North Carolina
Weatherization
Assistance Program

North Carolina Weatherization Installation Standards

VERSION 1.2

Effective Date: January 1, 2012

Issued December 2011

ACKNOWLEDGEMENTS

SUMMARY OF CHANGES SINCE VERSION 1.1A

1) *1500: Guidance on the on which measures may be refused by owners has been added.*
2) *1600: Guidance on restrictions additional HARRP services has been added.*
3) *2120: Guidance on performing weatherization on homes with limited chance of energy savings*
4) *5200: Letter I) has been revised to only prohibit toilets and tubs.*
5) *5621: The requirement for a 10 year lithium battery has been removed for carbon monoxide alarms.*
6) *5720: Wording correction concerning the number of elbows in dryer vent.*
7) *5800: The sone rating has been increased sone rating to 6 for kitchens fans and deficiency credit for underperforming or missing fans has been added. Bathroom ducting must be insulated to R-4. The term "noncombustible" has been removed from bathroom venting.*
8) *5900: Removed redundant sentence in A(c).*
9) *6210: Clarification on using depressurization usage with blower doors.*
10) *6500: Corrected "1 inch" to "1 square inch" and clarified CO chart.*
11) *8100: Guidance on the spacing of duct supports.*
12) *8300: Changed clearance of insulation around ducts from 3 feet to 3 inches.*
13) *10100: Counties were R-30 is permissible have been added.*
14) *10140: The width for attic acceses has been reduced to 16 inches.*
15) *11300: Guidance on when piping pressure relief pipping would not be required to go to the outdoors.*
16) *Mobile Home Section has been added.*

North Carolina Weatherization Installation Standards
Table of Contents

1000 General Programmatic Guidance

1100 Scope

The mission of the North Carolina Weatherization Assistance Program (NC WAP) is to improve residential energy efficiency and energy-related health & safety conditions and to educate the public about ways to implement and enhance energy conservation strategies. The weatherization program focuses on serving the elderly, disabled, families with children, and heavily energy-burdened households. The goal of NC WAP is to keep North Carolina residents warm in the winter, cool in the summer, and safe all year long.

The State of North Carolina administers both NC WAP and the Heating and Air Repair and Replacement Program (HARRP) on behalf of the federal Department of Energy (DOE) and Department of Health and Human Services (DHHS). As a *grantee* responsible for administration of these federal programs, NC WAP contracts with local weatherization service providers who, as *subgrantees*, shall be responsible for compliant implementation of program objectives.

The North Carolina Weatherization Installation Standards shall govern installation procedures for all weatherization service providers, their representatives, and designees responsible for providing weatherization program services. The Installation Standards shall be divided into major sections as follows:

A) General Guidance and Site Built, Single Family Dwelling Section
B) Mobile Home Section
C) Multifamily Section

General Guidance and Site Built, Single Family Dwelling

Questions concerning the content, interpretation, or implementation of the Installation Standards shall be directed to NC WAP.

1200 Effective Date

The effective date for implementation and enforcement of these Installation Standards shall be specified in one attached cover page. All weatherization measures installed or performed by weatherization service providers on or after the effective date(s) specified shall comply with these Installation Standards. Prior versions of the Installation Standards shall be considered null and void.

1300 Code Compliance

No provision in the Installation Standards shall be interpreted in a manner which abridges safety, health, environmental codes, or other local ordinances. All weatherization program services shall comply with applicable local building codes. Local codes, where more stringent than the Installation Standards, shall always govern.

Applicable building, mechanical, electrical, plumbing, insulation, and other permits mandated by local or state code authorities shall be obtained by weatherization service providers either directly or via subcontractors performing the permitted work. Permits shall be obtained prior to commencement of work and copies shall be provided to dwelling owners upon request. Copies of each permit issued, *and the associated **passing** final inspection reports* shall be maintained in the job file. Actual permit and inspection fees shall be allowed as a materials expense and shall be reasonable and customary.
As local code requirements vary heavily between local jurisdictions, weatherization service providers shall take special care to ensure code requirements are understood and consistently complied with on a per-job basis.

1400 Amendment of Standards

From time to time the Installation Standards may be amended to reflect changes in state or federal law, technology, or general industry experience and best practices.

Amendments to the Installation Standards shall take effect 30 days from the date of written notification to subgrantees unless otherwise indicated. Changes in federal or state law, DOE guidance, or interpretations thereof may, in rare instances, necessitate amendments be made effective immediately upon written notification.

1500 Exceptions to Standards

Deviations from the Installation Standards, excepting deviations required under applicable local code requirements, shall require written authorization from NC WAP. Deviations from the Installation Standards required under local code shall be well documented and supporting documentation shall be maintained in the job file.

Weatherization service providers shall be excepted from performance of a particular measure where a preexisting, health, safety, or technical condition exists which inhibits performance of a particular measure; for example, serious moisture problems exist in the dwelling which cannot be corrected within the scope of allowable weatherization measures. All allowable exceptions shall be well justified and shall be documented in the job file.

Where a dwelling owner or legally authorized agent of the owner refuses to authorize performance of a required weatherization measure or to allow a previously authorized measure to be completed, weatherization service providers shall determine if safe, effective, and meaningful weatherization services can still be provided. The dwelling owner or legally authorized agent may refuse the installation of up to one energy efficiency measure located on the Priority List of Measure for Site-Built Dwellings for measures two through five. No weatherization work shall be performed if the client refuses more than one required measure required measure, any combustion, Category A fan in a home with a combustion appliance, or Category B fan. Priority List of Measure for Site-Built Dwellings for measures 6 through 8 and other baseload measures not directly tied to Health and Safety may be refused by the client without penalty.

If not, the dwelling shall not be weatherized. In all instances, refusal by the dwelling owner and the justification used to determine appropriate remaining measures to perform shall be documented in the job file.

Local weatherization service providers shall not avoid completing priority weatherization measures by "documenting away" the measure. Weatherization service providers shall never seek or promote refusal of a measure by a dwelling owner or legally authorized agent of the owner in an effort to deliberately avoid a weatherization measure.

1510 Prohibited Measures

Measures and materials not specifically prohibited herein shall not be assumed to be implicitly allowed, but rather weatherization service providers shall request prior written approval from NC WAP prior to performance of any measure or use of any material which falls outside the scope of customary weatherization services.

The following measures and materials shall be specifically prohibited from installation in single-family, site-built dwellings:

A) Skirting or underpinning of crawl spaces
B) Storm windows or doors
C) Foundation vents, except to provide combustion air to combustion appliances
D) Installation of zippered attic hatch tent kits.

1600 Re-Weatherization/Re-HARRP

Federal regulations permit the rendering of additional services to dwellings previously that were served before September 30, 1994. Dwellings weatherized or receiving HARRP services after September 30, 1994 may not receive additional services

It is the sole responsibility of the weatherization service provider to ensure that a comprehensive record of previously served dwellings receiving either weatherization or HARRP (per county) is compiled, maintained, and updated regularly to ensure compliance with these guidelines. The status of each subject dwelling with regard to prior weatherization and HARRP at the dwelling shall be verified during the application process and again during the energy audit initial inspection, and shall be documented in the job file.

A low priority shall be placed by weatherization service providers in selecting previously served dwellings to revisit. Written approval by NC WAP is required prior to a weatherization service provider rendering re-weatherization or HARRP on a dwelling that was served prior to September 30, 1994.

1700 Deferral of Service Based on Site Conditions

Certain health and safety conditions may exist which, until abated, make weatherization of certain dwellings unfeasible. In such cases, work for eligible households shall be deferred until such time as the conditions can be adequately mitigated or corrected entirely. Where such conditions exist, weatherization service providers shall diligently attempt to resolve such issues as well as pursue reasonable alternatives on behalf of the client, including making referrals.

Conditions requiring that a dwelling to be placed on deferral status shall include, but shall not be limited to:

A) The dwelling has been condemned or major dwelling mechanical systems have been "red tagged" by local or state code enforcement officials or utility providers.
B) The dwelling structure or its mechanical systems, including electrical and plumbing, are in such a state of disrepair that failure is imminent and the conditions cannot be resolved cost-effectively.
C) The primary heating system at the dwelling is nonfunctioning or is functioning improperly and is deemed unsafe and must be replaced, or major repairs are needed and there are insufficient resources available.
D) Dangerous conditions exist due to high CO levels in combustion appliances which cannot be resolved within weatherization program guidelines.
E) Moisture problems are so severe they cannot be resolved by allowable health and safety measures and within program guidelines.
F) Unsanitary conditions are present in the dwelling that may endanger the health and safety of dwelling occupants or weatherization personnel should weatherization work be performed.
G) Household members report documented health conditions that prohibit the installation of insulation and other weatherization materials.
H) Household members, guests, or pets maintained at the dwelling are uncooperative, abusive, or threatening to weatherization staff or contractors.
I) The extent and condition of lead-based paint or similar hazards in the dwelling may potentially create health and safety risks if weatherization work is performed.
J) Illegal activities are being conducted in the dwelling unit.

1800 Quality Assurance Monitoring

In compliance with federal WAP guidelines, NC WAP shall periodically conduct quality assurance inspections of all weatherization service providers for the purposes of assessing program compliance and providing technical assistance.

1810 General Monitoring Procedure

The effectiveness, safety, workmanship, overall appearance, and compliance with program guidelines will be evaluated during the monitoring visit. Dwelling units inspected will be selected by NC WAP from a list of completed jobs that will allow a representative sample.

Inspections may focus on problem areas identified in previous inspection reports to ensure that problems have been corrected. Recommended actions and/or required corrective actions may be issued to the weatherization service provider based on observations during these visits, and such guidance will be noted on a report provided to the weatherization service provider and the provider's governing authority, where applicable.

If a weatherization measure or repair is not in compliance with the Installation Standards and a waiver has not been issued by NC WAP, the expenditures for that measure may be disallowed. Deficiencies noted during quality assurance inspections that result in required corrective actions may be justification for requiring that the subgrantee re-inspect other dwellings.

A written response to NC WAP for all required corrective actions that details the completion of the corrective action is required.

1820 Required Corrective Actions

Any of the following circumstances generally result in a required corrective action:

A) The health and safety of dwelling occupants, weatherization staff or subcontractors, or the integrity of the dwelling structure is threatened by work completed with weatherization funds
B) A health or safety problem is created by, exacerbated by, or not corrected by the delivery of weatherization services
C) The omission of a required measure or technique with major energy savings potential, or the omission of a required procedure that addresses health and safety concerns
D) A poor quality of work that significantly affects the performance of measures or repairs
E) Expenditure of weatherization funds on measures that are not allowable or prohibited under the Installation Standards
F) Major expenditure of funds on measures that do not yield an acceptable SIR as defined by the Installation Standards
G) Any action or lack of action that may result in a liability that NC WP financial assistance award funds.

A monitoring report that contains required corrective actions shall result administrative action, including but not limited to:

A) Disallowed costs
B) Increased inspection or monitoring visits
C) Mandatory training for weatherization personnel

1830 Appeal of Findings and Corrective Actions

Weatherization service providers may appeal the findings of a monitoring inspection report in writing to NC WAP.

1900 Enforcement

Inability or refusal by weatherization service providers to comply with any of the guidelines set forth by NC WAP including, but not limited to, compliance with the Installation Standards shall result in administrative action by NC WAP including, but not limited in extreme instances to, termination of the subgrantee's award to provide weatherization services.

2000 Workflow Documentation

2100 General Documentation Tools and Methods

2110 Accountable Results for Community Action (AR4CA)

The Accountable Results for Community Action (AR4CA) data collection and reporting system was designed to be an organizational tool for weatherization service providers to streamline reporting requirements. NC WAP guidelines mandate that an AR4CA data profile be created for each application for weatherization services received by weatherization service providers and a job profile be created for each dwelling unit assessed. The AR4CA programming format may be revised from time to time as the data collection and reporting needs of NC WAP and local weatherization service providers change.

Key components of the data collection, reporting, and organizational tools provided by AR4CA include:

A) Generation of a prioritized client waiting list for each weatherization service provider, to ensure that the priority client populations receive priority consideration for services
B) Recording of data related to household demographics, contact information, callbacks, general case notes and comments
C) Entry of dwelling characteristics, inspection notes, and diagnostic testing results
D) Inclusion of preformatted work order and change order templates for use on each job
E) Tracking of materials and measures installed on a per-job basis, separating expenses by applicable budget categories.

AR4CA data shall be updated continually as each weatherization job progresses and shall at all times be an accurate reflection of the facts and circumstances related to each applicant profile or weatherization job. Regular AR4CA data audits shall be conducted as a quality assurance measure. Weatherization service providers shall ensure that access to AR4CA is monitored and restricted as needed to maintain data integrity. Official program documents generated from AR4CA, including priority scoring tools, work orders and change orders, materials and measures lists, and related documents as specified shall be maintained in each job file.

2120 Weatherization Assistant Energy Audit Software

The Weatherization Assistant energy audit software was developed by the Oak Ridge National Laboratory specifically for use by WAP. There are two components to the Weatherization Assistant software, the National Energy Audit Tool (NEAT) for site-built dwellings and the Mobile Home Energy Audit (MHEA) for manufactured dwellings.

Use of the Weatherization Assistant software shall be required wherever proposed weatherization measures deviate from NC WAP Priority List of Measures or where measure specific cost-justification is mandated to

ensure that the proposed scope of work complies with WAP cost-effectiveness guidelines requiring a measure-specific and/or cumulative project savings to investment ratio (SIR) of 1.0 or greater.

Measures requiring the use of the Weatherization Assistant software shall include, but not be limited to:

A) Incidental repairs lacking a direct relationship to priority list measures, including replacing windows or doors
B) Heating, ventilating, and cooling (HVAC) system sizing for replacements
C) HVAC sizing for system installations required to establish adequate primary heat sources

Dwellings in which no air sealing is needed, and in which adequate insulation in the attic, sidewalls, and floor is already present shall require a Weatherization Assistant audit in order to ensure that the entire job will still be cost-effective.

The Weatherization Assistant software tools may additionally be used to cost-justify refrigerator replacements and to assess the cost-effectiveness of certain health and safety measures, where applicable, to support leveraging and efficient management or program resources.

One or more weatherization personnel members employed by each weatherization service provider shall possess a thorough working knowledge of the Weatherization Assistant software packages.

2130 Photographic Documentation

The job file for every weatherized dwelling shall contain specific photographic documentation of pre, interim, and post-weatherization conditions. Circumstances, events, or measures requiring mandatory photographic documentation shall include, but not be limited to:

A) Conditions resulting in a dwelling being placed on deferral status
B) Conditions inhibiting installation of priority weatherization measures
C) Unusual or hazardous conditions encountered during the course of work
D) Justification for an atypical measure or course of action
E) Verification of Lead-Safe work practices
F) Photographs required for State Historic Preservation Office (SHPO) compliance
G) Existing and replacement appliances or equipment
H) High-priority measures.

Photographic documentation shall additionally comply with the following minimum specifications:

A) Images shall be digital
B) Shall be clear and easy to view
C) Shall contain captions which identify the job site and the specific events being depicted
D) Shall be date and time stamped where feasible
E) Image source files shall be retained electronically and shall be made available upon request
F) The quantity of photographs taken shall be adequate to document all applicable circumstances, events, and measures
G) Shall be printed using a quality color printer, grouping not more than six images per 8 ½ in. x 11 in. letter-sized page

H) Print images as specified herein shall be maintained in the job file

2200 Pre-Audit Documentation

2210 Permission to Enter Premises Agreement

Weatherization service providers and dwelling owners shall complete a Permission to Enter Premises Agreement (PEPA) prior to the start of the initial audit in every weatherized dwelling. The PEPA not only provides protection for weatherization service providers, including conveying the legal right to enter a dwelling for purposes of inspection and evaluation, but it also serves as formal notification to the dwelling owner of pertinent NC WAP policies and procedures. By signing the PEPA, dwelling owners acknowledge their acceptance of responsibility to cooperate with weatherization providers, should the dwelling be determined eligible for services. Under no circumstances shall weatherization personnel enter a dwelling to perform an energy audit, or for any other purpose, prior to a PEPA being signed by the dwelling owner and the weatherization service provider.

2220 Occupant Preexisting Health Condition Notification

Weatherization service providers shall specifically request and document preexisting health condition reporting by dwelling occupants in every weatherized dwelling, whether reported during application processing, at the time of initial audit, or throughout the course of weatherization work. Precautions shall be taken where applicable to avoid exacerbating preexisting health conditions. Conditions reported and the associated actions taken, if any, shall be documented in the job file.

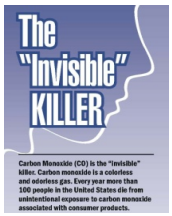
2230 Client Education Documentation

Client education topics including, but not limited to, energy efficiency, health and safety, and weatherization process education shall be provided to the occupants of every dwelling weatherized prior to the start of weatherization work and as mandated thereafter per applicable standards listed herein for the provision of client education. Specific client education topics shall be considered mandatory for every dwelling, while other topics may be covered where applicable based on dwelling conditions. Written documentation of client education provided shall be maintained in the job file.

