.3.1 Minimum Service, No Hazards .....	5-57
<b>14.4 Heating System Replacement .....</b>	<b>5-57</b>
14.4.1 Excessive Repair Cost.....	5-58
14.4.2 Health-and-Safety Reasons .....	5-58
14.4.3 Replacement for Efficiency .....	5-58
14.4.4 Fuel Switch .....	5-58
14.4.5 Permit Required.....	5-59

14.4.6	Minimum Efficiency of New System.....	5-59
14.4.7	Thermostats.....	5-59
<b>15.0</b>	<b>Heating and HRV Ducts .....</b>	<b>5-59</b>
15.1	Duct Survey, Inspection, and Testing .....	5-60
15.2	Duct Testing Required.....	5-60
15.3	Dominant Duct Leak Test Required.....	5-60
15.4	Ducts to be Repaired or Replaced.....	5-60
15.5	Duct Sealing .....	5-60
15.5.1	Gaps.....	5-61
15.6	Flex Duct Requirements .....	5-61
15.7	Metal Duct.....	5-61
<b>16.0</b>	<b>Domestic Water Heater Replacement.....</b>	<b>5-62</b>
16.1	Health-and-Safety Reasons for Replacement.....	5-62
16.2	Fuel Switching.....	5-62
<b>17.0</b>	<b>Domestic Water Pipe Insulation.....</b>	<b>5-62</b>
17.1	Installation Standard for Foam Pipe Insulation .....	5-62
<b>18.0</b>	<b>Water Heater Insulation .....</b>	<b>5-63</b>
18.1	Insulation Wrap R-Value.....	5-63
18.2	Minimum Clearances for Heat Producing Appliances and Venting.....	5-63
<b>19.0</b>	<b>Window Replacements and Repairs.....</b>	<b>5-63</b>
19.0.1	Energy Efficiency.....	5-63
19.0.2	Health-and-Safety Reasons.....	5-64
19.0.3	Security Reasons .....	5-64
19.0.4	Durability Reasons .....	5-64
19.1	Lead-Based Paint.....	5-64
19.2	Replacement Windows .....	5-64
19.2.1	Photo Documentation .....	5-64
19.2.2	Screens .....	5-64
19.2.3	Exterior and Interior Trim.....	5-65
19.3	Storm Windows .....	5-65
19.3.1	Operable Storm Windows.....	5-65
19.3.2	Storm Window Removal .....	5-65
19.4	Safety Glass.....	5-65
19.4.1	Safety Glass Requirements.....	5-65
19.5	Replacement Glazing.....	5-66

19.6	Obscure Glass .....	5-66
19.7	Egress Window.....	5-66
<b>20.0</b>	<b>Door Replacement and Repairs .....</b>	<b>5-66</b>
20.0.1	Energy Efficiency .....	5-66
20.0.2	Health-and-Safety Reasons.....	5-66
20.0.3	Security Reasons.....	5-66
20.0.4	Durability Reasons.....	5-66
<b>20.1</b>	<b>Replacement doors .....</b>	<b>5-67</b>
20.1.1	Photo Documentation .....	5-67
20.1.2	Exterior and Interior Trim .....	5-67
<b>20.2</b>	<b>Door Finishes .....</b>	<b>5-67</b>
<b>20.3</b>	<b>Locksets and/or Deadbolts.....</b>	<b>5-67</b>
<b>20.4</b>	<b>Other Attached Items .....</b>	<b>5-67</b>
<b>21.0</b>	<b>Carbon Monoxide Detectors .....</b>	<b>5-68</b>
21.1	Detector Standards .....	5-68
21.2	Detector Power Options.....	5-68
21.3	Labeling Devices .....	5-68
21.4	Manufacturer's Instructions .....	5-68
21.5	Education of Dwelling Unit Occupants.....	5-69
21.6	Installation of CO Detectors .....	5-69
21.7	Installation in Sleeping Areas .....	5-69
21.8	Testing.....	5-69
<b>22.0</b>	<b>Smoke Detectors .....</b>	<b>5-69</b>
22.1	Detector Standards .....	5-69
22.2	Detector Power Options.....	5-69
22.3	Manufacturer's Instructions .....	5-70
22.4	Labeling Devices .....	5-70
22.5	Education of Dwelling Unit Occupants.....	5-70
22.6	Installation Location(s) for Smoke Detectors .....	5-70
22.7	Hearing Impaired.....	5-70
22.8	Testing.....	5-70
<b>23.0</b>	<b>Lead-Safe Weatherization (LSW).....</b>	<b>5-70</b>
<b>24.0</b>	<b>Asbestos .....</b>	<b>5-70</b>
<b>25.0</b>	<b>Radon .....</b>	<b>5-71</b>

<b>26.0</b>	<b>Other Measures</b> .....	<b>5-71</b>
26.1	Types of Measures.....	5-71
<b>26.2</b>	<b>Energy Efficient Lamps (i.e., Bulbs)</b> .....	<b>5-71</b>
26.2.1	Types of Compact Fluorescent Lamps.....	5-72
26.2.2	Light Output.....	5-72
26.2.3	Outdoor Locations.....	5-72
26.2.4	Testing.....	5-72
<b>27.0</b>	<b>Lighting Retrofit</b> .....	<b>5-72</b>
27.1	Type of Fixtures and/or LED Lamps.....	5-72
27.2	Light Output.....	5-72
27.3	Exterior Fixtures.....	5-73
27.4	Testing.....	5-73
<b>28.0</b>	<b>Refrigerator Replacement</b> .....	<b>5-73</b>
28.1	Document Cost-Effectiveness.....	5-73
28.2	Allowable Methods to Determine SIR.....	5-73
28.2.1	Data Logging and Databases.....	5-73
28.3	Replacement Refrigerators.....	5-73
28.4	Refrigerator Sizing.....	5-74
28.5	Client Agreement.....	5-74
28.6	Establishment of Ownership.....	5-74
28.7	Disposal of Removed Refrigerators.....	5-74

## General Policies

The intent of the Alaska Weatherization Assistance Program is energy conservation not housing rehabilitation.

Installation of 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 1.0 per AkWarm. Measures provided for applicable health-and-safety reasons only need to be identified as such without further detail.

Additional requirements are provided throughout the Weatherization Operations Manual (**WOM**) and the grant. Technical information and the Energy Outwest *Weatherization Field Guide* can be obtained at <http://www.energyoutwest.org/technical-information/presentations/policy-and-specifications/>.