2231 Mandatory Client Health and Safety Education Topics

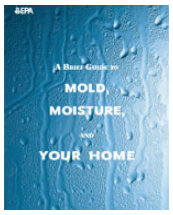
Mandatory acknowledgement of receipt of health and safety education as well as delivery of the specified reference publication shall be obtained from dwelling occupants in every weatherized dwelling prior to the start of weatherization work and documentation of each written acknowledgement shall be maintained in the job file.

A) Carbon Monoxide (CO)—is an odorless, colorless, tasteless, poisonous gas produced by incomplete combustion. CO poisoning poses immediate harm to humans and pets and can be fatal. Any fossil fuel-burning activity including cooking, automobile, or heating system exhaust is a potential source for CO exposure. Every client household shall be educated on the potential health hazards related to CO poisoning and provided with a copy of *The Invisible KILLER.*

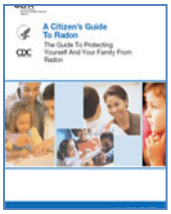


B) Lead—exposure to lead dust, commonly found in dwellings containing lead-based paint, can adversely affect child brain and nervous system development, causing learning disabilities and behavioral problems. Lead dust exposure is also harmful to adults. Federal law mandate that individuals receive notification of potential lead hazards prior to the start of interior or exterior renovation projects in housing built in or before 1978. Every client household shall be educated on the potential health hazards related to lead dust exposure and provided with a copy of *The Lead-Safe Certified Guide to Renovate Right.*

C) Mold and Moisture—because tightening a dwelling through air sealing may cause an increase in relative humidity levels indoors, dwelling occupants should be informed about how to identify moisture related problems and possible solutions. Every client household shall be educated on the potential health hazards related to mold and mildew exposure and be provided with a copy of *A Brief Guide to Mold, Moisture, and Your Home.*



D) Radon—is a naturally occurring, colorless, odorless, tasteless, cancer-causing, radioactive gas found throughout the United States. Tightening a dwelling through air sealing may cause an increase in indoor radon levels. Every client household shall be educated on the potential health hazards of exposure to radon gas and provided with a copy of *A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon*.



E) Spray Polyurethane Foam (SPF)—is a widely used and highly effective insulator and sealant. However, exposure to its key ingredient, isocyanates, and other SPF chemicals in vapors, aerosols, and dust during *and after installation* can cause health conditions including asthma, other respiratory conditions, and severe skin and eye irritation. Every client household shall be educated on the potential health hazards related to SPF products and provided with a copy of *Weatherizing your home with SPF*

2300 Initial Audit Documentation

2310 Residential Energy Audit Tool (REAT)

Applicable sections of the Residential Energy Audit Tool (REAT) shall be completed fully in conjunction with every initial dwelling audit performed as per the NC WAP REAT instructions provided with the tool. Non-applicable sections of the audit tool shall be marked with the designation of N/A. The REAT shall be used to

record pre and interim diagnostic test readings and relevant dwelling specific data including, but not limited to, square footage, existing insulation values, health and safety hazards observed, and the make, model, and type of all existing appliances and heating systems. The REAT shall be provided to weatherization installers and subcontractors where applicable prior to the start of work as a supplement to the dwelling specific scopes of work delivered.

2320 Refrigerator Replacement Evaluation Data

Refrigerator replacement evaluation data shall be maintained in the job file for every dwelling weatherized. Replacement data may be used to perform calculations prepared through use of the NC WAP Refrigerator SIR calculator or the Weatherization Assistant software. Replacement evaluation data to be documented shall include, but not be limited to:

A) Appliance manufacture date, model number, and serial number (where determinable)
B) kWh/yr of energy consumption, determined by properly metering the appliance
C) SIR calculation data used to determine eligibility for replacement
D) Photographic documentation showing details of existing appliance (where applicable)
E) Procurement data for replacement appliance
F) Specification data for replacement appliance
G) Photographic documentation showing details of replacement appliance (where applicable)
H) Associated expense entry in the AR4CA materials list.

2400 Post-Audit Documentation

2410 Evaluation, Clean, and Tune

Documentation of a completed Evaluate, Clean, and Tune (ECT) (or the basis for exemption from the requirement) shall be maintained in the job file for every weatherized dwelling. Standard NC WAP ECT reporting documents shall be completed by HVAC technicians performing services and shall record all conditions observed and recommended corrective actions, if any. ECT reports shall contain sufficient details and information to substantiate tasks completed during the ECT, as well as to adequately justify any repair or replacement measures subsequently performed.

2420 Lead-Safe/Renovate Right

In compliance with federal regulations relating to lead paint hazard exposure, weatherization service providers (renovation firms), field personnel (installers and certified renovators), and subcontractors shall jointly be responsible for ensuring that standards governing lead-safe work practices including, but not limited to, the following provisions are at all times adhered to:

A) Individuals performing activities that disturb painted surfaces on behalf of the firm are either certified renovators or have been trained by a certified renovator
B) A certified renovator is assigned to each renovation and performs all of the certified renovator responsibilities

C) Renovations performed by the firm are performed in accordance with the work practice standards of the Lead-Based Paint Renovation, Repair, and Painting Program (RRP)
D) Pre-renovation education requirements of the Lead-Based Paint RRP Program are met
E) Mandatory recordkeeping requirements are followed.

Lead-safe documentation including inital, interim, and final-work certifications and acknowledgements shall be maintained in the job file.

2430 State Historic Preservation Office Authorization

The State Historic Preservation Office (SHPO), located within the North Carolina Department of Cultural Resources, is tasked with identifying and safeguarding historic structures and sites. NC WAP has entered into a programmatic agreement with SHPO to review and authorize use of specified weatherization measures proposed for weatherization-eligible site-built dwellings 45 or more years old which may adversely impact the historic character of such structures, in compliance with federal historic preservation regulations.

Weatherization service providers shall be responsible for implementing procedures to ensure compliance with pre-weatherization SHPO project review standards where any of the following measures are proposed for site-built dwellings 45 or more years old:

A) Measures requiring holes to be drilled in exterior wood weatherboard (siding)
B) Measures requiring alteration, major repair, or replacement of wood windows
C) Measures requiring alteration, major repair, or replacement of wood entry doors
D) Measures related to installation of solar thermal devices.

Where any of the above measures are proposed, documentation including, but not limited to, the following shall be submitted to SHPO for review and authorization prior to proceeding with work:

A) Physical dwelling address
B) Name of dwelling owner
C) Map denoting the location of the dwelling within the state
D) Copy of preliminary scope of work (work order) for the dwelling detailing proposed measures
E) Four or more digital color photographs depicting each dwelling elevation (front, rear, and sides).

SHPO project review documentation shall be submitted by weatherization service providers via electronic mail (only) to: energy.projects@ncdcr.gov. Submission and authorization data and communications shall be maintained in the job file.

2440 Permission to Perform Services Agreement and Preliminary Scope of Work

Every dwelling weatherized shall be subject to a Permission to Perform Services Agreement (PPSA) signed by the dwelling owner and the weatherization service provider prior to the start of any work (excepting the initial energy audit). Weatherization service providers shall be responsible for obtaining informed written consent from the property owner for all proposed measures and acknowledging a willingness to comply

with program guidelines prior to job start via a signed PPSA and detailed preliminary scope of work (work order). The following minimum standards shall apply to the PPSA:

A) Weatherization measure proposed for the dwelling shall be described in detail in the attached scope of work, including the method of performance and materials to be used.
B) Only the dwelling owner can sign authorizing work. Both the dwelling owner and the occupants shall have the right to review and understand the results of the initial audit or other inspections and the details regarding each proposed measure prior to the start of work.
C) Dwelling owners shall have the right to refuse performance of any measure; however, refusal to authorize performance of particular measures may result in non-performance of all or other proposed measures.
D) Weatherization service providers shall provide information as needed to ensure that owners (and to the extent possible, occupants) possess a thorough understanding of the services that will *and* will not be provided at the dwelling.
E) Signature by each dwelling owner or co-owner shall be required to authorize work.

2450 Work Orders, Change Orders, and Scope of Work

Standard NC WAP work order and change order documents shall constitute the formal scope of work for weatherization jobs. The terms of standard NC WAP weatherization subcontractor agreements, as well as compliance with NC WAP standards, mandate that a scope of work be issued to weatherization personnel and subcontractors containing detailed specifications for all measures performed on weatherized dwellings. Work orders shall be generated by initial auditors or weatherization management as appropriate, based on dwelling data collected during the initial audit and recorded in the REAT. Work orders and, as needed, change orders shall contain reasonable estimates of labor and material expenses associated with each specified measure and shall be delivered to field personnel and subcontractors prior to installation of the measures specified.

Weatherization personnel and subcontractors shall perform measures as specified in work order and change order documents only. Deviation from the scope of work initially supplied by the weatherization service provider in the form of a compliant work order shall require written documentation and authorization for the revision in scope issued in the form of change order. The scope of work specified in the work orders/change orders for the job shall form the basis by which subcontractors shall be compensated and by which invoices and expenditures submitted to NC WAP shall be evaluated prior to payment.

2610 Warranty Documentation and Operating Manuals

Manufacturer warranty documentation and operation manuals for all newly installed appliances and equipment shall be obtained from the subcontractor, distributor, or manufacturer and provided to the dwelling owner prior to completion of the final inspection. Effort shall be made to provide warranty documentation and operation manuals in Spanish or other languages where needed to aid non-English speaking clients.

Final inspectors shall be responsible for ensuring that essential information regarding the proper operation and maintenance of appliances and equipment, as well as instructions for initiating warranty related repairs,

is clearly explained to dwelling owners prior to completion of the final inspection and formal acceptance of services.

3000 Priority List of Measures

The NC WAP priority lists of measures serves as the basis upon which the vast majority of weatherization measures shall be performed in North Carolina dwellings. The priority lists were developed based on data collected by conducting numerous computerized audits performed on typical low-income housing stock throughout the state using the Weatherization Assistant software. Audit data collected identified the following "frequently recommended" measures as being the most cost-effective to perform based on the measures consistently delivering an SIR of 1.0 or greater. The NC WAP priority lists of measures are approved by DOE.

A dwelling-specific computerized audit shall be mandated per applicable guidelines herein, particularly where *non-priority list measures* are proposed for a particular dwelling. Energy-related health and safety measures shall be considered on a dwelling-by-dwelling basis and are not included in the priority list of energy efficiency measures, nor subject to cost-effectiveness requirements.

3100 Priority List of Measures for Site-Built Dwellings

1. **Air Sealing**
   (Chapters 9000—Air Sealing)

2. **Attic Insulation**
   (Chapter 10000—Insulation)

3. **Dense Pack Sidewalls**
   (Chapter 10000—Insulation)

4. **Floor Insulation**
   (Chapter 10000—Insulation)

5. **Seal & Insulate Ducts**
   (Chapter 8000—Duct Sealing & Insulating)

6. **Smart Thermostats**
   (Chapter 7000—Heating, Ventilating, and Cooling Systems)

7. **Compact Fluorescent Lamps (CFLs)**
   (Chapter 11000—Baseload Reduction and General Heat Waste)

8. **Refrigerator Evaluation**
   (Chapter 11000—Baseload Reduction and General Heat Waste)

4000 Client Education

Weatherization services provide a greater and more lasting benefit where clients are partners in the process, working alongside weatherization service providers. As in any partnership, each partner in the weatherization process has certain responsibilities and expectations. NC WAP and its network of providers is charged with quality installation of appropriate energy-saving measures intended to reduce fuel and utility expenses in weatherized dwellings and, where possible, to increase comfort for client households. Weatherization clients are responsible for cooperating fully with reasonable requests made by weatherization service providers before, during, and after weatherization process, as well as for the maintenance and upkeep of measures and systems installed and for adopting strong energy saving behaviors. Where the Weatherization partnership is well balanced, the result can be greater energy savings, lower fuel and utility bills, and increased client comfort that lasts for years to come.

Meaningful delivery of quality client education plays a large role in a balanced weatherization partnership by enabling clients to understand and participate in improving the efficiency of their dwelling. Weatherization client education includes discussion, instruction, brochures, and pamphlets that explain the weatherization process, measures installed and how to use them, low-cost/no-cost ways to save energy, and how to avoid potential dwelling-related safety hazards.

Weatherization service providers shall ensure that weatherization personnel responsible for providing weatherization client education are proficient in the knowledge and abilities required to effectively deliver quality client education including, at minimum, possessing a strong working knowledge of:

A) Basic steps in the weatherization process, including auditing, testing, installation, inspection, and monitoring
B) Actions that can be taken to reduce energy use in the dwelling
C) Actions that can be taken to maintain a safe and healthful indoor environment
D) The purpose and operation of basic equipment involved in the weatherization process, including blower door, pressure pan, combustion analyzer, gas leak detector, insulation blowing machine, and generator
E) Techniques to demonstrate estimated economic impacts of suggested actions to bolster occupant commitment to changes in household behaviors.

Client education shall be provided at specified intervals throughout the weatherization process and shall be repeated as needed to ensure clients are comfortable with the information provided.

4100 Energy Education

Changing household behaviors is a key factor in improving the energy consumption in a dwelling. Where household members become aware that choices related to thermostat settings, hot water usage, and switching off unused electrical devices can reduce energy bills, occupants are more likely to adopt energy-saving behaviors.

Client energy education shall be provided to client households in every weatherized dwelling and shall include relevant, dwelling-specific information on energy efficiency improvements including, but not limited to:

A) Heating and cooling system efficiency
B) Infiltration and air sealing
C) Thermal comfort improvements
D) Indoor air quality (IAQ) improvements
E) Baseload energy reduction
F) General heat loss improvements.

4200 Health and Safety Education

In addition to energy education, client households shall also be provided with client health and safety education to advise clients of potential dwelling-related health and safety hazards which may be present, created, or exacerbated by weatherization work.

Mandatory delivery of specific client education and the related reference publication for the following topics shall be provided to *dwelling owners and occupants* in every dwelling prior to the start of weatherization work. Weatherization educators shall underscore the importance of the information provided for each topic and shall fully answer questions and address concerns raised by clients, if any.

A) *The Lead-Safe Certified Guide to Renovate Right*
B) *A Brief Guide to Mold, Moisture, and Your Home*
C) *A Citizen's Guide To Radon: The Guide To Protecting Yourself And Your Family From Radon*
D) *The Invisible KILLER*
E) *Weatherizing your home with SPF*

Detailed information on each mandatory education topic and the related reference publication may be found in section 2231 of the Installation Standards. A written acknowledgement of receipt for each topic, as well as any related communication on these and other topics, shall be maintained in the job file.

Additional client health and safety education topics to be reviewed with client households as needed based on actual conditions present in the dwelling shall include, but shall not be limited to:

A) Maintaining weatherization jobsite safety
B) Hazardous materials exposure and proper handling (existing or used during work)
C) Electrical hazards and fire safety
D) Structural integrity, fall hazards, or other building durability issues
E) Biological and sanitation hazards, including insect or rodent infestations, animal dander or feces, raw sewage contamination, or hazards related to the presence of excess debris

4300 Weatherization Process Education

Ensuring a smooth and beneficial weatherization experience also requires that client households be informed and updated regularly about what is expected from all partners throughout the weatherization process.

Aspects of the weatherization process that shall be discussed with client households at various stages throughout the weatherization process shall include, but not be limited to:

A) Schedule of milestone events in the weatherization and HARRP processes
B) Who will communicate with the client and when
C) Events that shall take place before weatherization work can begin
D) What to expect during the energy audit
E) Client responsibilities to prepare for weatherization
F) Who will perform weatherization work
G) Daily work schedule
H) Weatherization measures and appliance that will be installed as part of weatherization
I) Repairs or improvements that will *not* be provided in conjunction with weatherization
J) Personal property that will be altered or removed during weatherization
K) When the work will be complete
L) Final inspection and quality assurance monitoring processes
M) How the dwelling may perform differently as a result of weatherization
N) Proper operation and maintenance of new or existing equipment and systems

5000 Energy-Related Health and Safety

While the primary purpose of NC WAP is to reduce energy use for elderly, disabled, and low-income residents, ensuring the health and safety of clients and personnel must always be the most paramount factor for all weatherization service providers and related weatherization professionals.

Allowable energy-related health and safety measures shall be defined as only those specified measures deemed necessary by NC WAP to maintain the physical wellbeing of the dwelling, the dwelling occupants, and weatherization personnel. Energy-related health and safety measures shall be allowable only where energy efficiency measures are also installed.

Effective management and implementation of energy-related health and safety measures require weatherization service providers to clearly understand:

A) What jobsite conditions are necessary to effectively perform weatherization work
B) What changes in jobsite conditions are necessary as a result of weatherization work
C) What expenses are reasonable, allowable, or required to ensure jobsite conditions are as safe as possible for weatherization personnel and dwelling occupants before, during, and after weatherization.

The extent to which allowable energy-related health and safety concerns can reasonably be addressed using available health and safety resources is inherently limited; therefore, dwellings must be evaluated on a case-by-case basis. Placing dwellings in deferral status shall be required wherever energy-related health and safety concerns cannot be adequately addressed.

The decision to defer work in a dwelling is difficult, but cannot be avoided in some instances. This does not mean that assistance will never be available, but rather that work must be postponed until health and safety problems can be resolved and/or alternative sources of assistance can be located.

5100 Health & Safety Education and Hazard Notification

Weatherization service providers shall be responsible for providing energy-related health and safety education to client households living in every dwelling weatherized in compliance with applicable standards herein for mandatory client education. This responsibility shall specifically apply to educating clients about the potential risks and necessary safety precautions associated with each section of this chapter.

In every instance weatherization service providers shall be responsible for notifying property owners and dwelling occupants, both verbally and in writing, of pertinent facts and necessary safety precautions relating to any conditions observed on a jobsite that could result in harm or loss to either life or property. Examples of such conditions may include, but shall not be limited to, code compliance issues, existing or potential health and safety hazards, or any atypical condition encountered on the jobsite.

Notification requirements shall apply to all activities undertaken in conjunction with the provision of weatherization program services and to *all* sections of the Installation Standards. Notification requirements shall include observation of hazard conditions that may fall outside the scope of weatherization activities.

5200 Energy-Related Health and Safety Expenditures

Allowable energy-related health and safety measures, where provided in conjunction with required energy efficiency measures and in compliance with applicable standards and limitations specified herein shall include, but not be limited to:

A) Repairing or replacing unsafe, nonfunctioning, or inadequate HVAC systems or components
B) Correcting IAQ issues
C) Preventing excess moisture intrusion
D) Repairing minor plumbing problems
E) Repairing or replacing leaking or unsafe water heaters
F) Repairing minor electrical problems
G) Installing carbon monoxide and smoke alarms
H) Repairing unsafe fuel-fired cook stoves
I) Performing lead-safe work practices
J) Purchasing personal protective equipment (PPE)
K) Procuring specified pest control services
L) Testing for radon in moderate to high potential risk areas
M) Removing excess debris from dwellings in limited instances.

Prohibited activities shall be defined as activities which are not permitted by NC WAP under any circumstances. Disallowed activities shall be defined as those activities conducted in a manner which does not comply with applicable NC WAP technical standards or administrative guidelines.

Prohibited or disallowed activities, where conducted in a noncompliant manner or where WAP resources are misappropriated for purposes which are not specified as energy-related health and safety activities shall include, but not be limited to:

A) Procuring termite control services
B) Treating to kill viruses or bacteria
C) Installing or repairing portable or unvented space heaters
D) Installing or repairing attic, ceiling, or portable fans
E) Installing or repairing heat recovery ventilators or energy recovery ventilators
F) Installing or repairing humidifiers or dehumidifiers
G) Installing or repairing wheelchair ramps or bathroom grab bars
H) Installing or repairing septic tanks, covers, or lines
I) Installing toilets and tubs
J) Installing or repairing windows and doors*
K) Installing or repairing refrigerators*
L) Installing cook stoves
M) Installing or repairing any appliance not expressly specified herein as an allowable energy-related health and safety measure including, but not limited to, clothes washers or dryers, dishwashers, microwaves, and stand-alone freezers.

*This list of prohibited or disallowed activities shall **not** be considered exhaustive. Where clarification of prohibited or disallowed activities is required, weatherization service providers shall be responsible for contacting NC WAP prior to any expenditure of health and safety resources. Misappropriation of energy-related health and safety resources to perform prohibited or disallowed activities shall result in the expenditure being disallowed.*

**Under no circumstances shall repair or replacement of refrigerators, windows, or doors be allowed as an energy-related health and safety measure.*

5300 Occupant Pre-existing Health Conditions

Special precautions shall be taken where any occupant of a weatherization-eligible dwelling suffers from respiratory ailments, allergies, is pregnant, or has a similar health condition that puts the occupant at greater potential risk for medical complications as a result of any aspect of weatherization work. It shall be the responsibility of the weatherization service provider to document any such condition reported by any member of the client household, whether during the application process, at the time of initial audit, or as work progresses and to immediately inform weatherization workers of any precautions that must be taken to avoid exacerbating the reported health condition.

In particular circumstances, temporary relocation of at-risk household members may be the most appropriate course of action to avoid potential exposure to hazardous conditions. Weatherization service providers shall communicate with client households in advance of scheduling weatherization services to identify viable personal alternatives that may be arranged by the dwelling occupants for temporary relocation; for example, temporary relocation to the home of a friend or relative. In extreme circumstances, it may necessary for the weatherization service provider to provide for temporary relocation of the at-risk household member. Authorization for the use of health and safety resources to provide for temporary relocation shall be considered in extreme circumstances and on a case-by-case basis, and may be expended only with the prior written consent of NC WAP.

Where weatherization personnel encounter clients suffering from bacterial infections or viruses known to be contagious, weatherization service provider management shall be contacted and, where instructed, work may be temporarily delayed to allow for the individual suffering from the illness to recover and the contagious period for the specific illness to pass.

Where a weatherization service provider is for any reason unable to implement necessary precautionary measures or to take actions required to avoid the potential for exacerbation of pre-existing occupant health concerns (including refusal by the dwelling occupants to reasonably comply with requests for temporary relocation), the dwelling shall be placed in deferral status and no weatherization work shall be performed until adequate safety precautions can be implemented.

Documentation and required notifications related to any such instance shall be maintained in the job file.

5400 Weatherization & Health and Safety Hazards

Weatherization program services shall at all times be provided in a manner that minimizes risk to client households. Any conditions which exist that may endanger the health or safety of the dwelling occupants and which cannot be resolved within the scope of allowable health and safety measures shall result in the dwelling being placed in deferral status until the conditions can be corrected.

Precautions to ensure occupant and worker health and safety shall at all times include the responsibility of weatherization service providers, personnel, and contractors to recognize potential hazards related directly to weatherization work and to take action to limit exposure to, or exacerbation of, the potentially hazardous condition.

5410 Air Pollutants

Weatherization service providers shall be responsible for ensuring that dwelling occupants and workers are protected from potential safety hazards related to irrespirable particles during the weatherization process.

Irrespirable particle hazards may include exposure to substances generally associated with weatherization work such as chemical vapors or insulation dust, as well as hazards created by improper handling of hazardous materials already present in the dwelling including asbestos, lead, and mold. While specific safety precautions apply to the handling of all hazardous materials, general precautions shall be taken in all phases of the weatherization process.

5420 Blower Door Operating Hazards

As a standard practice, blower door diagnostic testing shall be performed only after a dwelling has been thoroughly inspected, potential hazards identified and, where required, necessary precautions taken to remove, encapsulate, or otherwise mitigate the hazard to a level at which blower door diagnostics can safely proceed. Where risks related to hazardous material fibers or vapors being raised and circulated through the air during blower door operation exist, performing blower door diagnostics using the pressurization, rather than the depressurization method, may be appropriate.

5430 Spray Polyurethane Foam

Spray polyurethane foam (SPF) is a widely used and highly effective insulator and sealant. However, exposure to its key ingredient, isocyanates, and other SPF chemicals in vapors, aerosols, and dust during and after installation can cause:

A) Asthma, a potentially life-threatening disease
B) Sensitization, which can lead to asthma attacks if exposed
C) Other respiratory and breathing problems
D) Skin and eye irritation.

Minimum safety precautions required where SPF is used shall include, but not be limited to:

A) Ensuring health and safety training is completed and safe work practices are followed to prevent eye, skin, and inhalation exposures during and after SPF installation

B) Exercising extreme caution when determining safe re-entry times for unprotected dwelling occupants and workers based on the manufacturer's recommendations
C) Regular review of label and product information for ingredients, hazards, directions, safe work practices, and precautions.

Weatherization service providers shall minimize or restrict the use of materials that may be hazardous to the client to the extent feasible; however, where the weatherization service provider must allow the use of hazardous chemicals or materials in conjunction with the effective installation of weatherization measures, the contents, precautions, and potential consequences of exposure to the hazard shall be disclosed in writing to both the dwelling owner and the dwelling occupants prior to use and the parties must sign to acknowledge understanding of the information provided and to grant consent to proceed with work prior to use of the chemical or material. Documentation of the notification and consent shall be maintained in the job file. Installation of hazardous materials shall always be performed in well-ventilated areas.

5440 Formaldehyde and Volatile Organic Compounds

Substances containing formaldehyde, volatile organic compounds (VOCs), and similar air polluting agents which pose a potential risk to weatherization workers and dwelling occupants shall be identified and, where feasible, removed from the dwelling prior to weatherization work commencing. Where it is not feasible to remove such pollutants, care shall be taken not to disturb the substances and to limit exposure to the extent possible.

5500 Jobsite Management Hazards

5510 Excess Debris and Personal Property

Excess debris and other items located in and around dwelling units may not only pose potential health and safety risks to weatherization workers and dwelling occupants, but likely also inhibits proper execution of weatherization measures. Weatherization service providers shall be responsible for identifying and mitigating any such hazardous conditions prior to proceeding with weatherization services.

Where feasible, weatherization service providers may request that clients be responsible for the removal of excess debris and personal property from the dwelling. Where the property owner and/or the dwelling occupants are incapable of removing the items, it shall be allowable for weatherization service providers to provide for a reasonable amount of removal. All personal property surrendered or removed from a dwelling by weatherization personnel or contractors shall be documented in the job file, including written authorization from the dwelling owner as well as photo documentation of items removed.

Emphasis shall generally be placed on removing excess debris or extraneous items from attics, crawlspaces, the dwelling perimeter, and exterior doorways.

Large amounts of excess clutter contained in dwellings includes trash, clothing, collectables, toys, boxes, building materials, furniture, machinery, tires, or similar items which inhibit the ability of weatherization workers to fully access all areas of the dwelling to perform inspections and repairs or to install measures. The excess clutter poses greater potential hazards to weatherization workers and dwelling occupants, in

addition to inhibiting the proper execution of weatherization measures. Where excessively cluttered conditions exist, effort shall be required either by the client or the weatherization service provider, as appropriate, to substantially de-clutter the dwelling prior to weatherization work commencing.

5520 Biological Hazards and Poor Sanitation

Unsanitary dwelling conditions contribute to a host of potential biological hazards that can cause acute or chronic illnesses. Dwelling occupants are often unaware of household conditions that may promote biological hazards.

Weatherization service providers shall educate clients, where applicable, on locations within a dwelling (for example kitchens, bathrooms, and doorknobs) where biological hazards may be present, as well as regular housekeeping, food storage, and hand washing techniques essential to maintaining a safe and sanitary home.

Weatherization personnel shall be trained to identify and properly manage situations where potential biological hazards are encountered. For example, proper management of raw sewage discovered in a crawlspace might consist of steps such as:

A) Ceasing all crawlspace work to avoid contact with the potential hazard
B) Notifying weatherization management and the dwelling occupants that a potentially hazardous condition has been identified and should be avoided until corrected
C) Documenting the circumstances surrounding identification of the hazard in the job file
D) Procuring services from a licensed plumber to assess and then correct the problem where only a minor issue exists
E) Taking steps to avoid any future contact with the hazard, including allowing the area to dry completely prior to resuming work and ensuring personnel wear PPE while working in the crawlspace.

Measures to remediate conditions that may lead to or promote biological hazards shall be considered on a case-by-case basis. Measures intended specifically to eliminate the presence of bacteria and or viruses shall not be allowed. Where extreme conditions exist that are outside the scope of allowable health and safety measures, the dwelling shall be placed in deferral status until the conditions corrected.

5530 Insects and Rodents

Where severe insect or rodent infestations exist in a dwelling which may hinder safe weatherization work by endangering clients or workers, extermination or removal by a properly trained and/or licensed extermination professional shall be allowable. Extermination, where performed, shall be completed in advance of weatherization work commencing. In the case of insecticide applications, sufficient time shall be allowed for complete ventilation of treated areas to avoid unnecessary inhalation of the insecticides. Where applicable, repair work required to prevent re-entry by rodents, including closing points of entry by sealing holes and installing screening materials, may also be required prior to weatherization.

Written authorization by the dwelling owner and notification acknowledgment by the dwelling occupants shall be required prior to weatherization service providers procuring any insect and rodent removal

treatment or services, and documentation of all services and related authorizations and acknowledgements shall be maintained in the job file. Where infestations are particularly serious, notifying the local health department may be advisable.

Hazards related to insect or rodent infestations may include, but shall not be limited to, the following:

A) Bees, Wasps, Other
Flying insect stings can cause severe allergic reactions, and in rare instances may result in death.

B) Roaches, Fleas, Rats, Mice, Other
Extreme crawling insect infestations may be hazardous to the health of dwelling occupants and weatherization workers since contact with droppings or feces may cause infectious diseases. Disinfectant wipes may be needed to cleanse skin and contaminated areas, as soap and water alone may not kill harmful feces-related bacteria. Medical attention shall be sought for a rat or mouse bite, or for flea or roach bites that cause extreme irritation.

C) Bats
In addition to the hazards and precautions related to the presence of crawling rodents, work performed where bat feces or guano is present may present even greater potential hazards. Use of respirators and protective clothing shall be of even greater importance to avoid inhalation and skin contact with droppings. Protective goggles shall additionally be advisable to prevent contact through the eyes.

D) Snakes
Snakebites shall require that the individual bitten be transported to a medical facility immediately, particularly if the person was bitten by a snake confirmed as being venomous. First aid may be required prior to or during transport.

5540 Dwelling Accessibility Limits

As a practical consideration, as well as a health and safety matter for weatherization personnel, weatherization measures shall not be required in portions of a dwelling crawlspace where clearances of 18 in. or less as measured from the bottom of the floor joists to the ground below exist.

Where crawlspace clearances restrict access to portions of a crawlspace, priority weatherization measures including, but not limited to, vapor barrier installation, air sealing, and installing insulation shall be required in the accessible portions of the crawlspace to the extent compliance with applicable standards for each measure and the health and safety of weatherization personnel can be maintained.

Though measures shall not be required in crawlspace areas with clearances of 18 in. or less, reasonable efforts shall be made on the part of weatherization service providers and weatherization personnel to complete measures to the fullest extent practicable in an effort to provide the greatest potential benefit to clients.

5550 Jobsite Injury Prevention

Weatherization service providers shall take all reasonable precautions against performing work on dwellings where that work will subject weatherization personnel or dwelling occupants to health and safety risks, including risk of falls. *Minor* repair and installation shall be allowable to secure steps and handrails where such actions are necessary to effectively weatherize the dwelling. Measures deemed unnecessary or excessive shall not be allowed.

5560 Jobsite Awareness and Communication

Weatherization service providers shall be responsible for ensuring that all weatherization personnel and contractors are knowledgeable and capable of understanding and communicating potential safety concerns to dwelling occupants on an ongoing basis as the weatherization job progresses. Clients shall be educated prior to the start of work on the necessity to secure the work area to avoid injuries to adults, children, and pets, and weatherization personnel and contractors shall be responsible for continual reinforcement of this education.

Clients shall be responsible for ensuring weatherization tools, equipment, or materials on the jobsite are not disturbed, and likewise weatherization workers shall be responsible at all times for securing such items on the jobsite and leaving a reasonable pathway for dwelling occupants to move about wherever possible, which allows them to avoid contact with potential hazards.

Where weatherization personnel encounter circumstances where they cannot reasonably secure the work area or where there is a failure by the client to avoid work disturbances by people and/or pets, weatherization personnel and contractors shall notify weatherization service provider management and cease work where necessary until such time as a safe work area can be established on the jobsite.

5600 Dwelling-Specific Health and Safety Hazards

5610 Emergency Situations

During the course of an audit or weatherization work, situations may be encountered which warrant immediate action; for example, the presence of fuel leaks, elevated CO levels, or a fire. Weatherization service providers shall be responsible for determining the safest and most prudent course of action should an emergency situation be encountered, including determining whether or not the client may safely remain in the dwelling. Utility providers and local jurisdictions may have specified emergency response protocols which shall be respected. Documentation of actions taken in the event of an emergency shall be maintained in the job file.

5620 Carbon Monoxide Poisoning

Carbon monoxide (CO) is an odorless, colorless, tasteless, and poisonous gas produced by incomplete combustion. Even limited exposure to high levels of CO or CO poisoning can result in serious illness and/or death. Due to the extremely hazardous nature of CO poisoning, weatherization service providers shall be

responsible for testing, identifying, documenting, and correcting conditions that contribute to CO levels inside dwelling units that are in excess of applicable standards listed herein.

Ambient CO measurements shall be taken in *all* homes regardless of the fuel sources in use, including homes with all electric systems and appliances.