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

### Guiding Principles of the Alaska Weatherization Assistance Program

- Weatherization implements energy-efficiency measures with a Savings to Investment Ratio (SIR) of 1.0 or greater.
- Weatherization does not bring entire homes up to “code,” but the measures provided by the Program do comply with applicable codes.
- Measures provided by the Weatherization program must remain in the home. They are not to be sold, bartered, or given away for the duration of their useful life.
- Grantees are responsible for complying with manufacturer guidelines as well as state, federal, and local jurisdiction.
- All work, no matter the condition of the existing home, shall be done in a quality, professional manner.
- Weatherization only assists homes that are “substantially complete” per program guidelines.
- Weatherization does not finish new construction.
- Weatherization is not a home maintenance or rehabilitation program.
- Weatherization is not a “preventative” program; i.e., it does not replace components merely because they are old.
- Weatherization improves ventilation to enable clients to control moisture and pollutants in the home that may be exacerbated by air-sealing.
- Weatherization is not an emergency service/response program.
- Weatherization implements mandatory health-and-safety measures as well as weatherization-related health-and-safety measures that are necessary to install energy-efficiency measures, to provide a safe workplace, and/or to protect clients.

## Mandatory Health-and-Safety Measures

The following guidelines must be met in any home assisted with Weatherization funding.

1. Smoke Detectors
  - a. Required: replacement of units over eight years old or units that do not operate.
  - b. 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.
2. Carbon Monoxide Detectors
  - a. Required: replacement of units over three years old and/or that do not meet Program standards.
  - b. Required: outside of each sleeping area in the immediate vicinity of the bedrooms and on each additional story of the dwelling including basements, but not including crawlspaces and uninhabitable attics.
  - c. CO detectors shall be installed before any work on the dwelling commences.
3. Correction of combustion failures before leaving the home.
4. A whole house ventilation fan is required.
5. An exterior vented range hood fan over a gas combustion range is required.

After funding mandatory health-and-safety measures, all energy-efficiency measures with an SIR of 1.0 or greater and weatherization-related health-and-safety measures should be considered and implemented as the budget allows.

Grantees are to complete the assigned number of homes—serving high priority clients first as funding and logistics allow—to minimize residential energy consumption in the State. The majority of the budget for each home served should be spent on energy-savings measures to ensure successful implementation of the program.

### 1.0 General Requirements

The Grantee shall perform all work or ensure that its subcontractors 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

Subcontractors must comply with the requirements of the grant.

### 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. The Grantee is responsible for complying with applicable codes for its service area(s).

## 1.4 Materials

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

### 1.4.1 Alternate Materials

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

## 1.5 Manufacturers' 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. Whenever the information provided in this WOM may not be consistent with a manufacturer's requirements, the Grantee shall follow the manufacturer's requirements. If the manufacturer's requirements are less restrictive than the WOM, the Grantee shall document the manufacturer's requirements in the client file.

## 1.6 Certificate of Insulation—All Forms 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.

### 1.6.1 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 also shall be kept in the client file of the Grantee.

### 1.6.2 Posting Empty Bag/Wrapper—Loose Fill

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 Savings to Investment Ratio (SIR)

The Grantee shall install those individual conservation measures that have a Savings to Investment Ratio (SIR) of 1.0 or greater, prioritizing them in the order of greatest savings to investment. In certain situations, due to variables, the Grantee may not be able to complete the highest SIR measure(s).

### Exception(s):

- a. A measure with an SIR of 1.0 or greater can be deferred if the Grantee does not have adequate funding to install the measure.

## 1.8 Level of Finish Required

The Grantee shall complete all work in a professional manner. Work will be finished to the minimum standards stated below:

- a. **Wood Exposed to Exterior**—All wood installed by Weatherization exposed to the exterior will comply with one of the following:
  1. Treated for exterior use.
  2. Primed.
  3. Rot-resistant species (for example, cedar).
- b. **Window Install**—Window replacement will include:
  1. Trim on both inside and outside.
  2. Reinstallation of curtain rods.
  3. A pre-work agreement with the owner on how shades, exterior shutters, or other specialty items will be handled.
  4. Window replacements on mobile homes that do not have overhangs must have angle flashing installed above the window and extending 6" horizontally beyond the window opening. This is for bulk water from the roof. Flashing can be installed anywhere above the window; i.e., it does not have to be right at the top of the window.
- c. **Door Install**—Door replacement will include:
  1. Trim on both sides.
  2. New door knob and deadbolt (keyed alike) if applicable (unless agreed to with the owner prior to work start).
  3. If multiple doors are replaced, locksets and deadbolts keyed alike.
  4. If house-to-garage door replaced, the door must have self-closing hinges or a door closer installed and operating.
  5. Door replacements on mobile homes that do not have overhangs must have angle flashing installed above the door and extending 6" horizontally beyond the door opening. This is for bulk water from the roof. Flashing can be installed anywhere above the door; i.e., it does not have to be right at the top of the door.
  6. If a glass lite is installed in a new door, the glass shall be no larger than 12" x 12".
- d. **Ductwork in Living Space**—New ductwork installed:
  1. Shall be installed so ducts fit into framing cavity when possible.
  2. Shall be designed for minimal chase work.
  3. Ducting joints shall be sealed (metal tape or mastic rated for use).
- e. **Fibrous Insulation**—Fibrous weatherization materials **INSTALLED** in living spaces (i.e., cellulose, fiberglass, etc.):

1. Shall be shielded from both indoor and outdoor environments. Shielding protects both the weatherization materials, and more importantly, the occupants from exposure to the insulation fibers.
- f. **Accidents or Inadvertent Damage to Home**—Damage to a home that occurs during weatherization work will be repaired to the finish state prior to damage. This would include new materials and paint if applicable. If a broken item is no longer available, a similar quality item will be installed.
- g. **Hollow Core Doors**—When installing a grill or under-cutting a hollow core door, solid backing (wood) must be installed if a cut exposes the hollow part of the door.

## 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 to identify potential or existing hazards (e.g., asbestos, mold, radon, structural instability, CO, other IAQ issues, uncontained sewage, etc.) to either weatherization workers or dwelling occupants. All work must be completed consistent with the provisions of the grant, 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. At no point, should the Grantee compromise employee or client health in pursuit of energy savings.

### 2.1 Worker Safety

Each worker is responsible for working in a safe manner so as to not endanger either himself or others. Worksite supervisors are responsible for ensuring the safety of all workers and clients 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.

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. The material should be removed from the premises at the end of each work day or when the job is completed.

Equipment (e.g., 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 or safety risks. During the initial assessment, the assessor will make an evaluation of conditions existing within the home. Clients shall be educated regarding work areas, barricades, no-entry areas, and work practices (e.g., lead safe work). 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 Health-and-Safety Limitations

State and federal guidelines limit expending WX funds on health-and-safety issues.