All fuel-fired appliances including, but not limited to, furnaces, boilers, domestic water heaters, cooking appliances, and clothes dryers shall be safety tested using allowable combustion testing methodology and diagnostic equipment. Direct-vent appliances need not be draft tested, but ambient CO levels shall be tested as a matter of precaution. All combustion appliances present in the dwelling, regardless of age or date of installation, shall be tested at specified intervals per applicable standards for combustion testing referenced herein.

The results of all CO testing performed, as well as the details of any actions taken to correct elevated CO levels, shall be documented in the job file.

5621 Carbon Monoxide Alarms

Not less than one properly functioning carbon monoxide alarm shall be present on each level of a weatherized dwelling. Existing carbon monoxide alarms that are functioning properly at the time of the initial audit shall not be replaced. Where installed, carbon monoxide alarms shall be equipped with:

A) A digital liquid crystal display (LCD)
B) An alarm capable of producing 85 decibels at a distance of 10 ft
C) An electrochemical sensor with a warranty of not less than 5 years.

Excepting instances where the Installation Standards shall conflict with manufacturer specifications or local codes, carbon monoxide alarms to be existing post-weatherization shall be installed such that the devices are:

A) Located not less than 15 ft away from any fuel-fired appliance
B) Located as close to the main sleeping area as possible
C) Not located in proximity to high moisture areas such as bathrooms
D) Located at the optimal height as specified by the device manufacturer.

As of the effective date of the Installation Standards, NC WAP is unaware of any combination unit that meets the minimum applicable standards for both carbon monoxide and smoke alarms as listed herein. Combination carbon monoxide/smoke alarms that meet the minimum standards for both devices listed herein (should such devices be become available in the future) shall be allowable.

Weatherization service providers shall ensure that clients are well educated regarding the purpose and operation of carbon monoxide alarms, the actionable carbon monoxide levels for their device, and the appropriate safety precautions to take, should an alarm occur.

5630 Fire Hazards

Weatherized dwellings shall be inspected for conditions which pose potential fire hazards. Reasonable efforts shall be made to eliminate existing or potential fire hazards where encountered. Eliminating many potential fire hazards can often be accomplished through greater client education with relatively limited resource expenditures. Installation of fire extinguishers shall be allowed on a limited case-by-case basis in dwellings where compliant solid-fuel burning appliances (wood, pellet, or coal) are present and where the extinguishers provided are appropriate for the purpose intended.

5631 Smoke Alarms

Not less than one properly functioning smoke alarm shall be present on each level of a weatherized dwelling. Devices shall be equipped with a 10-year lithium ion battery. Existing smoke alarms that are functioning properly at the time of the initial audit shall not be replaced.

Excepting instances where the Installation Standards shall conflict with manufacturer specifications or local code requirements, smoke alarms to be existing post-weatherization shall be installed at the optimal height as specified by the device manufacturer.

As of the effective date of the Installation Standards, NC WAP is unaware of any combination unit that meets the minimum applicable standards for both smoke and carbon monoxide alarms as listed herein. Combination smoke/carbon monoxide alarms that meet the minimum standards for both devices listed herein (should such devices be become available in the future) shall be allowable.

Weatherization service providers shall ensure that clients are well educated on the operation of any smoke alarm installed as well as on appropriate safety precautions to take, should an alarm occur.

5640 Electrical Hazards

A) Knob and Tube Wiring

Knob and tube wiring present in a weatherization-eligible dwelling shall be inspected by a licensed electrician prior to any weatherization work being performed in the affected area. Actions required to ensure code compliance, as well as occupant and weatherization personnel safety when working in areas with existing knob and tube wiring, may include full or partial replacement.

A licensed electrician shall inspect each dwelling component (attic, walls, and floor) where knob and tube wiring is present and shall document in writing the condition of the wiring observed. The electrician shall further make a determination certifying any action required in order for weatherization work (including insulation) to safely proceed. If a licensed electrician determines, based on conditions observed or applicable local code requirements, that the knob and tube wiring or any portion thereof must be replaced, and replacement of the wiring is cost prohibitive based on applicable health and safety expenditure guidelines and resources available, no insulation shall be installed in the areas where the knob and tube wiring is located; however, air sealing and related work may still be performed.

Copies of electrical inspections and certifications shall be provided to the property owner, be posted at the dwelling where required by code, and shall be maintained in the job file.

B) Junction Boxes

Electrical connections throughout the weatherized dwelling, where exposed, shall be placed inside covered, code compliant, electrical junction boxes by a licensed electrician. The location of junction boxes shall be flagged when concealed beneath insulation or other weatherization materials or measures.

C) Aluminum Wiring

Dwellings constructed between 1965 and 1973 must be inspected for the presence of single strand aluminum wire. Aluminum wiring can combine with the oxygen in the air and form a coating on the wire that resists the flow of electricity. This resistance can cause the wires to overheat which may lead to a fire. Aluminum wiring can be identified in the following ways:

A) The color of aluminum (whitish in color);
B) Wiring-device binding terminals are CO/ALR, which stands for “copper/aluminum revised."; or
C) "Aluminum" or the initials "AL" are printed in embossed letters the plastic wire jacket.

Dwellings with aluminum wiring must be deferred.

5650 Materials Containing Asbestos

Asbestos is the name given to a naturally occurring group of minerals composed of tiny, easily inhaled fibers. Common building materials where asbestos may be encountered include floor tile, linoleum or sheet vinyl, cement siding, roofing, pipe insulation, sprayed-on fireproofing, and decorative ceiling treatments. Weatherization work may disturb building materials containing asbestos. Such disturbances can result in the production of dust containing asbestos (friable asbestos) which may contaminate a structure.

Weatherization service providers shall be responsible for ensuring weatherization personnel possess adequate training and knowledge to enable them to properly identify asbestos encountered during initial dwelling audits. Where asbestos is identified, weatherization service providers shall ensure that all weatherization program services subsequently provided comply with applicable state regulations as specified by the North Carolina Asbestos Hazard Management Program (AHMP) administered by the Health Hazards Control Unit (HHCU), as well as the Installation Standards and applicable local codes. Where the Installation Standards, AHMP regulations, and applicable local codes conflict, the more stringent standard shall govern.

Asbestos management measures undertaken in compliance with state and local regulations and using weatherization program resources shall be limited in scope. Where undertaken, asbestos testing, encapsulation, or removal activities shall be restricted to only the scale or scope required to provide for safe installation of weatherization measures. For example, removal of a limited portion of exterior siding material to allow for safe installation of a properly vented range hood exhaust fan shall be allowed. Removal of the exterior siding material from an entire dwelling shall not be allowed. The scope of allowable asbestos management measures shall, additionally, not exceed the following limits:

A) Siding/Ceiling/Wall Coverings- removal of materials where *supervised* by an appropriately trained or Asbestos Hazard Emergency Response Act of 1986 (AHERA) certified asbestos control professional*

B) Vermiculite – testing and encapsulation where *performed* by an appropriately trained or AHERA certified asbestos control professional. Removal shall not be allowed. Blower door testing is discouraged. Where performed, pressurization rather than depressurization shall be mandated*

C) Ducts/Pipes/Furnaces/Other – testing, encapsulation, or removal on a case-by-case basis, where *performed* by an appropriately trained or AHERA certified asbestos control professional.* Blower door testing shall be performed only after removal is complete.

*Material categories specified in items A-C of this section shall be treated as containing asbestos unless testing conclusively determines otherwise.

The AHMP is additionally responsible for accrediting individuals performing asbestos management activities such as inspection, design, and removal; approving asbestos training courses; issuing permits for asbestos removal projects; inspecting asbestos removal projects; and related functions. The AHMP shall be consulted for information on the management of asbestos-containing materials and can be reached at (919) 707-5950 or http://www.epi.state.nc.us/epi/asbestos/ahmp.html.

5660 Lead Dust Exposure

Common construction-related activities including, but not limited to, sanding, cutting, and demolition can create hazardous lead dust and chips by disturbing lead-based paint, which can be harmful to adults and children.

To reduce potential lead exposure risks, organizations performing renovation, repair, and painting projects that disturb lead-based paint in homes, childcare facilities, and schools built before 1978 shall be certified and shall follow specific work practices to prevent lead contamination.

A) Renovate Right
Weatherization service providers shall be responsible for compliance with the Environmental Protection Agency's (EPA) Lead RRP Rule; "Lead Hazard Information Pamphlet"; Notice of Availability; Final Rule, and with the requirements of the EPA's "Renovate Right: Important Lead Hazard Information for Families, Child Care Providers, & Schools" publication.

All dwellings built prior to 1978 shall be *assumed* to contain lead-based paint, and thus weatherization service providers shall be responsible for ensuring compliance with lead-safe work practices wherever weatherization measures with the potential to disturb lead-based paint shall be performed in such dwellings. *De minimus* lead levels shall not be recognized and lead testing shall not be allowed.

Weatherization service providers shall further be responsible for complying with mandatory documentation requirements for lead-safe work practices including, but not limited to, photographic documentation of jobsite and containment set up, a listing of materials used and measures performed, and identification of the certified lead renovator assigned to the job.

B) Lead-Safe Weatherization
Lead-safe weatherization (LSW) is a set of protocols based on federal EPA and Occupational Safety and Health Administration (OSHA) regulations, applied when disturbing surfaces that may contain lead-based paint, and is intended to reduce and control the amount of lead dust and paint chips generated. LSW shall apply to all weatherization services providers administering the WAP and specific training shall be required.

While LSW should not be confused with the EPA's RRP Rule, for the purposes of compliance with the Installation Standards compliance with the RRP Rule, any additional NC WAP guidance, and local codes shall constitute compliance with LSW protocols.

5670 Radon Gas

Radon is a naturally occurring, colorless, odorless, tasteless, cancer-causing, radioactive gas found throughout the United States and can permeate the walls of any building type. Radon can only be confirmed by testing, which is generally inexpensive and noninvasive.

The EPA is charged with identifying areas of the United States with an increased potential for elevated indoor radon levels, and small portions of Western and Central North Carolina have been designated as

"Radon Risk Areas". Weatherization service providers shall consult the EPA's website at http://www.epa.gov/radon/states/northcarolina.html for a map of the EPA's designated Radon Risk Zones to identify impacted counties.

Allowable radon safety measures include testing, client education, and compliant vapor barrier installation in NC counties designated as either:

A) Red - High Potential Radon Risk Area (*testing recommended*)
B) Orange - Moderate Potential Radon Risk Area (*testing allowable*).

Weatherization service providers serving radon risk areas shall be responsible for educating clients on the potential presence of radon, associated health conditions, results from testing performed on the dwelling, and living conditions that may contribute to higher radon concentrations.

5700 Mold and Moisture Remediation

Mold and mildew can pose serious potential health hazards for dwelling occupants. Weatherization service providers shall be responsible for ensuring steps are taken to alleviate moisture problems wherever feasible. All weatherization-eligible dwellings shall be inspected at the time of initial audit to determine that only minor moisture damage or mold growth, if any, is present. Where severe mold or moisture problems exist, the dwelling shall be placed in deferral status until such time as the conditions can be corrected.

Visual assessment as well as diagnostics techniques such as the use of moisture meters shall be recommended both at the time of the initial audit and again during the final inspection. Mold testing shall not be allowed.

5710 Mold Treatment Limitations

Where existing mold growth is determined to affect greater than 10 ft^2 of surface area within a dwelling interior, crawlspace, or attic, the dwelling shall be placed in deferral status and no weatherization program services shall be provided. Where areas of 10 ft^2 or fewer exist, the affected area shall be treated prior to proceeding with any subsequent weatherization work.

Every individual remaining in the work area during treatment shall be equipped with a minimum N-95 respirator, leak-proof eye protection, and protective gloves and clothing. The work area shall be well ventilated and the mold-affected area shall be scrubbed clean using a brush, water, and a household detergent.

5720 Dryer Exhaust Venting

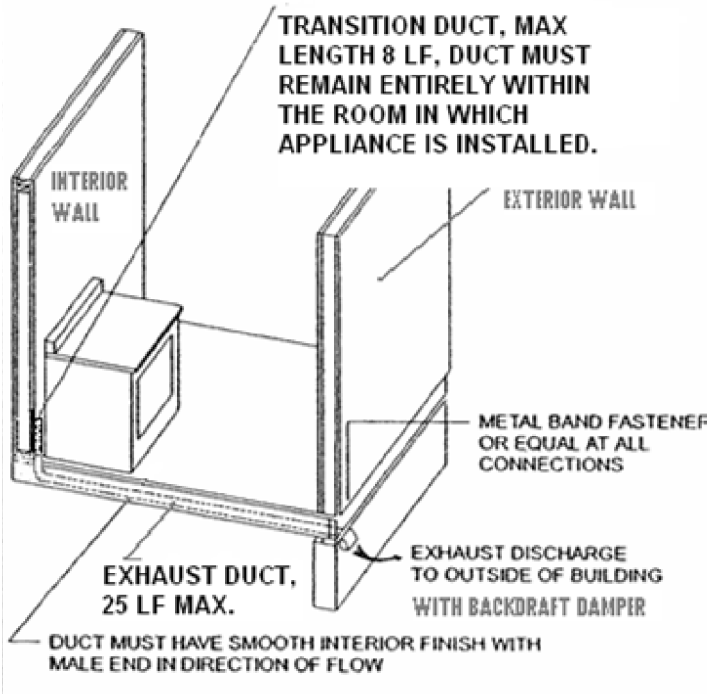
Exhaust venting for clothes dryers shall be installed or repaired as needed to ensure that warm, moist air exhausted during the drying cycle is properly vented to the outdoors in every dwelling weatherized.

Dryer exhaust venting shall:

A) Move moisture beyond the perimeter of the dwelling (crawlspace, basement, other)
B) Consist of rigid metal pipe

C) Be as straight as possible and span the minimum length required when taut to exit the exterior of the dwelling, but shall never exceed 25 ft
D) Be properly supported to avoid loops or sags
E) Be fitted with an outdoor hood and backflow damper
F) Not contain more than two total elbows (, elbow shall count as 5 ft of run length)
G) Not consist of sections secured using screws.

Dryer Exhaust Venting Exiting Through Exterior Wall Diagram



Dryer exhaust venting exiting the dwelling through crawlspace vents shall pass completely through the vent opening, be fitted with a draft hood and backflow damper, and any excess space remaining at the opening shall be filled with a rigid sheet-good and sealed to prevent moisture from blowing back into the crawlspace.

5730 Vapor Barriers

A continuous vapor-retarding ground cover or vapor barrier shall be installed in all enclosed, accessible, crawlspaces beneath conditioned space to prevent the diffusion of soil moisture into the dwelling or building materials.

Vapor barriers installed shall:

A) Consist of not less than a 6 mil polyethylene sheet-material
B) Be opaque or non-translucent to decrease UV light transmittance that may promote material-deteriorating conditions beneath the barrier
C) Extend up the crawlspace walls and piers not less than 6 in.
D) Be continuous with sealed overlapping seams of not less than 6 in.
E) Be firmly mechanically fastened to perimeter walls and interior piers using a power actuated fastener/washer combination or nylon fasteners (with a pre-drilled hole), not less than 1 inch in length and head diameter. Butyl tape (or, a non-water-based exterior grade sealant must be used to complete the seal

Where unconditioned spaces such as porches or decks with permanent foundations are attached to enclosed crawlspaces beneath conditioned areas of the main dwelling, an artificial wall shall be constructed between the crawlspace areas beneath conditioned and unconditioned spaces to separate the areas and allow for continuous installation of the vapor barrier. The barrier may be secured to flooring members where appropriate to create an artificial wall between spaces. The artificial wall shall be equipped with an access that can be removed and later resealed in a manner which maintains the sealed integrity of the vapor barrier.

5740 Moisture Diversion

Major drainage issues are beyond the scope of WAP services. Minor repair or installation of gutters, downspouts, drainage extensions, and/or flashing to divert moisture away from the foundation of a weatherized dwelling, as well as corrections to the grade of the landscape and installing trenches shall be allowed on a limited case-by-case basis.

Weatherization service providers shall be responsible for ensuring the use of weatherization program resources to correct drainage-related issues is justified and well documented. A lack of compelling evidence justifying the need for drainage-related work may result in expenditures for such work being disallowed.

5800 Indoor Air Quality and Modified ASHRAE 62.2-2010

Weatherization-eligible dwellings are often susceptible to poor IAQ conditions. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international organization with the mission of advancing heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world through research, standards writing, publishing, and continuing education.

The American National Standards Institute (ANSI)/ASHRAE Standard 62.2-2010, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*, is the only nationally recognized IAQ standard developed solely for residences. It defines the roles of, and minimum requirements for mechanical and natural ventilation systems and the building envelope intended to provide acceptable IAQ in low-rise residential buildings.