- a. The program cannot address health-and-safety items that exceed the scope needed to make installation of WX measures possible.
- b. In some cases, it may be cost-prohibitive to provide an allowable health-and-safety item.
- c. The program is not intended to provide *general* home rehab, repair, or health-and-safety improvements.
- d. The program does not remediate mold, lead, asbestos, or radon. However, some Weatherization measures may impact these hazards and are addressed later in this section of the WOM.

## 2.5 Walk-Away Policy

If conditions exist where repairs are required that are beyond the scope of the program, 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 not to 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*.

### 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 35 PPM ambient. Clients shall be notified of the potential dangers of CO exposure.

**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.

The assessor shall 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 are obvious hazards to workers or clients. The Grantee shall notify the client/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 envelope (i.e., drywall, plywood or other sheathing material). Another measure may include repairing damaged or leaking components to protect insulation.

The Grantee shall notify the client/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.).

### 3.2.2 All assessments will include:

- a. Diagnostic testing (blower door testing). See 4.0 *Diagnostic Testing*.
- b. Combustion safety diagnostic testing when combustion appliances are present. See example in WOM Section 6, *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. Any changes after work has started must be documented and pre-approved by the client before continuing with work.

### 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 two 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 AkWarm

The Grantee shall evaluate 100% of homes using an AkWarm computerized energy assessment. A copy of the improvement options report, pre-weatherization rating, and post-weatherization rating must be retained in the client file.

The Grantee shall install those individual conservation measures that have a Savings to Investment Ratio (SIR) of 1.0 or greater.

#### Exception(s):

- a. A measure with an SIR of 1.0 or greater can be deferred if the Grantee does not have adequate funding to install the measure.

#### 3.6.1 AkWarm Updates and Training

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

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

#### 3.6.2 Calculation of Installed Measure Cost

The Grantee shall calculate installed measure costs. Measure costs shall be calculated using one of the following methods:

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

## 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.

Required Tests:

- Blower Door
- Zonal Pressure
- Duct Pressure Pan (Forced Air System)
- Dominant Duct (Forced Air System)
- Room to Room Pressure Differential
- CAZ Max Depressurization
- Combustion Safety
- Gas Range CO
- Combustion Efficiency
- Whole House Fan Flow
- Gas Line Test

### 4.1 Diagnostic Testing Equipment

The Grantee shall:

- a. Use a digital manometer to perform all pressure diagnostic testing measurements.
- b. Maintain blower door(s) and calibrate digital manometer(s) as recommended by the manufacturer(s).
- 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 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. A second (different house configuration) blower door test is required if the home has an attached conditioned garage and/or conditioned crawlspace with access from the living area (See 4.2.2 only if using ASHRAE 62.2 Option 1.). Results of pre- and post-weatherization blower door testing must be documented in the client file. If unable to complete pre- or post- weatherization blower door tests, provide documentation in the 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., vermiculite in attic). If it is required to complete a positive test, then the post-weatherization test also will be a positive pressure test.

**4.2.1 Building Set-Up to Test Thermal Boundary (AkWarm)**

The goal of the set-up is to test the **thermal boundary** of the dwelling. The Grantee shall include conditioned crawlspaces, lofts, and attached conditioned garages. **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.)
- Open all doors between house and conditioned garage.
- Close exterior garage pedestrian and vehicle doors.
- Close exterior crawlspace hatches.
- Open all interior doors to rooms and basements 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 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 Building Set-Up to Test Living Space (For Ventilation ASHRAE 62.2 Option 1)**

The goal of the set-up is to test the **living space** of the dwelling. This test is required only if the home has an attached conditioned garage and/or conditioned crawlspace with access from the living area. **DO NOT** include conditioned crawlspaces, lofts, and attached conditioned garages. **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 home to unheated arctic entries are considered exterior and shall be closed for the test.)
- Close all doors between house and conditioned garage.
- Close exterior garage pedestrian and vehicle doors.
- Close exterior crawlspace hatches.
- Open all interior doors to rooms and basements that are conditioned, including doors to conditioned utility/heater rooms.
- Close access hatch to a conditioned crawlspace.
- 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.

#### 4.2.3 Blower Door Set-Up 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, the Grantee will need to depressurize the building to -52 Pascals for the One-Point Test. The main point to remember is that the Grantee must change building pressure by 50 Pascals from the starting point (baseline) pressure.*

#### 4.2.4 Baseline Data

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

#### 4.2.5 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 tests. To acquire reliable numbers, consistent building set-up 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 still must 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 the Grantee's resources make it impossible to complete an accurate blower door test, an explanation of why no test was performed with detailed justification must be 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 test 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 crawlspace 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  $\pm 10$  percent.
  2. Collect data and make corrections for the 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 (R<sup>2</sup>) 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  $\pm 2.0$  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. 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. The standard for duct system for tightness is 1 pa or less at each supply register. The standard for return plenums is 5 pa or less. See 15.5 *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 home plumbing system and potential freeze-ups. If duct sealing is not completed and numbers are above the standard, document the reason for not sealing in the client file.

#### 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*. The standard for dominant duct leakage is no more than 1.5pa or 100 CFM of leakage to outside.

#### 4.6 Room-to-Room Pressure Differential Testing

The Grantee shall test and record the pressure differential between rooms with only supply ducts and the main body of the dwelling. Pressure differentials of more than 5 pa 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.

## 5.0 Combustion Appliance Zone Depressurization

The Grantee shall perform a worst-case depressurization test in each Combustion Appliance Zone (CAZ). When 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 Limits<sup>1</sup>

Venting Condition	Limit (Pascals)
Natural draft water heater (including outside chimneys) or fireplace	-3
Wood stoves and fireplace inserts, including airtight models with outside combustion air	-10
Individual natural draft boiler or furnace	-5
Toyo stove/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

### Exception(s):

- a. 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. (**Note:** *The worst-case test shall be completed with the garage-to-house pedestrian door closed if this is the “normal” operation of house. If the occupants have the door propped open, then test with the pedestrian door open; but, if there are self-closing hinges, then test with the door closed. The same applies for a sealed utility room with a normally closed door.*)

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

### 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.

<sup>1</sup> Building Performance Institute Standard

### 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.

### 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 unless it is allowed by the manufacturer. Documentation must be in the client file.

#### 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 feet 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. If the owner refuses suggested work to remedy the failure, the Grantee shall document on a health-and-safety notice and have the owner sign.

Table 2: Minimum Acceptable Draft Test Action Levels<sup>2</sup>

Outside Temperature (degree F)	Draft Pressure Standard (Pa)	Water Column
<10	-2.5	1" = 249 Pascals
10-90	$(\text{Outside temp} / 40) - 2.75$ *	
>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 one minute fails spillage test. If the owner refuses suggested work to remedy a failure, the Grantee shall document on a health-and-safety notice and have owner sign. The Grantee shall make appropriate repairs.