All weatherized dwellings up to three stories shall be supplied with adequate whole house mechanical ventilation in compliance with modified ASHRAE Standard 62.2-2010 (ASHRAE 62.2). Weatherization service providers shall be responsible for ensuring that a properly trained member of weatherization personnel or management determines the accurate calculation of the required rate of ventilation per dwelling for every dwelling weatherized using the following standard equation:

$$Q_{fan} = \left[0.01 \times \_(A_{floor}) + 7.5 \times (\_N_{br} + 1)\right] + \left[.25 \times \_CFM_{Fan\ Deficient}\right] - \left[0.5 \times (\frac{\_(CFM_{50})}{\_(N)} - \frac{2\_(A)_{floor}}{100})\right]$$

Where

Q_{fan}	*= Calculated required continuous flow rate in CFM*
A_{floor}	*= Heated floor area in ft^2*
N_{br}	*= Number of bedrooms (cannot be less than 1)*
CFM_{50}	*= Blower door reading at -50 pascals*
$CFM_{Fan\ Deficient}$	*= Total amount of airflow from missing or underperforming local exhaust fans*
N	*= Energy Climate Factor (determined using standard factors)*

N-Values for Infiltration Credit (Saturn Resource Management)

North Carolina	1	1.5	2	2.5	3
Asheville	28.5	25.3	23.2	21.7	20.5
Cape Hatteras	20.9	18.5	17.0	15.9	15.1
Charlotte	26.6	23.6	21.6	20.2	19.1
Greensboro	27.3	24.2	22.2	20.8	19.7
Raleigh	27.3	24.2	22.2	20.8	19.7

5810 Ventilation Device Categories

Devices installed to achieve compliant ventilation levels shall include a combination of intermittent and continuous whole house ventilation (WHV) and local exhaust ventilation (LEV) fans. An LEV fan may be used to help achieve compliant WHV where the fan is rated for continuous use or is equipped with a timer.

Category A. Fans All kitchens containing a fuel-fired range shall be equipped with an intermittent LEV fan rated at less than 6.0 sones, with an installed airflow rate of not less than 100 cubic feet per minute (CFM). A range hood fan is recommended wherever feasible, but shall not be required. To increase the probability of uniform compliance with this standard, devices

installed in kitchens shall have a rated airflow, specified by the device manufacturer, of not less than 120 CFM.

Category B. Fans At least one full bathroom in every dwelling shall be equipped with a timer-equipped WHV fan with a sone rating of 1.0 or less and an installed airflow rate of not less than 50 CFM .

A) To increase the probability of uniform compliance with this standard, devices installed in bathrooms shall have a rated airflow specified by the device manufacturer of not less than 70 CFM.
B) Where two or more full bathrooms are present, *Category B. Fans* shall be located in the full bathroom located in closest proximity to the main living area.
C) When the fan exhaust duct is outside the conditioned space, *Category B. Fans* shall be insulated to R-4. Ducts shall be installed so as to minimize sagging. While smooth, hard metal pipe is optimal, flexible duct is acceptable.
D) Flex duct shall have a 5 in. diameter minimum; use the same diameter size for duct and hood/termination kits (do not use a reducer to the termination kit).
E) No more than two elbows shall be used. Where possible, elbows shall be of a long radius design.
F) Ducts shall be installed with the shortest possible run to minimize static pressure. While roof venting is preferred, gable and soffit venting is allowed, so long as the termination is on the outside of the gable/vent and properly installed to avoid crimping.

Category C. Fans Any remaining full bathroom requiring fan installation shall be equipped with an intermittent LEV fan meeting the same minimum CFM and sone specifications as *Category B. Fans*.

5820 Ventilation Evaluation and Implementation

Upon completion of all cost-effective air sealing measures, all fans present shall be metered and the need for additional ventilation, if any, shall be determined using applicable diagnostic standards listed herein for calculating adequate WHV. Where the need for whole house intermittent ventilation exists, *Category B. Fans* shall be calibrated as needed to provide the required airflow using the standard equation provided to calculate continuous flow, and the following chart to set intermittent fan flow.

NC Wx Intermittent Fan Flow Settings (CFM)										
		30	**35**	**40**	**45**	**50**	**55**	**60**	**70**	**80**
		Minutes Per Hour								
Continuous Fan Flow (CFM)	5	10	9	8	7	6	5	5	4	4
	10	20	17	15	13	12	11	10	9	8
	15	30	26	23	20	18	16	15	13	11
	20	40	34	30	27	24	22	20	17	15
	25	50	43	38	33	30	27	25	21	19
	30	60	51	45	40	36	33	30	26	23
	35		60	53	47	42	38	35	30	26
	40			60	53	48	44	40	34	30
	45				60	54	49	45	39	34
	50					60	55	50	43	38

Where a functioning fan existing in a kitchen is metered and determined to be performing at less than 100 CFM, efforts shall be made to correct deficiencies in the installation of the fan and venting to increase the flow. Where existing fan or venting cannot be repaired to achieve airflow of at least 100 CFM, such fans may be replaced with *Category A. Fans*. Where a kitchen is missing a fan and it is not feasible to either correct an underperforming fan or install a *Category A. Fan*, the amount of airflow deficiency shall be added to the *Category B. Fan* whole house runtime.

Where functioning fans existing in second or third full bathrooms are metered and determined to be performing at less than 50 CFM, efforts shall be made to correct deficiencies in the installation of the fan and venting to increase the flow. Where existing fans or venting cannot be repaired to achieve airflow of at least 50 CFM, such fans may be replaced with *Category C. Fans.* Where a bath is missing a fan or it is not feasible to either correct the underperforming fan or install a *Category C. Fan*, the amount of airflow deficient shall be added to the *Category B. Fan* whole house runtime.

Where fans shall be installed, to the extent practicable, efforts to install fans with features and attributes highly similar to the features and attributes of existing devices shall be allowable where such attempts are reasonable, and where such devices are in full compliance with all other standards listed herein. For example, existing, noncompliant, white, fan/light combinations shall be replaced with compliant, white, fan/light combinations wherever feasible. Fan/light combination devices shall be IC-rated. Devices that specifically include heat as a feature shall not be allowed. Installation of a compliant fan alongside an existing heat/light combination device shall be allowed.

Mechanical exhaust ventilation fans installed shall be installed per manufacturer specifications and with electrical connections performed by a licensed electrician. Fan controls shall be installed in the same room as the fan and fans rated for continuous operation shall be controlled by a dedicated switch. Bathroom exhaust venting shall be insulated to a minimum R-4. Kitchen exhaust venting shall be made of noncombustible materials but shall not be insulated. All fans to be existing post-weatherization shall be exhausted to the outdoors. *Under no circumstances shall installation or repair of recirculating fans be allowed, regardless of location or fuel sources present.*

The presence of materials containing asbestos covering ceilings or exterior walls or the presence of a metal roof shall not constitute justification for failure to comply with ventilation standards. Similarly, where moisture issues exist in areas of a dwelling not adequately served by mechanical ventilation as specified herein, weatherization service providers shall be responsible for identifying and addressing the need for additional intermittent or spot ventilation devices.

Weatherization service providers shall ensure that dwelling owners and occupants are educated on the rationale and requirement to provide adequate mechanical ventilation in every dwelling at the outset of the job, as well as proper operation and maintenance of all devices present. Documentation of actions taken to comply with this standard, including specification data for each fan installed, shall be maintained in the job file.

5900 Subgrantee Health and Safety Policy

Weatherization service providers shall have a written Health and Safety Policy designed to protect workers. Such policies shall be reviewed and updated as needed not less than once per year. A safety officer shall be designated and shall have primary responsibility for coordinating and enforcing health and safety policies and maintaining all related records and documentation. Mandatory health and safety meetings shall be conducted no less than once per month and shall be used to provide instruction on health and safety policy-related topics.

Subgrantee health and safety policies shall additionally apply to weatherization subcontractors and shall provide at minimum procedures for effectively addressing the following health and safety categories:

A) Occupational Safety and Health Administration (OSHA) Compliance
   a) all weatherization work to be performed shall comply with applicable OSHA regulations
   b) in accordance with this requirement, all crew members and/or subcontractors shall attend an approved OSHA 10-hour training course for construction safety
   c) all auditors/final inspectors shall be required to attend an approved OSHA 30-hour training course for construction safety.

B) Medical Emergency Procedures
   d) written procedures for reporting medical emergencies, including posting the poison control hotline telephone number (800-222-1222) in all vehicles
   a) written procedures for reporting non-emergency accidents and where to go for treatment
   b) provision of basic first aid training and Cardio Pulmonary Resuscitation (CPR) training for one or more members of each crew
   c) provision of one fully stocked first aid kit and eye-wash station provided per vehicle.

C) Personal Protective Equipment (PPE)
   a) provision of properly fit-tested personal respiratory protection equipment for every field employee
   b) provision of training to employees on proper respirator use and maintenance
   c) provision of medical examination of pulmonary capacity at the frequency recommended by OSHA standards
   d) provision of eye protection, gloves, and protective clothing

e) provision of ear protection provided to personnel performing work near high decibel equipment or in high dust environments
f) provision of head injury protection, including hard hats or bump caps for every field employee.

D) Hazardous Material Safety
a) provision of personnel training on hazardous material identification and handling procedures to include lead, asbestos, radon, and all chemicals used on the job
b) precautions to ensure proper treatment and disposal of hazardous materials are used on all jobsites
c) provision of catalog of Material Safety Data Sheets (MSDS) for all hazardous materials available on all jobs sites that contains all legally required safety data and actions required in the event of chemical exposure
d) provision of personnel training ensuring the ability to read and interpret chemical container labels and MSDS
e) precautions to ensure that legible and prominent labels shall be used on all chemical containers identifying chemical contents, appropriate application, and necessary precautions.

E) Fire Safety
a) provision of fire extinguishers in each vehicle that are inspected/charged as needed
b) provision of personnel training on fire emergency procedures and fire extinguisher use.

F) Tool and Equipment Safety
a) precautions to ensure that tools and equipment provided are safe and adequate for the job
b) provision of ground-fault protection available for use with all power tools
c) provision of personnel training in the safe and proper operation of tools and equipment used in their work
d) precautions to ensure ladders and scaffolding provided are adequate for the required task, have the proper weight rating, and are constructed of non-conductive material.

5910 Prohibition on Smoking and Tobacco Use

NC WAP funded jobsites and vehicles shall at all times be smoke and tobacco-free environments. Cigarette smoking or the use of other tobacco products including, but not limited to, pipes, cigars, snuff, or chewing tobacco by weatherization personnel or subcontractors shall not be allowed on any portion of a weatherization jobsite. A weatherization jobsite shall include the dwelling and the surrounding property on which the weatherized dwelling is located. Use of tobacco products of any type shall also be prohibited inside any vehicle owned, leased, or rented by a weatherization service provider. Failure to adhere to limitations on the use of tobacco products on weatherization jobsites or in WAP funded vehicles may result in administrative action.

6000 Diagnostic Testing Procedures

Dwelling-specific diagnostic testing shall be conducted on every dwelling weatherized, both at the time of initial audit and as mandated thereafter.

Weatherization service providers shall ensure that weatherization field personnel including, but not limited to, auditors, weatherization installers, inspectors, and subcontractors possess appropriate equipment and training to properly perform all required diagnostic testing.

Pre, interim, and post-work diagnostic tests shall be conducted at specified intervals throughout the weatherization process per the specifications listed herein, and in compliance with instructions for completing applicable components of the standard NC WAP energy audit tool or workbook. Documentation of test types performed, test readings, and the identity of the individuals performing tests shall be maintained in the job file.

Diagnostic test types and guidelines listed herein shall not be considered exhaustive. Allowable diagnostic procedures not listed herein shall be performed where required to maximize the potential benefits of energy efficiency measures installed or to maintain the health and safety of the dwelling and its occupants.

6100 Pre-Diagnostic Inspections

Prior to conducting diagnostic testing a full dwelling inspection shall be completed to identify and document pre-test dwelling conditions, including potential health and safety hazards. Appropriate diagnostic tests and testing methods shall then be determined and conducted based on the specific conditions observed within the dwelling.

Potentially hazardous dwelling conditions requiring special consideration and caution prior to conducting diagnostic testing include, but shall not be limited to, the presence of:

A) Building materials suspected to contain friable asbestos, including vermiculite-based attic insulation
B) Mold, excessive moisture issues, or biological hazards, including raw sewage
C) Dwelling occupants with preexisting health conditions which testing may exacerbate.

The limiting conditions listed above shall not be considered exhaustive. Diagnostic testing shall cease or be postponed wherever dwelling conditions that may pose an immediate safety hazard are identified or where conditions observed necessitate that the dwelling be placed on deferral status.

6200 Blower Door Diagnostics

Blower door diagnostics shall be performed using a blower door fan to create a specific, sustained pressure difference between two spaces for the purposes of diagnosing air leakage or connectivity between the spaces.

6210 Blower Door Guided Air Sealing

The blower door (used in concert with a digital manometer or pressure and flow gauge) is a building performance diagnostic tool used for the purpose of identifying air leakage or infiltration. Blower-door-guided air sealing and related blower door diagnostics shall be performed using either the pressurization or the depressurization test set-up.

Blower-door-induced dwelling depressurization has the ability to draw contaminants into the living space; therefore, it is vital that a complete inspection of the dwelling be performed prior to conducting blower door testing. Identification of specific dwelling conditions may necessitate use of pressurization testing versus depressurization testing to avoid exposing the dwelling and occupants to potential adverse effects resulting from blower door testing including, but not limited to, conditions listed in section 6100 of this Chapter.

Blower door testing shall be performed based on a sustained 50 Pascal (Pa) pressure difference in the dwelling with reference to (WRT) the outdoors, measured using a digital manometer. Airflow readings measured in CFM shall be adjusted as needed where a 50 Pa. pressure difference cannot be established by using either the " Can't Reach Fifty" multiplier or use a manometer that makes this conversion automatically.

Testing procedures for pressurization testing require some alterations to the test set up in addition to reversing the direction of the airflow per manufacturer instructions for the particular device model in use. Exhaust vent dampers (bathroom, kitchen, and dryer) must be temporarily blocked to insure accurate readings.

6220 Zonal Pressure Diagnostics

ZPD shall be performed at intersections between the intentionally conditioned main body of a dwelling and areas where unintentional connections with unconditioned spaces most often occur including, but not limited to, areas such as:

A) Garages
B) Basements
C) Additions
D) Dropped soffits
E) Bath or shower enclosures
F) Upper or lower floor levels.

Example: Where a basement has a zonal pressure reading not higher than 10 Pa WRT the main body, insulating ductwork would not be required in the basement.

Test holes or penetrations drilled or cut into the dwelling shell to perform ZPD shall be located in inconspicuous areas such as closets, utility rooms, or other areas where holes are least likely to be visible post-work. Penetrations made in ceilings or floors shall be located as close to the perimeter of the dwelling as possible and where feasible shall not be located in living or dining rooms.

Use of test probes with diameters less than that of standard wire clothes hanger shall be recommended. For post-testing, holes shall be patched with a caulking material similar in color to the drilled or cut surface. Use of similarly colored plastic plugs or “buttons” for repairing test penetrations shall also be allowed.

6230 Duct-Tightness Testing

Duct-tightness testing shall be conducted in every weatherized dwelling where a ducted distribution system is present. Distribution systems shall be carefully visually inspected, including operation of the associated air handler to identify leakage in the system, in addition to conducting duct-tightness testing using the blower door and pressure pan/duct mask method. Pressure readings shall be recorded for all supply and return registers.

Accessible portions of active duct distribution systems shall be sealed to a tightness of 1.0 Pa or below, as measured with the blower door depressurizing the dwelling to 50 Pa and ducts measured WRT the dwelling. Where compliant test pressures of 1.0 Pa are not achieved, justification for the failure shall be documented in the job file. A Pressure Pan Multiplier shall be applied where ductwork is located in an area with a 45 Pa or lower pressure difference WRT to the dwelling in order to normalize measurements based on the lack of pressure difference between the two spaces.

Abandoned duct distribution systems shall be closed off from the dwelling and sealed to restrict airflow between conditioned and unconditioned space with the goal of limiting pressure variations between the two spaces to as near zero (0.0 Pa) as possible.

6300 Duct Induced Room Pressure Testing

Room-to-room duct-induced pressure testing shall be conducted in every weatherized dwelling where an active ducted distribution system is present. Room-to-room pressure readings shall not deviate more than plus or minus 3.0 Pa WRT the outdoors. Where induced pressure readings exceed 3.0 Pa WRT outdoors, one or more of the following corrective measures shall be required:

A) Undercutting doors
B) Adding pass-through vents above doors
C) Adding jump-over ducts between rooms
D) Adding return air to the room (performed only by licensed HVAC technicians on a limited case-by-case basis).

Where dwelling owners fail to authorize installation of standard corrective measures for providing room pressure relief, written documentation of the measures proposed and the signature of the dwelling owner declining the measures shall maintained in the job file.

6400 Exhaust Fan Flow Meter Diagnostics

All functioning exhaust fans located in weatherized dwellings shall be metered pre and post-work using an approved fan-exhaust metering device. Existing re-circulating fans shall either be corrected to exhaust to the outdoors or shall be replaced as part of the weatherization process and therefore need not be metered at the time of audit.