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.

#### 5.3 Carbon Monoxide Tests

The Grantee shall perform a CO test on 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 Table 3 in 5.4.

#### 5.4 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.

<sup>2</sup> Building Performance Institute Standard

Table 3: Carbon Monoxide Test Action Levels  
For Combustion Appliances<sup>3</sup>

CO Test Result*	Retrofit Action
0 – 99 PPM	Proceed with work; if gas and above 25 PPM, recommend cleaning of appliance burner
100 – 400 PPM	Considered unsafe and the problem needs correcting. 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.

**Exception(s):**

- a. Direct-vent on-demand water heaters (e.g., Toyo, Monitor, etc.) are exempt from the Retrofit Action for the 0-99 PPM and 100-400 PPM test levels in Table 3. The Retrofit Action for the “More than 400 PPM” test level is required.

#### 5.4.1 Range Tops and Gas Ovens

##### Range Top Test Protocol

- a. Turn on and visually inspect all burners.

**Level I Action**—If burners do not ignite properly or do not burn cleanly, a clean-and-tune of the appliance shall be recommended.

##### Oven Test Protocol

- a. Remove any items/foil in or on oven.
- b. Make sure self-cleaning features are not activated.
- c. Preheat oven to 350 degrees.
- d. Turn to 400 degrees.
- e. Test oven for CO in the flue, before dilution air.
- f. Continually monitor ambient CO levels during test.

**Level I Action**—100 PPM to 400 PPM as measured; educate the client and issue a health-and-safety notice.

<sup>3</sup> Building Performance Institute Standard

**Level II Action**—If greater than 400 PPM, the problem needs to be corrected before sign-off of the completed job. Notify the owner and occupant in writing.

- a. Typically, the Grantee will arrange for a qualified appliance technician to repair the unit. When the cost for a technician to repair the unit at the home is prohibitive, the Grantee may replace the cookstove after meeting the following conditions:
  - The Grantee has verified the cookstove is jetted correctly for the type of fuel.
  - The Grantee has tested the unit 2 times using different Monoxers to verify the test was performed correctly.
  - The test results exceed 400 pm after 5 min or steady state.
  - The client/owner certifies accepting replacement with a similar unit. (The existing unit most likely will not be available.)
- b. However, the Grantee shall not replace a burner or an oven that does not work.

#### 5.4.2 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. Take action if over 10 PPM.

#### 5.4.3 Gas Leak Test

The Grantee shall test accessible gas lines for leaks with a gas detector of the following appliances:

- a. Water heater
- b. Heating system
- c. Gas dryer
- d. Gas cookstove (Gas cookstove does not need to be moved to access gas line unless gas leaks are suspected.)

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 (if applicable).

#### 5.5 Documentation

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

## 5.6 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.

## 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. This includes house-to-garage penetrations.

### 6.0.2 Cost Effective Air-Sealing

Priority air-sealing is an allowable expense and shall include air-sealing of all large holes, obvious bypasses, chase ways, and gaps that exist between the unconditioned areas and the conditioned areas. Priority areas to address include:

- Ceiling/Attic—top plates, wire penetrations, plumbing stacks, dropped kitchen or similar soffits, chimneys, light boxes (Preferred: air-sealing completed from attic when feasible, otherwise from living space).
- Recessed lights into unconditioned space.
- Purlins and ridgepole intersection to wall AND ceiling.
- Walls—holes or damage to wall.
- Rim joists.
- Cantilevered floors.
- Ceiling and wall connection of double-wide mobile homes.
- Addition connection to main body of mobile home.
- Common walls between dwelling units in multi-families.
- Garage-to-house separation.
- Blower door guided air-sealing.
- Weather-stripping of doors and windows

### **6.0.3 Use of Pressure Diagnostics and Blower Door**

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

### **6.0.4 Air-Sealing Documentation**

If all recommended areas are not air-sealed (See 6.0.2.), the reason must be documented in the client file.

## **6.1 Building Airflow Standard (BAS)**

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" to a depth of 3/8" 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 metal flashing. Combustible materials must be a minimum of 3" from the chimney (Refer to 7.4.3.). Closer clearances are acceptable if allowed by the manufacturer. The distance between the flashing and chimney cannot exceed 1/16". The flashing must be no less than 26 gauge galvanized steel. (Photo documentation must be in the client file.)

### 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. The preferred method is to upgrade existing recessed lights to airtight IC-rated or surface-mount light fixtures. Both are allowable weatherization expenses.

**Closed Top Dam Defined**—A fixture that is dammed with a metal, sheetrock, or other non-combustible material that extends at least 24" 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

Insulating attics and ceilings are allowable expenses when justified using the AkWarm improvement options report where the Savings to Investment Ratio (SIR) is 1.0 or greater.

**7.0.1 Installing Loose Fill**—Insulation material shall be installed in a uniform manner throughout the attic and cover exterior wall plates. Two insulation depth markers will be installed approximately 5' and 15' from the attic access and visible from the access.

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

### 7.1 Ceiling Loading

Visually assess the ability of the ceiling to bear the weight of additional insulation.

## 7.2 Insulating Knee Walls

Insulating knee walls (when part of the thermal boundary) is an allowable expense when justified using the AkWarm improvement options report where the Savings to Investment Ratio (SIR) is 1.0 or greater.

### 7.2.1 Cavity under Knee Wall

The floor cavity immediately below the knee wall shall be air-sealed.

### 7.2.2 Vapor Barrier

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

### 7.3 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 *Energy Outwest Field Guide Section 5.4, Attic Insulation*.
- b. Sloped cavities may be insulated with loose fill, batt, or rigid insulation while maintaining a ventilated 1" air space between the insulation and the roof sheathing. Refer to *Energy Outwest Field Guide Section 5.4, Attic Insulation*.

### 7.4 Attic/Ceiling Damming

Attic/ceiling damming requirements are detailed below.

#### 7.4.1 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 doorbell transformers) that are not listed for insulation cover (IC). Such enclosures shall:

- a. Keep insulation at least 3" but not more than 4" 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. (See WOM Section 6.)
- c. Be securely attached to the ceiling structure to prevent their displacement during and after the installation of insulation.
- d. Extend at least 24" 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 4" above the final level of insulation. There shall be 1" 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."

#### 7.4.2 Exhaust Fans

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

### 7.4.3 Flues and Chimneys

If insulation is added, these conditions apply:

- a. 3" air space required around all chimneys and flues.
- b. A retaining dam shall be constructed to ensure 3" air space is permanently maintained, extending a minimum of 4" above the final level of insulation. The dam needs to be capped with non-combustible material before insulating.
- c. Closer clearances are acceptable if allowed by the manufacturer. (Documentation must be in the client file.)