Fans present in weatherized dwellings shall comply with following measured airflow CFM requirements:

A) At least one intermittent kitchen fan shall exhaust not less than 100 CFM
B) Fans installed in full bathrooms (intermittent and continuous) shall exhaust not less than 50 CFM; existing fans remaining in full bathrooms post-weatherization shall exhaust not less than 25 CFM.

Where existing exhaust fans are determined to be providing less than the required minimum CFM, the following corrective measures shall be performed:

A) Fan shall be checked to ensure it is installed per manufacture specifications and corrected where installed incorrectly
B) Fan shall be cleaned to ensure it is free of debris or obstructions
C) Fan exhaust venting shall be repaired or replaced to achieve the shortest and straightest run possible.

Upon completion of all cost effective air sealing measures, all fans present shall be re-metered and the need for continuous ventilation, if any, shall be determined. Where the need for additional ventilation exists, the WHV fan shall be calibrated as needed to provide the required CFM of additional airflow based on specifications provided in section 5800.

6500 Combustion Analysis

Combustion analysis shall be performed in every weatherized dwelling where fuel-fired or combustion appliances are present. Applicable combustion analysis inspection and diagnostic requirements shall include *at minimum* the following procedures where applicable:

A) Fuel Supply Inspection—the fuel supply for all liquid or gas-fired appliances shall be tested for leaks and addressed as needed prior to additional system testing.

B) Exhaust Venting Inspection—exhaust venting systems shall be inspected to ensure systems are suitable for the heating unit type and location where installed. Venting shall be properly sized, material types shall be appropriate, vent pipe condition shall be satisfactory, clearances shall meet applicable codes, and the vent system shall unobstructed.

C) Combustion Air Supply—an adequate combustion air supply shall be provided for all combustion appliances located in weatherized dwellings as mandated by the Installation Standards and National Fire Protection Association (NFPA) code. Where additional combustion air is required, the following minimum combustion air supply limitations shall apply:

    a) where combustion air is obtained from the house, 1 square in. of net free area per 1,000 Btu of output shall be allowed.
    b) where combustion air is obtained from the outdoors via a vertical pipe, 1 square in. of net free area per 4,000 Btu of output shall be allowed.
    c) where combustion air is obtained from the outdoors via a horizontal pipe, 1 square in. of net free area per 2,000 Btu of output shall be allowed.

    Combustion air shall be provided using a high/low orientation where one source is located 12 in. from the floor and another source is located 12 in. from the ceiling. Obtaining additional combustion air from both the living space and from the outdoors shall be prohibited. Use of a

combination of the above listed remedies shall be allowed.

D) Steady State Efficiency (SSE)—SSE testing shall be performed on all vented combustion heating systems to determine whether systems are functioning at or near the rated or peak efficiency for the particular unit type. SSE is tested in conjunction with CO or draft tests and is measured automatically using a combustion analyzer.

SSE readings recorded shall reflect the efficiency percentage for the unit under ideal conditions, or as measured once the system has been operating long enough to reach steady state. Steady state has typically been reached when stack temperatures increase by not more than 2 degrees Fahrenheit (°F) in 60 seconds. SSE test readings coupled with CO, Oxygen, and stack temperature readings may provide clues as to the cleaning or tuning needs for a heating unit.

HEATING UNIT/SYSTEM TYPE	COMMON STEADY STATE EFFICIENCY RANGES BY SYSTEM TYPE (%)*
High-Efficiency Condensing	*85 - 95 %*
Powered Boiler	*75 - 85 %*
Oil Burner System	*70 - 85 %*
Low-Efficiency Atmospheric	*70 - 80 %*
Vented Space Heater	*50 - 80 %*
*Rates shall be used for reference purposes only and shall not define "pass" or "fail" for any unit type.	

E) Carbon Monoxide Testing— ambient CO levels shall be monitored upon entering dwellings and throughout the testing period for all appliances to ensure safe CO levels are not exceeded. Ambient CO levels of 9 parts per million (ppm) or greater shall require immediate action to identify and correct the problem prior to resuming system testing. The maximum allowable post-work ambient CO levels in weatherized dwellings shall be 9 ppm.

CO levels in undiluted flue gases shall be tested on all vented combustion appliances. Where CO levels in undiluted flue gasses are measured at 100 ppm or greater, immediate action shall be taken to identify and correct the deficiency prior to resuming testing.

CO levels shall be tested in association with all unvented combustion space heaters. Tests shall be conducted by holding the test probe at or near the unit while firing and shall be measured based on the 9 ppm maximum for ambient CO levels.

Carbon Monoxide Readings in Parts per Million (Diluted)	Allowable Carbon Monoxide Action Levels for *Flue Gases and Fuel-Fired Cooking Appliances*
	Action Required
100 - 400 ppm	Notify occupants immediately and in writing. The system must be serviced and the issue is corrected.
> 400 ppm	Weatherization work may not proceed until the system is serviced and issue is corrected. Retesting required.

F) Draft Testing—a worst-case depressurization draft test shall be conducted on all liquid or gas-fired

appliances to ensure allowable draft pressures for the venting system can be sustained under worst-case conditions, enabling combustion gases to be safely exhausted from the dwelling.

Heating Unit and Venting System Type	Allowable Draft Reading for Worst Case Draft Tests at Listed Outdoor Temperatures (°F)				
	<20	21-40	41-60	61-80	>80
Atmospherically Vented Fuel-Fired Furnace or Water Heater	-5.0 Pa -0.020 in. wc	-4.0 Pa -0.016 in. wc	-3.0 Pa -0.012 in. wc	-2.0 Pa -0.008 in. wc	-1.0 Pa -0.004 in. wc
Fuel Oil Furnace	-15.0 Pa -0.06 in. wc	-13.0 Pa -0.053 in. wc	-11.0 Pa -0.045 in. wc	-9.0 Pa -0.038 in. wc	-7.0 Pa -0.030 in. wc

6510 Draft and Carbon Monoxide Testing Locations by System Type

A) Sealed Combustion or Power Vented (90% +)—No draft measurement shall be required and no holes shall be drilled in flues for power vented or sealed combustion units. CO levels shall be measured at the exterior outlet of the flue. Where it is deemed unsafe to access termination points for testing due to the height of the roof, testing requirements shall be waived; but such situations shall be documented in the job file.

B) Atmospheric or Natural Draft (70%)—Draft testing shall be conducted in the center of the longest straightest accessible section of the vent connector. Holes drilled in order to measure draft shall be drilled using a 5/16th drill bit. Post-testing, holes shall be plugged using a 3/8 in. stainless steel or nylon tap bolt and sealed with high-temperature 100% Room Temperature Vulcanizing (RTV) silicone caulk. To ensure a tight seal, plug bolts shall be coated with high-temperature silicone prior to being placed. CO testing shall be conducted at the heat exchanger cell outlets in undiluted flue gases.

C) Induced Draft (80%)—Draft testing shall be conducted a minimum of 3 ft down-flow from the inducer motor. Holes drilled to measure draft and CO (single location for both tests) shall be drilled using a 5/16th drill bit. Post-testing, holes shall be plugged and sealed in the same manner as holes on atmospheric or natural draft devices.

Care shall be taken by weatherization personnel to ensure that holes drilled for testing purposes are consistently as close to 5/16 in. in diameter as possible both for purposes of repeat testing and ease of plugging such holes using standard ***3/8 in. stainless steel*** *or* ***nylon tap bolts.*** *Care shall additionally be taken to ensure that holes are well plugged and sealed, particularly holes drilled through the inner liner of B- vent piping both for reasons of manufacturer warranty and local code compliance.*

A diagram depicting common heating unit types and testing locations may be referenced at the end of this chapter.

6520 Fuel-Fired Cooking Appliance Testing and Repair

Fuel-fired cooking appliances, specifically range-top and oven burners, shall be tested to ensure appliances are not emitting unsafe levels of CO. Where unacceptable CO levels are detected, servicing or repairing appliances shall be allowed. Under no circumstances shall cooking appliance replacement be allowed.

Maximum allowable CO levels for fuel-fired range-top and oven burners:

A) Range-top burners - 25 ppm as measured
B) Oven burners - 100 ppm as measured or 400 ppm air-free.

A) Range-Top Burners—each range-top burner assembly shall be tested separately by firing the burner and reading the associated CO level after four minutes of continuous operation. Measurements shall be taken with the test probe located approximately 6 in. above each operating burner.

   Where initial test readings are 25 ppm or greater as-measured, corrective actions shall include but not be limited to:

   a) Inspecting burners for obstructed ports
   b) Servicing of the appliance by a repair professional trained and certified to service the *brand* of appliance in use
   c) Retesting the burner CO levels post-cleaning
   d) Educating occupants on burner cleaning and maintenance procedures where applicable.

B) Oven Burner—primary fuel and liquid-fired oven burner assemblies shall be tested. Testers shall ensure that all cooking utensils, protective pans, or aluminum foil are removed from the oven. Primary oven burners shall be fired on the highest baking-mode temperature setting. Broil-mode temperature settings *shall not* be used during oven testing; where present, separate broiler burner assemblies shall be excluding from testing.

   After approximately ten minutes of operating time, test probes shall be inserted into oven exhaust vents at a depth that enables testing of the undiluted exhaust gases. CO levels customarily peak just after burner firing and then fall to a momentary plateau prior to the burners shutting down as part of the duty cycle. CO readings recorded shall be taken during this stable plateau.

   Where initial test readings are 100 ppm or greater as-measured or 400 ppm air-free, corrective actions shall include but not be limited to:

   a) Identifying and removing obstructions in secondary air supply
   b) Servicing of the appliance by a repair professional trained and certified to service the *brand* of appliance in use
   c) Confirming burner is in alignment and leveling the entire appliance where applicable
   d) Educating occupants on how to clean the flame plate where applicable.

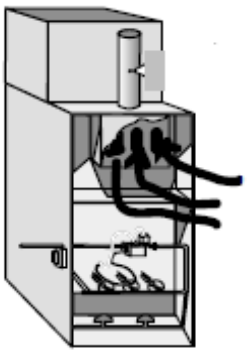
   Where servicing or repair work is necessary and is determined to be unfeasible or cost-prohibitive, the dwelling shall be placed on deferral status until the hazard condition can be corrected.

6530 Fuel-Fired Clothes Dryer Testing and Repair

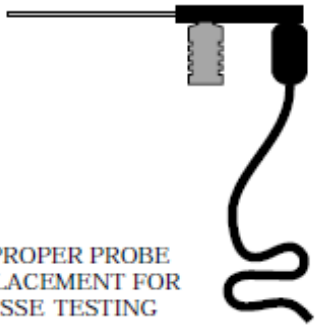
Fuel-fired clothes dryers shall be inspected for proper operation including, but not limited to, gas leak testing and testing ambient CO levels in the room in which the dryer is located and at the exhaust hood located outside of the dwelling.

Where unacceptable CO levels are detected, servicing or repairing appliances shall be allowed. Where servicing or repair work is necessary and is determined to be unfeasible or cost-prohibitive, the dwelling shall be placed on deferral status until the hazard condition can be corrected. Under no circumstances shall clothes dryer replacement be allowed.

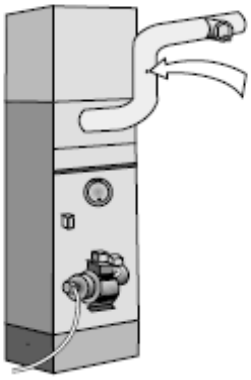
Common Heating Systems and Combustion Testing Locations



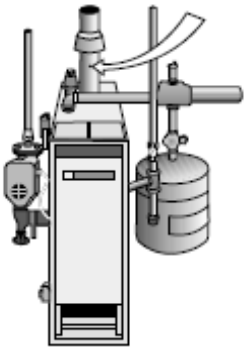
Atmospheric Furnace



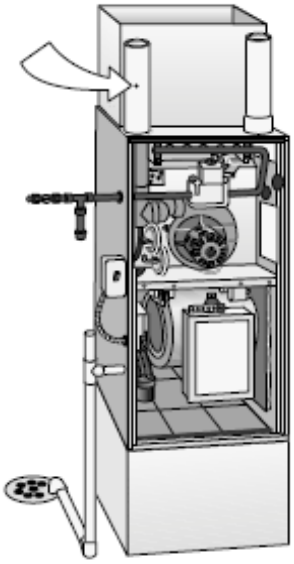
PROPER PROBE PLACEMENT FOR SSE TESTING



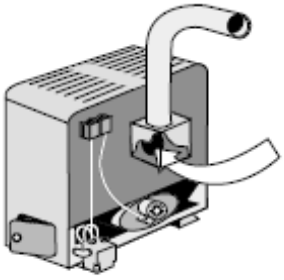
Fuel Oil Furnace



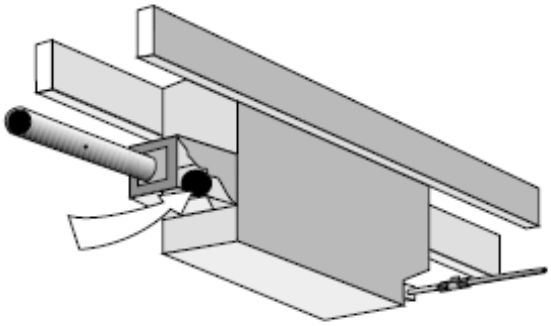
Atmospheric Boiler



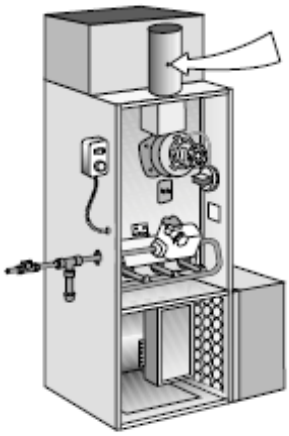
90+ Condensing Furnace



Space Heater



Floor Furnace



80+ Induced-draft Furnace

7000 Heating, Ventilating, and Cooling Systems

Improperly functioning HVAC systems often contribute to serious adverse conditions in low-income dwellings including, but not limited to, moisture and mold growth, CO poisoning, fire hazards, and increased heating and cooling expenses. Each of these serious potential conditions may be exacerbated by weatherization work where steps in the weatherization process are skipped or poorly performed, putting both the dwelling and the dwelling occupants at risk. Guidance issued in this section shall apply to HARRP.

7100 ACCA Standard 4–Maintenance of Residential Heating, Ventilating, and Air Conditioning Systems

As substantial harm can result from failures to properly address heating, ventilating, and air conditioning (HVAC) systems in weatherized dwellings, NC WAP has adopted standards for inspecting, repairing, and replacing HVAC equipment that include employing the services of professional HVAC technicians licensed by the State of North Carolina.

In addition to compliance with the Installation Standards and applicable local codes, all HVAC-related services performed, whether by professional HVAC technicians or weatherization service providers, shall additionally comply with the ANSI/Air Conditioning Contractors of America (ACCA) Standard 4 - Maintenance of Residential HVAC Systems -2007. Where conflicts exist between these Installation Standards, ANSI/ACCA Standard 4, and applicable local codes, the more stringent standard shall govern.

Under no circumstances shall the act of employing a licensed HVAC technician in any way diminish the responsibility of weatherization service providers as program administrators to ensure compliance with all applicable standards and guidance governing the identification, inspection, maintenance, repair, replacement, and safe operation of HVAC systems.

HVAC repairs, upgrades, or replacements performed in compliance with the standards listed herein shall be as energy-efficient for the client and as cost-effective for WAP as possible.

7200 Evaluate, Clean, and Tune Requirements

Every dwelling weatherized shall have all HVAC systems evaluated, cleaned, and tuned (ECT) by a licensed HVAC technician unless otherwise excepted herein. The ECT shall be performed only after completion of the dwelling audit. Required repairs or replacements shall be complete prior to any subsequent weatherization work commencing. An ECT shall consist at a minimum of inspection, safety & efficiency testing, cleaning, and adjustment of all system components, fuel supply, piping, venting components, chimneys, flues, and all heating units present in the dwelling, including domestic water heaters. ECT requirements shall extend to central air conditioning systems and fuel-fired cook stoves or fuel-fired clothes dryers where applicable.

HVAC technicians performing ECTs shall hold at minimum a current Heating, Group 3, Class I or Class II license issued by the State of North Carolina. Possession of a Heating Group 1, Class I or Class II license is required for work on boilers or other steam systems. Weatherization service providers shall be responsible for ensuring that all HVAC technicians performing services are properly licensed, insured, and bonded (where applicable). HVAC contractor license status may be verified online by accessing the State Board of Examiners webpage located at: http://www.nclicensing.org/OnlineReg.htm.