### 7.4.4 Photo Documentation

A photo that clearly shows the installed insulation dam shall be kept in the client file.

## 7.5 Exhaust Ducting in Attics/Ceilings

Refer to 12.0 *Mechanical Ventilation*.

## 7.6 Heating and Cooling Ducting in Attics/Ceilings

Refer to 15.0 *Heating and HRV Ducts*.

## 7.7 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.

### 7.7.1 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.

### 7.7.2 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 above referenced National Electric Code.

### 7.7.3 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.

## 7.8 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.

### 7.8.1 Splices and Connections

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

## 7.9 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.

### 7.9.1 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 1/2" x 24", and be installed in a workmanlike manner. In all cases, a rigid dam around the opening shall extend at least 4" above the level of the insulation and made of a minimum 1/2" plywood or equivalent.

### 7.9.2 Knee-Wall Access Openings

If attic access is provided through a knee wall, the access shall be at least 14 1/2" x 24". 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.

### 7.9.3 Insulating Access Openings

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

### 7.10 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.

### 7.11 Passive Ventilation

When no electricity is available, the installation of ventilation is allowable, such as opening windows or opening wall ports. The installation of additional ventilation is not required.

#### 7.11.1 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 4" 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.

## 8.0 Wall Insulation

Insulating walls is an allowable expense when justified using the AkWarm improvement options report where the Savings to Investment ratio (SIR) is 1.0 or greater.

### 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. **Un-insulated Soffit Next to Cavity**—The cavity is open to an un-insulated soffit with a recessed light fixture or other heat-producing device that cannot be properly dammed.

- e. **Cavities Next to Fireplace or Chimney**—The cavity is next to a masonry fireplace or chimney with less than 3” clearance between cellulose and masonry.
- f. **Cavity Next to Pocket Door**—The 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 Dense Pack Wall Insulation

All closed wall cavities that can be insulated shall be insulated by means of dense-packing insulation. Manufacturer’s specifications shall be adhered to for density and installation techniques.

### Exception(s):

- a. The voltage drop is greater than 5 volts at any outlets or lights before insulating.

### 8.1.1 Fill Tube Method

Insulation will be installed using the fill-tube method.

### 8.1.2 Interior/Exterior Installation

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

### 8.1.3 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.

### 8.1.4 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.

## 8.2 Treatment of Interior and Exterior Surfaces

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

### 8.2.1 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 23.0 *Lead-Safe Weatherization (LSW)*.

### 8.2.2 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.

### 8.2.3 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.

## 8.3 Open Wall Cavities

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

### 8.3.1 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 Interior Applied Insulation

- a. An appropriate air/vapor barrier shall be established.
- b. Insulation shall be covered to meet applicable manufacturer's specification and fire code.

## 9.0 Crawlspace/Under-Floor/Perimeter Insulation

Insulating floors over unconditioned crawlspaces and basements or walls of crawlspaces or basements is an allowable expense when justified using the AkWarm improvement options report where the Savings to Investment Ratio (SIR) is 1.0 or greater.

**Exception(s):**

- a. The clearance between the ground and the structural framing of the sub-floor is less than 24”.
- 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 shall be cut to fit each joist space.
- c. All ends shall fit tight without overlapping.
- d. Insulation shall fit tight against structural members, rim joist, foundation walls, and pipes.
- e. 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 Insulation Support**

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

**9.2 Ground Cover**

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

- a. Shall be installed in a crawlspace 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” and taped with tape rated for polyethylene, or sealed with a compatible poly sealant.

- e. The poly cover shall extend at least 6" up the foundation wall/footer 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 or crawlspace and has no exposed soil, ground cover is not required.
- b. Ground cover is not required when there is no air boundary (i.e., skirting) between the under-floor and outside.

### 9.3 Crawlspace Access

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

**Exception(s):**

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

#### 9.3.1 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. The 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.

#### 9.3.2 Interior Access

Interior access to the crawlspace 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" 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.

### 9.4 Passive Ventilation in Crawlspace

#### 9.4.1 Closeable Vents

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

### 9.4.2 Vent Opening Location

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

### 9.4.3 Vent Screening and Framing

All new and existing vents shall be screened with 1/4" 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.

### 9.4.4 Rigid Foam Plug

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

## 9.5 Sealed Crawlspace and Mechanical Ventilation

If installing an exhaust fan in the crawlspace, the exhaust fan shall be rated for continuous operation, sized to provide a minimum of 1 CFM exhaust for every 50 square feet of crawlspace floor area. Exhaust termination shall be a minimum of 5' (measured on the horizontal) from any operable door or window fresh air inlet. Refer to 12.0 *Mechanical Ventilation*. Ground cover is required as detailed in 9.2 *Ground Cover*.

### 9.5.1 Combustion appliances in crawlspaces must have combustion air to code.

## 9.6 Crawlspace/Unconditioned Basement Combination

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

### 9.6.1 Crawlspace/Unconditioned Basement Combination, Option 1

Treat the entire area as a crawlspace and insulate accordingly.

### 9.6.2 Crawlspace/Unconditioned Basement Combination, Option 2

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

## 9.7 Rim Joist Area

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

## 9.8 Exterior Foundation Insulation

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

### 9.8.1 Minimum R-Value for Walls

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

### 9.8.2 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 2' below grade.

#### Exception(s):

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

### 9.8.3 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.

### 9.8.4 Utility Locating

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

### 9.8.5 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.

### 9.8.6 Protection and Flashing of Insulation

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

## 9.9 Interior Foundation Insulation

When interior perimeter insulation is installed, the installer shall follow the specifications detailed below.

### 9.9.1 Minimum R-Value

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

### 9.9.2 Batt or Blanket Insulation Installation

Batt or blanket insulation shall be in contact with foundation, extend from the bottom surface of the sub-flooring (including band joists), and permanently fastened downward to the crawlspace floor. All seams between adjacent batts, blankets, or sheets shall be either continuously taped or stapled (on no more than 6" spacing) along their entire length.

### 9.9.3 Rigid Insulation and/or Spray Foam

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

## 9.10 Cantilevered Floors

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

### 9.10.1 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 crawlspace. 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 air-seal 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 are situated such that insulation cannot be installed. Do not insulate and document the reason in the client file.

### 9.10.2 Insulate Cantilever, Open Under Floor

The installer shall install insulation batt that is the full thickness of the floor joist from the exterior. A cover of 3/8" 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 shall be used. Air-seal penetrations through sheathing or sub-floor.

### 9.10.3 Insulate Cantilever, No Access

The installer 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.

### 9.11 Floor over Unheated Attached Garage, No Access

The installer 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.

#### 9.11.1 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 do not 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.