Where dwellings rely on fuel-fired or combustion heating units (particularly wood burning stoves, fireplaces, and oil furnaces), evaluation of the venting components and associated chimneys or flues is critically important. In such instances the services of a chimney sweeping professional certified by the North Carolina Chimney Sweep Association (NCCSA) may additionally be retained where the HVAC technician responsible for performing the ECT either lacks adequate knowledge of servicing fuel-fired venting components and chimneys, or where the ECT identifies deficiencies a chimney sweep might be better trained and equipped to rectify. NCCSA certified chimney sweeps may be located by accessing the NCCSA webpage located at: http://www.ncchimneysweeps.com/.

HVAC technicians (and chimney sweeping professionals where applicable) shall complete an ECT report for every weatherized dwelling. Reports must fully document conditions observed during the evaluation including, but not limited to, diagnostic testing results, conditions observed through visual inspection, and suggested corrective actions for any deficiencies identified. A copy of the ECT Report and any supplemental data provided shall be maintained in the job file.

Exception: Evaluation by a licensed HVAC technician shall not be required where a dwelling relies solely on permanently installed electric space heaters (for example, hard-wired electric baseboard heaters) as the primary heat source and no fuel-fired supplemental heat sources are present. Evaluation and cleaning shall still be performed on such units, though the services may instead be performed by a qualified member of weatherization service provider staff in compliance with applicable standards listed herein.

Weatherization service providers shall be ultimately responsible for ensuring the compliance of all HVAC systems present in weatherized dwellings and shall therefore be required to provide detailed specifications, maintain detailed documentation, and thoroughly inspect all work performed by licensed HVAC technicians and related third-party professionals prior to accepting such services as complete.

7300 Mandatory Heat Provision Requirement

A PROPERLY FUNCTIONING, ADEQUATE, AND SAFE PRIMARY HEAT SOURCE SHALL BE PRESENT IN EVERY ELIGIBLE DWELLING PRIOR TO ANY WEATHERIZATION PROGRAM SERVICES (EXCEPTING THE INITIAL AUDIT AND THE ECT) BEING PROVIDED.

A properly functioning heat source is one that is functioning as intended by the manufacturer and is free from defects in installation, maintenance, and operation. A properly functioning heating source should perform at or near the maximum rated efficiency for that unit. An adequate heat source is one that provides heat sufficient to warm the intentionally conditioned spaces within the dwelling to not less than 68°F at an outside temperature of 20°F. A safe heat source is one that when used as intended poses no risk of adverse effects to the dwelling or to the client.

7310 Definition of Primary Heat Source

Primary Heat Source – The primary heat source shall be defined as one or more safe, permanently installed, properly functioning, central or space heating units and their associated fuel sources which together are capable of heating all intentionally conditioned spaces within the dwelling to not less than 68°F, where the outside temperature is 20°F or greater.

Where a weatherization-eligible dwelling initially lacks a system or systems which together comprise a compliant primary heat source as defined herein, weatherization service providers shall take necessary actions to establish a compliant primary heat source for the dwelling, using existing fuel sources, prior to any subsequent weatherization work commencing.

At the time of the initial audit, weatherization service providers shall document the type and condition of all heating and cooling systems present in the dwelling pre-weatherization. When the weatherization job is complete, the type and condition of all heating and cooling systems shall again be documented, recording data for systems at current post-weatherization status. For federal reporting purposes (such as AR4CA) where only a single primary fuel source may be recorded, the recorded primary fuel source shall be deemed the post-weatherization source that generates the greatest percentage of heat for the dwelling, (i.e. the fuel source that generates 51% or more of the total heat where two contributing systems fueled by different fuel sources are present).

Allowable unit types that may contribute to the mandatory provision of a compliant primary heat source shall include:

A) Electric
    a) central heat pumps
    b) window heat pumps
    c) ductless (mini-split) heat pumps
    d) packaged terminal air conditioners (PTAC) and packaged terminal heat pumps (PTHP)
    e) central electric resistance furnaces
    f) existing hard-wired space heaters, including wall, ceiling, and baseboard units (repairs only, replacements not allowed)

B) Fuel-Fired
    a) central package systems
    b) central split systems
    c) vented or sealed combustion space or room heaters
    d) vented atmospheric space or room heaters
    e) vented solid-fuel burning stoves (wood, pellet, coal)
    f) steam, hot water, or boiler units (prior approval required)
    g) gravity warm-air furnaces (repairs only, replacements not allowed)
    h) vented fireplaces

Unvented fuel-fired space heaters, as well as portable heating units, regardless of fuel source, shall never constitute or contribute to a primary heat source.

Portable heating units are those designed for easy regular movement from room to room. Unit types listed herein as allowable contributors to a primary heat source may be considered moveable under certain conditions, but shall not be considered portable.

7320 Definition of Supplemental Heat Source

An audit, an ECT, and any work required to establish a primary heat source as defined herein shall be completed prior to any additional weatherization work being performed.

Supplemental Heat Source – The supplemental heat source shall be defined as one or more safe, properly functioning, portable or permanently installed space heating units and their associated fuel sources which provide additional heat to areas within the dwelling on a temporary or intermittent basis above and beyond the heat provided by the primary heat source.

UL Listed portable electric space heaters may remain in the dwelling during and post-weatherization where such units have been properly inspected and deemed to be operating safely.

A limited variety of unvented fuel-fired space heaters may remain in a dwelling during and post-weatherization where such units have been properly inspected and deemed to be operating safely and where the unit complies with the minimum standards for unvented fuel-fired space heaters listed herein.

Where a compliant system serving as a supplemental heat source is evaluated and determined to be unsafe, the system may be repaired to the extent allowable or shall be surrendered by the owner and permanently removed from the dwelling and demanufactured prior to proceeding with weatherization.

7330 Unvented Fuel-Fired Space Heaters

Any unvented (also referred to as vent-less or vent-free) fuel-fired space heater remaining in a weatherized dwelling during or post-weatherization to serve as a compliant supplemental heat source shall:

A) Not have an input rating in excess of 40,000 Btu/hr regardless of location
B) Not be located in or obtain combustion air from utility rooms, closets, or similarly restricted spaces.

Any single UL Listed, unvented, fuel-fired space heater remaining in a bathroom or a bedroom where allowed by local code shall:

A) Not have an input rating in excess of 6,000 Btu/hr in a bathroom or 10,000 Btu/hr in a bedroom
B) Be equipped with an oxygen depletion sensing safety shut-off system
C) Have an adequate supply of combustion air based on the volume of the room where located
D) Be wall-mounted or permanently installed in a solid-fuel burning fireplace.

Any unvented fuel-fired space heater that does not comply with the standards listed herein shall be surrendered by the owner, permanently removed from the dwelling, and demanufactured prior to providing any subsequent weatherization program services.

Where unvented fuel-fired space heaters that do not comply with the standards listed herein exist in an otherwise weatherization-eligible dwelling, weatherization service providers shall be responsible for educating the client on the potential safety hazards associated with the operation of such units. Weatherization service providers shall obtain voluntary, written surrender authorization from the property owner to remove and permanently demanufacture all such units prior to providing any additional weatherization program services.

Owners who decline to authorize removal of noncompliant unvented fuel-fired space heaters shall be notified in writing that the dwelling must be placed in deferral status until the potential safety hazard represented by the noncompliant space heater has been removed.

Total program expenditures associated with dwellings where unvented fuel-fired space heating units are present may be disallowed where weatherization service providers fail to ensure either that:

A) Noncompliant space heating units are properly identified
B) Steps taken to address noncompliant space heating units are properly documented
C) Written surrender authorization is obtained from the dwelling owner and the unit removed
D) The dwelling is placed in deferral status until such time as the noncompliant space heating unit is surrendered.

7340 Mandatory Deferral Due to Lack of Primary Heat Source

Where evaluation of a system contributing to the primary heat source for a dwelling determines that the system must be repaired or replaced in compliance with the Installation Standards and insufficient program resources exist to complete the required work, no subsequent weatherization services shall be performed and the dwelling shall be placed on deferral status until such time as resources become available.

Failure by weatherization service providers to ensure that only compliant primary and supplemental heat sources are present in weatherized dwellings may result in all program expenditures associated with weatherizing the dwelling being disallowed.

7400 Pre and Post-Weatherization Heating, Ventilating, and Air Conditioning System Evaluation

Under no circumstances shall the act of employing a licensed HVAC technician in any way diminish the responsibility of weatherization service providers as program administrators to ensure compliance with all applicable standards and guidance governing the identification, inspection, maintenance, repair, replacement, and safe operation of all HVAC systems.

In addition to compliance with ACCA Standard 4 and local codes, certain general evaluation requirements shall apply to HVAC assessments performed as part of initial audits and final inspections, for both the purposes of identifying potential hazards at the earliest opportunity as well as in order to assess the dwelling conditions on which the work performed by HVAC technicians and other third-party subcontractors shall be predicated and judged.

Weatherization service providers shall be responsible for ensuring that all auditors and inspectors possess necessary training and equipment to enable them to accurately identify system type(s) and effectively perform type-specific preliminary evaluations as part of the initial audit/final inspection. Emphasis shall be placed on the ability of auditors to accurately identify and document heating system types existing pre-weatherization. Similar emphasis shall be placed on the ability of final inspectors to identify and document systems existing post-weatherization.

Weatherization personnel shall remain responsible for completing a variety of standard HVAC evaluation functions as mandated by initial audit and final inspection protocols or as necessitated by conditions present in a particular dwelling. Such inspection functions shall include, but shall not be limited to, identifying safety hazards that constitute emergency situations or that require repair work must be completed prior to proceeding with weatherization. Weatherization personnel shall at all times be responsible for documenting conditions observed and notifying dwelling occupants, as well as providing ongoing client education.

Pre and post-weatherization HVAC system evaluation shall include, but not be limited to, functions outlined in Items 7410-7460 of this Section.

7410 System Maintenance

Where a forced air distribution system is used, filter(s) shall be installed or replaced and a 6-month supply of appropriately sized filters for each filter location shall be provided to the client. Filters provided shall meet manufacturer specifications based on the type of system present, and per manufacturer specifications for the specific filter product selected. Replacement of return grilles with filter grilles for greater client accessibility shall be allowed.

7420 Power Supply Inspection

The electric power supply for all applicable heating units shall be inspected for safety hazards at the time of the initial audit.

7430 Fuel Supply Inspection

All fuel-fired heating units shall be inspected for leaks in the fuel supply at the time of the initial audit and again at the time of final inspection. Fuel leaks shall be corrected before the heating system inspection can continue.

7440 Clearance from Combustibles

Heating units shall have sufficient clearance from combustible surfaces including walls, ceilings, floors, and framing members, as well as from items including stacks of newspapers, rags, oil, gasoline cans, and other such materials.

7450 Venting System Inspection

Functional exhaust venting systems in weatherized dwellings including chimneys, flues, and all related venting components shall be inspected as per applicable standards listed herein to ensure that the systems are both safe and code compliant. For the purposes of the Installation Standards, a functional exhaust venting system shall be defined as any system that is actively or could reasonably be placed in service with minimal effort by the dwelling occupants. Examples of nonfunctional exhaust venting systems shall include, but not be limited to, chimneys that have been permanently closed off and no longer penetrate the roof, which have been filled using some other permanent fill method, or which have been walled-in or covered-over in a manner which clearly indicates an intent to place the chimney permanently out of service.

While venting evaluation and installation requirements vary by venting system type and local code, all functional exhaust venting systems present in weatherized dwellings shall generally be evaluated to ensure that:

A) Vent piping is properly rated for use on the unit type, fuel source, and in the environment to which it is exposed
B) Masonry chimneys are appropriately lined
C) Venting is free of obstructions, corrosion, residue, and deposits which may hinder proper drafting
D) Venting components are well connected and sealed where applicable
E) Vent connectors are installed with adequate slope and the fewest elbows possible
F) Venting passing through the roof shall have compliant clearances from roofing materials
G) Where two units share a common main vent, the unit with the lower Btu input is vented above the higher Btu unit and the size of the common main vent is adequate to properly vent the Btu input of both units.

7460 Combustion Analysis

A) Combustion Air Supply

The volume of combustion air required varies based on unit characteristics and dwelling conditions and shall be calculated based on applicable standards for adequate combustion air as listed herein for each unit type.

Auditors shall inspect the area surrounding combustion appliances and shall make an initial determination regarding the adequacy of the existing combustion air supply based on the calculation standards herein. Where the combustion air supply is initially determined to be insufficient, instructions to recalculate the supply and the manner in which to correct deficiencies shall be included in the Scope of Work subsequently provided to HVAC technicians and/or weatherization contractors.

B) Carbon Monoxide Testing

Due to the severity of the hazard posed by CO poisoning, which can be fatal, weatherization personnel shall be responsible for performing CO testing at mandatory intervals throughout the weatherization process.

Dwellings with combustion appliances shall be tested for the presence of CO in the living area (ambient air) and the flue gases in compliance with applicable standards listed herein.
Testing for elevated levels of CO in the living area shall be repeated at minimum after completion of all repair work on each combustion appliance, prior to the start of weatherization work, at the end of each subsequent workday, and again at the time of final inspection.

C) Draft and Combustion Appliance Zone Testing

Draft and Combustion Appliance Zone (CAZ) Testing shall be performed per applicable standards listed herein on all functioning fuel-fired heating systems in each weatherized dwelling during the initial audit, the final inspection, and as needed throughout the weatherization process.

Where a compliant, nonfunctioning, fuel-fired unit exists and will remain in the dwelling post-weatherization, combustion analysis shall be performed as soon as the unit is made functional.

Exception: Wood burning and lump coal units where no fuel is available during the cooling season shall be visually inspected to determine the condition of the following components - cracks in the heat exchanger, corrosion, improper venting, and clearance from combustibles.

7500 Heating, Ventilating, and Cooling System Repairs

Minor HVAC system repairs (as defined annually by applicable weatherization program guidance) may be performed by the subcontractor assigned to perform the ECT, ideally as part of the initial service appointment.

Where conditions warrant major repairs or system replacement, weatherization service providers are strongly encouraged to identify a minimum of three alternate subcontractors to provide estimates or competitive bids to perform the installation or major repair work.

Repairs shall be considered cost-effective where repair expenses do not exceed 1/3 of the replacement cost of a comparable installed unit.

7600 Heating, Ventilating, and Cooling System Replacements

Every effort shall be made to repair an existing heating system prior to considering replacement. Replacement shall be considered justified where repair expenses are equal to 1/3 or greater of the expense of a comparable replacement unit. A load calculation shall be used to determine correct sizing of replacement units taking estimated post-weatherization dwelling characteristics into consideration. Care shall be taken to ensure that the replacement unit is suitable for the dwelling and that associated system components including the location, power supply, venting, and duct systems are compatible with the replacement system.

Inability by the dwelling occupants to supply fuel for an existing primary heat source(s) shall under no circumstances constitute justification for a system replacement. Documentation justifying the necessity and dwelling owner authorization, as well as the specifications and selection criteria for every system installed shall be maintained in the job file.

7610 Replacement System Efficiency Requirements

Installed heating systems shall have a rated performance efficiency of not less than:

Fuel Source	Coastal	Non-coastal	Space Heaters
Gas Furnace	80% AFUE	90% AFUE	80% AFUE
Oil Furnace	80% AFUE	85% AFUE	80% AFUE
Gas/Oil Boiler	80% AFUE	85% AFUE	80% AFUE
Heat Pump	8.2 HSPF	8.5 HSPF	2.6 COP
AFUE-Annual Fuel Utilization Efficiency HSPF-Heating Seasonal Performance Factor			

7620 Replacement System Sizing

All installed heating systems shall be adequately sized for the dwelling based on a properly prepared load calculation. Preparation of a Manual J by the licensed HVAC subcontractor awarded the contract for installation of the unit is recommended. The Weatherization Assistant NEAT and MHEA software may also be used. Please note that MHEA cannot be used to size the cooling load of a mobile home. Weatherization service providers shall be responsible for ensuring the accuracy of the load calculations used to size installed systems. Load calculations shall reflect accurate dwelling-specific data including, but not limited to:

A) Number of dwelling occupants
B) Total square footage
C) Wall, ceiling, and floor square footage
D) Window schedule
E) Associated local weather station
F) Wall and window orientation
G) Projected post-weatherization insulation value.

Where sizing calculations are performed for systems that include cooling, calculations shall be based on ensuring the cooling load for the dwelling is adequate. Where systems provide only heat, sizing shall be based on supplying the heating load for the dwelling only. In no instance shall a central HVAC system be sized to provide less than 50,000 Btu/hr input for site-built dwellings and 40,000 Btu/hr input for mobile or manufactured homes.

Fuel-fired central systems shall not exceed design specifications by greater than 25%. Heat pumps shall not exceed design specifications by greater than ½ ton.

7630 Heating System Fuel Source Switching

Where it is determined that an existing heating system shall be replaced based on the standards listed herein for allowable heating system replacements, every effort shall be made to provide a replacement system that is comparable to the system being removed, including installation of a system with the same associated fuel source.

Weatherization service providers may consider replacement units with different fuel sources and configurations on a limited case-by-case basis only. Authorization from NC WAP shall be required prior to any system replacement where fuel switching occurs.