Un-insulated 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 the 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 contact 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 9.2 *Ground Cover*.) If this is not possible, the use of an exhaust fan that keeps the crawlspace at negative pressure is required. (See 11.5 *Sump Pumps* and 11.6, *Mechanical Crawlspace Ventilation for Moisture Control*.)

Skirting shall:

- a. Be securely fastened to existing structure.
- b. Be able to withstand wind loading.
- c. Be able to shed bulk water and prevent water intrusion.
- d. Have all joints sealed with exterior grade caulk.
- e. Have at least one access door provided.
- f. Be fastened with exterior grade fasteners that are compatible with AWW materials.

### 10.2 Skirting Insulation

- a. Insulation should be a minimum R-Value of R-10. 2" rigid board foam is recommended.
- b. Insulation shall be applied to the 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 unattended, 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 Roof/Plumbing Leak

The Grantee shall not air-seal or insulate locations that contain plumbing or roof leaks. The Grantee shall inspect for indications of leaks prior to insulating and, if found, make the owner aware using a health-and-safety notification form. A copy shall be retained in the client file.

### 11.2 Gutters and Downspouts

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

### 11.3 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 the crawlspace shall be eliminated before weatherization work is completed in the crawlspace.

### 11.4 Ground Cover

All crawlspaces shall have ground cover installed as outlined in 9.2 *Ground Cover*.

### 11.5 Sump Pumps

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

### 11.6 Mechanical Crawlspace Ventilation for Moisture Control

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.

### 11.7 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 13.0 *Dehumidifiers*.

### 11.8 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.

## 11.9 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.

### 11.9.1 Observed Pre-Existing Mold

The initial home weatherization assessment shall record 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, photographs shall be taken, and the location and an estimate of the area in square feet shall be documented in the client file.

### 11.9.2 Pre-Work Notification

If mold is observed, the Grantee shall provide to the client (and owner if rental dwelling) notification to inform the client of the observation of mold in the home. The notification will include specific work to be 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). A copy of the signed statement shall be retained in the client file.

### 11.9.3 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." The client shall sign a document acknowledging receipt of the pamphlet and a copy shall be kept in the client file. (Acknowledgment of receipt of the pamphlet can be part of notification listed in 11.9.2 *Pre-Work Notification*.)

### 11.9.4 Personnel Training

Grantees are required to provide assessor AND crew training on identification and assessment of moisture and mold hazards, methods to alleviate conditions that promote mold growth, prevention of mold, and protocols for client notification. DOE developed a recommended mold training curriculum that 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>).

### 11.9.5 Deferral of Weatherization Work due to Mold

- Weatherization in dwelling units with mold conditions greater than 30 contiguous square feet (i.e., is touching without any breaks; if questionable, assume it is contiguous) 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. Refer clients to the EPA website (<http://www.epa.gov/mold>) for more information—not remedial action.

### 11.9.6 Moisture Control and Ventilation

In situations where mold conditions are observed but do cause a deferral, regular weatherization work shall assess for and incorporate ways to minimize moisture sources, condensation problems, and ensure an operational ventilation system is installed per 12.0 *Mechanical Ventilation*.

### 11.9.7 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.

### 11.9.8 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 ensure 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.

- a. The ventilation system shall have an override control, which is appropriately labeled and readily accessible to the occupant. It may be integrated in a labeled wall-mounted control or in the air-moving device that requires the removal of the cover plate or grill. It may be a labeled breaker.

## 12.1 Whole House Mechanical Ventilation

Mechanical whole house ventilation is required. The Grantee may select Option 1 or Option 2 in order to meet this requirement (only one of them). The option used to comply with whole house ventilation must be documented in the client file. All options must comply with 12.1.1, 12.1.2, and 12.1.3. **If using *Department of Energy funds*, the Grantee must use ASHRAE 62.2 2013.**

**Option 1:** ASHRAE 62.2 2010

**Option 2:** Install a fan that is flow-tested to meet or exceed the flow requirement determined in the table below (if applicable, adjusted for occupancy density). The fan shall be controlled by an automatic switch that does not require the occupant to activate it or a similar control.

### Option 2 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 10 CFM for each additional person.

### 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
- b. Heat Recovery Ventilator.

### 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.

**Exception(s):**

- a. Heat Recovery Ventilator and remote mounted fans are exempt from sone rating requirements.
- b. Fans designed and wired to operate constantly do not require a damper.
- c. No sone rating required for mobile home ventilation.

### 12.1.3 Verification of Fan Performance

An exhaust fan will be performance-tested using an approved method to ensure the ventilation rate meets whole house ventilation required CFM flow. Document in the client file.

## 12.2 Source-Specific Exhaust in Kitchens

A working range hood, vented to the exterior, shall be present where a combustion range, cook top, or oven is present. If using a range hood as a whole-house fan, the range hood must comply with whole house requirements.

**Exception(s):**

- a. A home without electricity.
- b. A range hood is impractical. Document in the client file.

### 12.2.1 Kitchen Range Hood Ducting Shall:

- a. Be constructed of galvanized metal, stainless steel, or copper.
- b. Be airtight, with smooth interior finish and ducted to the outside.
- c. Be connected to the collar of a termination cap. Collar shall pass through the wall or roof sheathing.
- d. Be mechanically fastened at each joint using 3 equally spaced screws, and sealed using an approved UL Listed method.
- e. Have a terminal cap with an 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

Installation is an allowable expense for health-and-safety reasons. When replacing a fan that has a light, the replacement fan also must have a light.

**Exception(s):**

- a. When a like-for-like replacement is not available, obtain the client's signed approval of the type of fan unit that will be installed prior to changing the unit. Keep justification for the deviation and the client's certified acknowledgement in the client file.

#### 12.3.1 Sone Rating

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

**Exception(s):**

- a. Mobile Home exhaust fan.

#### 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 airtight and ducted to the outside.
- f. The duct shall be connected to the collar of the termination cap. The collar shall pass through the roof sheathing.
- g. Shall be mechanically fastened at each joint, to the fan outlet and to the collar of termination cap, using a minimum of 3 equally spaced screws and sealed using a UL Listed method.
- 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". Support strapping or hangers shall not compress

the insulation. Support strapping or hangers shall be installed within 1' of a joint or connection and a minimum of every 4' thereafter, or per manufacturer's recommendation.

- j. Insulated flex duct may be used if the diameter is 50% more than the fan outlet.

## 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. The fan installed shall meet the following requirements.

### 12.4.1 Fan Rating

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

### 12.4.2 Fan Termination Point

Fans installed for the purpose of maintaining a pressure boundary shall not terminate within 3' 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 the location prevents ducting from being installed per code, notify the client and document in the client file. Ensure the home has other means of mechanical ventilation and instruct the owner to use it while the dryer is operating.
- b. **Gas Dryer**—If the location of the dryer prevents code-compliant ducting to the outside, all weatherization work shall be deferred until the 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. The vent shall terminate in a non-screened vent cap with a damper.
- d. Not exceed 25' in length from the dryer location to the outlet terminal; the maximum length shall be reduced 2 1/2' for every 45 degree elbow and 5' for each 90 degree elbow.

- e. Extension material in excess of 6' must be metal with a non-ribbed interior and must be mounted in such a 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 behind the dryer may be used for extensions of 6' or less. This refers to transitional ducting, which is not included in the maximum length of the duct calculation ("d." above).
- h. Shall be insulated to a minimum of R-4 if the duct is more than 6' in length and passes through unconditioned space.

**Exception(s):**

- a. Condensing dryer.

## 12.6 Outdoor Air Inlets

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

### Whole-House Fan Test Protocol

With a digital manometer, test the pressure difference between the inside and the outside of the dwelling with only the whole-house ventilation fan operating.

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' of hazardous or unsanitary locations.
- e. Shall not be placed in closets.
- f. Shall not be placed within 6' of a chair, couch, or bed. Air should not be introduced where it will cause discomfort for the client.

## 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](http://www.aham.org)).

### 13.2 Sizing

The Grantee shall size dehumidifiers for installation according to the following general guidelines, and dehumidifiers 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](http://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. The hose shall be mechanically attached to the water bucket outlet and terminate at a drain or sump. The hose installed shall not create a tripping hazard.

## 14.0 Heating Systems

Grantees/subcontractors shall 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 producing the BTUs calculated by AkWarm needed to heat the habitable portions of the home at the outside design temperature for the location.

### 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 and upon completion of each project.

All newly installed or repaired heating systems will be operated to ensure safe and proper operation before job completion sign-off. This applies to all heating and hot water appliances including wood stoves, space heaters, furnaces, boilers, renewables, etc.

The Grantee shall document in the client file the condition of the heating system. This will include:

- a. Heating system inspection
- b. Pre and post combustion efficiency tests
- c. Pre and post combustion safety tests

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 removed immediately.

### 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.

### 14.2 Electric Heating System Service

Electric heating systems can 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- or oil-fired heating systems can be serviced to:

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

#### 14.3.1 Minimum Service, No Hazards

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

- a. Check and change furnace filter if necessary.

### 14.4 Heating System Replacement

Heating system replacement is allowed for the following reasons:

- a. Excessive repair cost.
- b. Health and safety.
- c. Efficiency.
- d. Fuel Switch.

#### 14.4.1 Excessive Repair Cost

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, and/or unsafe components. If repair costs would exceed 50% of the replacement cost, replacement is allowable.

#### 14.4.2 Health-and-Safety Reasons

Heating systems may be replaced for health-and-safety reasons (e.g., high CO, cracked heat exchanger, improper installation, occupant's disability, etc.). Document in the client file.

#### 14.4.3 Replacement for Efficiency

Replacement of a heating system to improve efficiency is allowable when justified using simple payback.

- a. 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.
- b. The replacement cost shall be determined by the Grantee.

#### 14.4.4 Mini Split Heat Pump Installation

Heat pumps may be considered eligible as a heating system replacement option when the SIR is 1.0 or greater. All systems must be UL Listed to be reimbursed under the Weatherization Program.

#### 14.4.5 Fuel Switch

A Grantee may change a dwelling's heating fuel type in certain, limited situations.

- a. Changing from wood or coal heat to other types of fuel-fired heating systems for medical reasons, such as when the client is elderly or disabled and wood or coal preparation is difficult or impossible. The new fuel type shall not require physical effort to use. If the client is not elderly or disabled, the Grantee may obtain a third-party verification of the need.
- b. Heat pumps can be installed as a fuel switch option in Southeast and Kodiak, only when the client, due to age or disability, cannot operate a solid fuel system (wood or coal) or health concerns are caused by a fossil fuel system. Documentation must be in the file justifying the installation of a heat pump. All other heat pump installations must be preapproved by the AHFC Program Manager
- c. Switching fuels is allowed in cases when it will be possible to save significant energy dollars for a Weatherization client through the course of fuel conversion, keeping in mind the priority of *energy* savings. Two AkWarms must be run for comparison, and an SIR of 1.0 must be met. Both AkWarms must be on file for

review by AHFC. (*The purpose of Weatherization is not to switch fuel types. This approach should be used minimally in the course of the program. If this is implemented regularly, the AHFC Program Manager will revisit the allowability of the measure.*)

- d. Replacing an electric water heater with a storage tank integrated with a fuel-fired boiler (i.e., indirect sidearm systems).
- e. Replacing a fuel-fired water heater with an electric water heater for health-and-safety concerns when the unit fails maximum depressurization testing and cannot otherwise be corrected. The new system must remedy the health-and-safety concern(s). (**Example:** *The new system now passes the maximum depressurization test when the previous one failed.*)
- f. When a client lives in an area of the state that has high electric costs and the client's primary heat is electric, an affordable direct-vent system (e.g., Toyo, Monitor, Rinnai, Navian, etc.) can be added to offset some of the electric heating cost.
- g. Fuel switches shall be funded by state funds only—not DOE.
- h. Prior written approval from the AHFC Program Manager must be obtained before expending funds on any other fuel switch including renewables.

#### 14.4.6 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 1.3 *Code Compliance*.

#### 14.4.7 Minimum Efficiency of New System

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

#### 14.4.8 Thermostats

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

### 15.0 Heating and HRV Ducts

All heating and HRV ducts located outside the heated envelope of the dwelling unit should be insulated to a minimum of the adjacent thermal envelope. Seal ducts before insulating. 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 4.0 *Diagnostic Testing*.

### 15.2 Duct Testing Required

Pressure pan testing of duct systems is required. Refer to 4.4.1, *Duct System Testing*. All mobile home duct systems must be tested.

**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 4.5 *Dominant Duct Leak Testing*.

### 15.4 Ducts to be Repaired or Replaced

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

### 15.5 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, airtight connections using mastic and fiber mesh.
- b. All accessible ductwork-to-ductwork connections both inside and outside shall be sealed to provide permanent, airtight connections using mastic and fiber mesh tape.
- c. All accessible elbows, holes, joints, seams, including lateral seams shall be sealed to provide permanent, airtight connections using mastic and fiber mesh tape.

### 15.5.1 Gaps

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

### 15.6 Flex Duct Requirements

- a. Flex duct shall be of the proper length for connection between two points without excessive bends or sag.
- b. Horizontal and vertical runs of flex duct shall be supported using nylon, plastic, or metal strapping having a minimum width of 1/2". Support strapping or hangers shall not compress the insulation.
- c. Support strapping or hangers shall be installed within 1' of a joint or connection with a maximum of 4' between supports.
- d. Flex duct shall not be installed in a manner allowing direct contact with the ground.
- e. 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.

### 15.7 Metal Duct

- a. Metal duct, existing or installed, in unconditioned spaces shall be insulated to the level of the thermal boundary. If this level cannot be met, document the reasons in the client file.
- 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/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". Support strapping or hangers shall not unduly compress the insulation.
- f. Support strapping or hangers shall be installed within 1' of a joint or connection with a maximum of 4' between supports.
- g. Metal ducts shall not be installed in a manner allowing direct contact with the ground.

## 16.0 Domestic Water Heater Replacement

Water heater replacement is an allowable cost when energy savings can be justified with an SIR of 1.0 or greater.

Installed water heaters shall be anchored or strapped to resist horizontal displacement per code.

Water heaters may also be replaced for a health-and-safety reason.

### 16.1 Health-and-Safety Reasons for Replacement

- Active water leak that is not cost-effective to repair.
- Combustion byproducts are not venting to the outside properly, and there is no other appropriate solution to eliminate the problem but to replace water heater with a sealed combustion unit or non-combustible fuel unit (i.e., electric).
- Access to hot water is required to maintain the health of the occupants (i.e., sanitary conditions for households with young children).

### 16.2 Fuel Switching

Fuel switches also may be justified and allowed on a case-by-case basis. See 14.4.5 *Fuel Switch*.

## 17.0 Domestic Water Pipe Insulation

Installation of insulation on accessible hot and cold water lines in unconditioned and semi-conditioned spaces is an allowable cost. The first 5' of supply and return of a water heater also is an allowable cost.

### 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 Installation Standard for Foam Pipe Insulation

Insulation shall be installed to manufacturer's specification and be a minimum of 1 1/2" thick.

## 18.0 Water Heater Insulation

Water heater insulation blankets are allowable costs.

### 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" 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.
  - Manufacturer's required 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.

## 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 1.0 or greater.

### 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 ensure 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 23.0 *Lead-Safe Weatherization (LSW)*.

## 19.2 Replacement Windows

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. Window minimum U-value shall be .28.

### 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. 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.

### 19.4 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 WOM 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.

## 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 1.0 or greater.

### 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 ensure 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 Replacement doors

Replacement doors shall be metal or fiberglass, and insulated to a minimum R-5. All exterior door replacements shall be exterior grade.

### 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" thick hardwood.

### 20.1.1 Photo Documentation

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

### 20.1.2 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.

## 20.2 Door Finishes

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

## 20.3 Locksets and/or Deadbolts

The configuration of the lockset/deadbolt on a replacement door shall match the existing. If installing a new lockset/deadbolt, they shall be keyed alike. The Grantee will provide two keys to the owner or occupant of the dwelling unit. When multiple locksets/deadbolts are installed in the same dwelling unit, they shall have matching keys.

## 20.4 Other Attached Items

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

- d. If replacing an exit door, door shall have exterior landing and stairs (including guardrail and handrail) per prevailing building code.
- e. Peepholes can be installed on solid doors and shall be no more than 60" from the bottom of the door.

**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 the basement, but not including crawlspaces and uninhabitable attics.

Specifically for multi-family buildings, one detector is required in each unit or more as required by code.

Replace an existing CO detector that is over 3 years old or does not meet Program standards.

### 21.1 Detector Standards

Detectors shall:

- a. Have a minimum 5-year operating life.
- b. Have a battery with a minimum 5-year life.
- c. Have a digital display that indicates CO levels in Parts Per Million (PPM).
- d. Be UL Listed.

### 21.2 Detector Power Options

**Battery-Operated Detectors**—Battery operated detectors shall make an audible noise when the battery is at the end of its life cycle.

### 21.3 Labeling Devices

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

### 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 at least one occupant 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 of CO Detectors

- a. CO detectors shall be installed before any work on the dwelling commences.
- b. All CO detectors will be installed per manufacturer's instructions by the Grantee.

### 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.

New/replacement is required for any units that are over 8 years old, inoperative, or do not meet Program standards.

### 22.1 Detector Standards

Detectors installed shall be UL Listed.

### 22.2 Detector Power Options

Detectors 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 Labeling Devices

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

### 22.5 Education of Dwelling Unit Occupants

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

### 22.6 Installation Location(s) for Smoke Detectors

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

### 22.7 Hearing Impaired

Hard-wired smoke alarms with visual alarms for hearing-impaired individuals are allowable weatherization expenses when current occupants would benefit from a specialized detector.

### 22.8 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.

- a. Required: compliance with current EPA Renovator Repair and Painting Rule.
- b. Required: documentation of compliance in the client file.

## 24.0 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 code requirements shall be followed.

## 25.0 Radon

Radon abatement is not an allowable activity. In a dwelling previously identified as having a radon problem, weatherization work that would exacerbate this problem should be limited. However, costs associated with precautionary measures in a dwelling known to have a radon problem are allowable (using state funds only) if the assessment indicates that routine weatherization techniques would help in radon remediation.

## 26.0 Other Measures

The purchase and installation of the following energy conservation measures is allowable.

### 26.1 Types of Measures

- 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 weatherstripping, 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 lamps.
- f. Replacement lamps for energy-efficient fixtures.

### 26.2 Energy Efficient Lamps (i.e., Bulbs)

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

#### Exception(s):

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

- a. The socket or fixture is nonfunctional, damaged, or unsafe.
- b. The circuit is controlled by a solid-state timer.
- c. The circuit is controlled by a non-CFL-compatible dimmer. (LED is allowable.)
- d. The fixture is located in a storage room, closet, or other seldom-used room.
- e. The fixture is controlled by an occupancy sensor.
- f. The client refuses to have lamps installed.

### 26.2.1 Types of Compact Fluorescent Lamps

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

### 26.2.2 Light Output

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

### 26.2.3 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.

### 26.2.4 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.

## 27.0 Lighting Retrofit

Retrofit of lighting fixtures or replacing fluorescent tubes with LED lamps is allowable if the cost is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1.0 or greater.

### 27.1 Type of Fixtures and/or LED Lamps

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 fluorescent or LED lamp that is easily replaceable.
- e. Interior fixtures shall be with electronic ballast only.
- f. Installed according to local electrical code and manufacturers specifications.

### 27.2 Light Output

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

### 27.3 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.

### 27.4 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.

## 28.0 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.

### 28.1 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 the approved calculator from [www.energytools.com](http://www.energytools.com).

### 28.2 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](http://www.energytools.com)

#### 28.2.1 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](http://www.kouba-cavallo.com/refmods.htm)

### 28.3 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.

### 28.4 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

### 28.5 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.

### 28.6 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.

### 28.7 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.