Where authorization for fuel switching is requested, weatherization service providers shall compile a cost analysis comparing the expenses related to:

1. Installation of a comparable replacement system with the same associated fuel source (i.e., replacing a nonfunctioning central fuel oil furnace with a new central fuel oil furnace).

vs.

2. Installation of a comparable replacement system with a different proposed fuel source (i.e., replacing a nonfunctioning central fuel oil furnace with a new electric heat pump).

A complete fuel switching cost analysis shall consist of not less than three estimates for the installation of each system type, prepared by a licensed HVAC subcontractor who has previously or is able and willing to enter into an installation contract with the weatherization service provider, to actually provide the estimated services. Each of the estimates prepared shall include all expenses associated with the purchase and installation of both proposed replacement systems. Such estimates shall include, but not be limited to:

A) Base system price plus all additional materials required
B) Fuel lines or piping and associated fuel tanks where applicable
C) Labor expenses to install each replacement unit and remove the existing unit
D) Thermostat replacement
E) Required permits
F) Ductwork repairs or modifications.

Fuel switching shall only be authorized on the basis of the cost-effectiveness to the program. Fuel switching shall not be authorized where an existing unit is functioning properly or where cost-effective repairs to an existing system are possible. Fuel switching for domestic water heaters shall not be allowed.

7700 Water Heater Repair and Replacement

Applicable ECT standards shall apply to water heaters present in weatherized dwellings.

Allowable water heater repair measures shall include:

A) Flushing the tank
B) Replacing heating elements (electric)
C) Replacing ignition mechanisms (fuel-fired).

Water heaters shall be replaced on a case-by-case basis where units are nonfunctioning or functioning improperly and cannot be repaired. Replacement of a conventional residential water heater would rarely, if ever, be justifiable based on an SIR greater than 1.0; therefore, most replacements can be justified only as a health and safety measure. Installed water heaters shall be comparable to the existing unit in size, construction, operation, and fuel source. Fuel source switching for water heaters shall not be allowed.

Installed water heaters shall have an energy efficiency factor of not less than:

Water Heater Capacity	Gas	Electric
30 Gallons	0.63 EF	0.94 EF
40 Gallons	0.62 EF	0.93 EF
50 Gallons	0.59 EF	0.92 EF
EF-Energy Factor		

7710 Heat Pump Water Heaters

ENERGY STAR qualified heat pump water heaters utilizing super-efficient technology can cut residential water heating costs substantially. As of the effective date of the Installation Standards, all known heat pump water heaters available have a minimum tank capacity of 50 gals, and due to their construction and method of operation such units cannot be installed in small or tightly enclosed areas.

Heat pump water heaters shall be allowable as an energy conservation measure when installed in dwellings where:

A) Adequate circulation and utility space exists in the dwelling to accommodate the new appliance
B) The existing water heating fuel source is electricity
C) Dwelling occupancy supports the capacity of the new appliance
D) The capacity of the existing and new appliances have a difference of less than 11 gals
E) A dwelling specific NEAT or MHEA evaluation yields an SIR of 1.0 or greater for the measure.

7800 Window Air Conditioner Repair and Replacement

Where present, functioning window or room air conditioners in weatherized dwellings shall be serviced per manufacturer specifications. This includes cleaning filters, coils, and fan blades, in addition to straightening the coil fins as needed. Repairs to nonfunctioning window or room units shall be allowed on a limited case-by-case basis where repair expenses do not exceed 50% of the expense of an installed replacement unit.

While not a cost-effective energy efficiency measure, window air conditioner installation or replacement shall be allowed where necessary to provide at least *one* "cooling room" for at-risk clients as a health and safety measure *and shall only be allowed after all other applicable priority measures are complete*. Where installed, units shall have an Energy Efficiency Ratio (EER) of 10.0 or greater, shall not exceed 115 volts, and shall not be equipped with remote control devices. A maximum of one unit shall be provided per dwelling.

Window air conditioners shall be air sealed per applicable air sealing standards listed herein. Client education shall be provided on operating expenses, maintenance, and energy losses associated with allowing window units to remain installed year round. Installation of prefabricated air conditioner covers shall be allowed.

7900 Thermostat Installation

7910 Smart Thermostats

Where properly programmed and consistently used, smart thermostats, also referred to as programmable or setback thermostats, can be an effective tool to reduce the energy consumption of central HVAC systems. Despite the potential benefits, smart thermostats are more often used improperly, negating any potential benefits and resulting in frustration for clients.

Smart thermostats shall be installed only where the dwelling occupants are both willing and capable of properly operating the device, and where written authorization from the dwelling owner is obtained. Where installed, smart, programmable, or setback thermostats shall comply with the following specifications:

A) Be equipped with a large digital display
B) Be hard-wired with a battery backup
C) Be equipped with the Smart Response/Adaptive Recovery/Smart Recovery feature
D) For heat pumps, be equipped with a control to lockout strip heat based on an outdoor temperature of above 40°F.

7920 Mercury Bimetal Thermostats

Existing mercury bimetal thermostats located in site-built dwellings shall only be replaced where they are nonfunctioning and cannot be repaired. Servicing a mercury bimetal thermostat should consist of leveling the device as well as testing the anticipator with an ammeter to ensure it is operating within manufacturer specifications as listed on the device. If these adjustments fail to correct the malfunction then the thermostat may be replaced with a basic digital or smart thermostat. Documentation of repair efforts made on the existing device prior to replacement shall be maintained in the job file.

7930 Digital Thermostats

Basic or nonprogrammable digital thermostats are not equipped with energy efficiency features and shall therefore only be installed as a replacement for an existing nonfunctioning basic digital thermostat, or for a nonfunctioning bimetal mercury thermostat which cannot be repaired.

Weatherization service providers shall educate clients on the proper operation of the particular type of thermostat in use in the dwelling.

8000 Duct Sealing and Insulating

Sealing and insulating the distribution system or ductwork for forced air heating systems can improve system efficiency and comfort for dwelling occupants.

Ductwork present in all accessible unconditioned areas of weatherized dwellings shall be sealed to a tightness or pressure of 1.0 Pa or below.

Duct tightness testing using the blower door and pressure pan shall be performed to monitor the effectiveness of duct sealing measures, ensuring complete tightness is achieved. Duct sealing and insulating measures shall not be required where portions of a distribution system are inaccessible due to location or immoveable obstructions.

Duct sealing and insulating measures shall generally be performed by weatherization personnel. An ECT completed pre-weatherization shall be used to identify required duct repairs or replacements, where present. Where duct connections must be repaired or replaced prior to sealing and insulating, applicable local codes shall govern requiring such work be performed only by licensed HVAC technicians.

Client education shall be provided reinforcing the importance of sealing and insulating distribution systems and of maintaining unrestricted airflow throughout the system.

8100 Duct Sealing Preparation

Prior to performing duct sealing measures, weatherization personnel shall ensure that:

A) Faulty connections in the duct system have been repaired or replaced per applicable local code
B) Supply registers located in conditioned space are open, operable, and unrestricted
C) Supply and return ducts are clear of obstructions and debris
D) Ducts connecting to unconditioned spaces (for example, an attached garage) have been sealed in a manner which permanently restricts airflow
E) Oily residues or deposits (where present) have been cleaned using a solvent such as mineral spirits or denatured alcohol
F) Duct runs are supported with code compliant straps in a manner that prevents sagging in accordance with manufacturer specifications, but at no greater distance than every 5 feet so that there is no greater than 6 inches of sag per foot of spacing between supports
G) Compliant procedures for addressing ductwork treated with tape or other materials suspected of containing asbestos have been implemented per applicable standards listed herein for asbestos hazard management

8200 Duct Sealing

A) Material Selection

Only duct mastic and fiberglass mesh tape listed for use in HVAC applications shall be used to seal ductwork. Spray polyurethane foam, cloth duct tape, and other such materials not intended for use on ducts shall not be allowed. All materials shall be installed per manufacturer specifications to the extent such specifications do not conflict with the minimum standards listed herein.

Duct mastic shall have the following specifications:

a) be non-toxic and moisture/mold resistant
b) be UL Listed and labeled per UL 181A or 181B standards
c) be compatible for use on the duct material to which it is applied
d) be either fiberglass infused, silicone infused, or fiber reinforced and have a 50% solids content

Draw bands used to support or secure ductwork shall have the following specifications:

a) consist of weather-resistant and UV-resistant material, or stainless steel worm drive clamps
b) be corrosion resistant

B) Application

Detached boot connections repaired by HVAC technicians shall be firmly reattached to the subfloor, taking care to prevent materials from inhibiting register grilles from fitting properly into the boot.

All ductwork located outside the building envelope, as well as plenums and returns, shall be sealed. Emphasis shall be placed on effectively sealing boot-to-subfloor connections and all accessible joints.

Gaps of less than 1/4 in. may be sealed using only duct mastic. Gaps of 1/4 in. up to 1 in. shall be sealed using duct mastic embedded with fiberglass mesh tape. Gaps of 1 in. or greater shall be treated by applying sheet metal or valley flashing fastened with screws, then sealed with mastic.

Where noncompliant cloth duct tape is present on ductwork, ducts may be effectively treated by applying mastic and fiberglass mesh tape atop the existing cloth duct tape in the same manner specified herein, taking care to achieve a durable, tight seal by applying the materials a minimum of 1-2 in. beyond the edges of the existing cloth tape.

8300 Duct Insulation

Prior to installing insulation, ductwork shall be repaired and sealed per applicable standards listed herein. Ductwork and plenums located within *conditioned space* shall not be insulated.

Accessible ducts and plenums located in *unconditioned space* shall be insulated to a minimum value of R-8. Duct insulation measures shall comply with the following specifications:

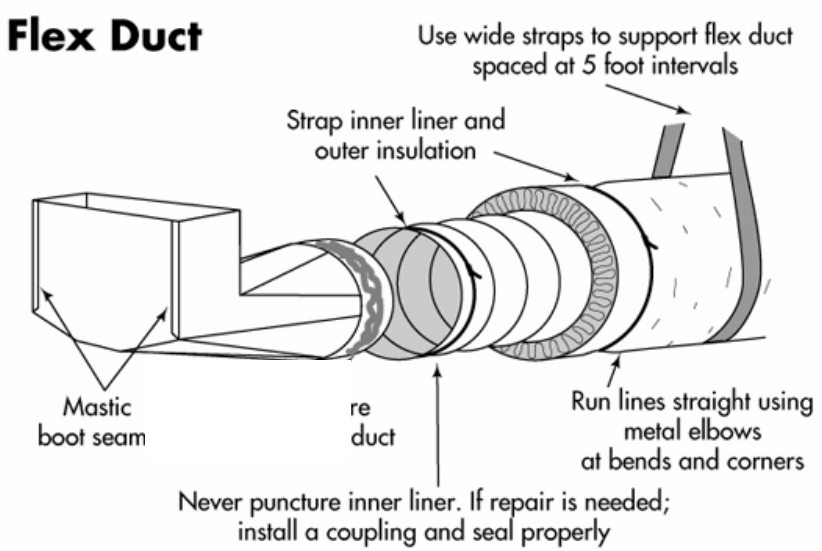
A) Reinforced foil duct wrap is recommended for duct insulation.
B) Flex ducts installed shall be foil-wrapped to prevent deterioration due to UV light.
C) Duct insulation shall be installed with the vapor barrier on the outside such that it covers the insulation.
D) Duct insulation shall not be compressed by greater than 50%.
E) Ducts and heating pipes shall not be insulated where located within 3 inches of heat-producing devices like flue pipes.
F) Ductwork insulated to a value of R-4 or greater shall be repaired as needed, but no additional insulation shall be installed.

Care shall be taken to properly identify areas of unintentionally pressure-connected space (defined as spaces having zonal pressures not greater than 10 Pa WRT the house including, for example, basements, dropped ceilings, and HVAC chases). Ducts located in unintentionally pressure-connected space shall not be insulated. ***Air handlers and combustion exhaust venting shall never be insulated.***

8310 Flex-Duct-to-Boot-Collar Connections

Where flex duct is attached to boot collars, the connection shall be sealed as follows:

A) Ensure flex duct and boot are well connected and the metal collar is clean.
B) Apply a band of mastic approximately 2 in. wide around the entire circumference of the existing collar connection.
C) Pull any loose inner liner up and over the collar and mastic and secure with a code-compliant tie.
D) Pull outer insulation layer and liner up and over the collar (taking care to fully insulate the boot) and secure with a code-compliant tie.
E) Apply additional mastic atop the joint to form a complete seal between the duct liner and the adjoining surface.



8400 Distribution System Replacement

Every effort shall be made to repair existing distribution system components before replacement is considered. Where complete or major ductwork replacement is required, weatherization service provides shall be responsible for documenting the need for the replacement (including photographs) in the job file. Installation methods and materials used for distribution system replacements shall comply with manufacturer specifications and local code.

Efforts shall be made to replace panned returns wherever prudent, including where other components of the system are not replaced. Where all or the majority of a distribution systems is replaced, all passageways for distribution air shall be comprised of rigid duct. Panned floor joists used as supply runs shall not be allowed.

Distribution system components shall be sized according to the most current ACCA, Manual D, Residential Duct Systems specifications.

Distribution system replacements shall be completed in a manner which ensures that ductwork:

A) Is located within the thermal enclosure
B) Is not located in exterior walls
C) Is not formed using building frame cavities, closets, crawl spaces, or chases for distribution
D) Does not utilize panned floor joists
E) Does not utilize dropped ceiling cavities
F) Is not crimped.

Flex duct shall be allowed per applicable code for replacement ductwork Installation.

9000 Air Sealing Measures

Air infiltration can account for 30% or more of heating and cooling costs in a dwelling and contribute to moisture problems, dust, and the entry of pollutants, insects, and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment.

Every dwelling weatherized shall be evaluated to identify air infiltration or leakage sources caused by penetrations in the building envelope, as well as thermal bypasses where heat loss may occur. All air infiltration sources identified which can be corrected cost-effectively through performance of allowable air sealing measures shall be fully addressed.

Repair work required to alleviate poor IAQ issues shall be completed prior to performing air sealing measures including, but not limited to, eliminating moisture problems, reducing elevated CO levels, correcting noncompliant combustion appliance venting, etc.

A properly calibrated blower door and infrared camera shall be used to guide the air sealing by helping to diagnose sources of air leakage not easily identified by manual inspection. Air sealing measures shall generally be performed until sealing is no longer cost-effective.

Air sealing measures shall address primary sources of air leakage first, followed by duct leakage, then progress to discrete or secondary leakage sources. Air sealing shall be prioritized beginning with the attic or uppermost areas of the dwelling, and ending with the crawlspace or lowest area of the dwelling.

Air sealing measures shall be performed regardless of performance of related measures including, but not limited to, attic, sidewall, floor, or duct insulation.

9100 Air Sealing Material Precautions

Applicable standards listed herein specifying appropriate handling and use limitations for hazardous materials shall apply to all materials and installation methods employed during the performance of air sealing measures including, but not limited to, restrictions on the use of spray polyurethane and extruded polystyrene foam products.

9200 Primary Air Sealing

Primary air sealing measures address larger (more primary) sources of air leakage or infiltration that often may be diagnosed through visual inspection. Primary sources of air leakage include, but shall not be limited to:

A) Holes in ceilings, walls, floors, or doors
B) Missing or broken windows
C) Missing dampers in chimneys, furnace flues, and exhaust fans
D) Leaks around window air conditioners.

Infiltration sources of this type tend to reflect direct openings between the interior of the dwelling and the outdoors.

9300 Discrete or Secondary Air Sealing

Discrete or secondary air sealing measures address smaller (more discrete) sources of air leakage that may not be easily visible, but are often still cost effective to correct. Secondary or discrete sources of air leakage include, but shall not be limited to:

A) Penetrations around chimneys, flues, and exhaust vents
B) Penetrations around plumbing and heating pipes
C) Penetrations around electrical service entries and wiring
D) Other small seams and gaps between conditioned and unconditioned space
E) Loose window glazing (where panes are in jeopardy of falling out only).

Discrete air sealing measures shall be performed only after primary air sealing and duct sealing measures are complete, and only where additional air sealing is determined to be cost effective using the Discrete Air Sealing Cost Effectiveness Chart located in the REAT.

9400 Thermal Bypasses

A thermal bypass refers to areas within a dwelling where unconditioned air can interact with a non-insulated air barrier. Effective identification and treatment of thermal bypasses is critical to achieving energy

efficiency and occupant comfort. While measures to address thermal bypasses are performed with the same materials and techniques as air sealing, addressing thermal bypasses may have no impact on air sealing diagnostics. Common examples of thermal bypasses include, but shall not be limited to:

A) Interior wall cavities
B) Mechanical chases
C) Dropped ceilings
D) Junctures between floor levels
E) Rim joists
F) Knee walls
G) Stairwells adjacent to unconditioned space
H) Cantilever framing details (overhangs, bay windows, etc.).

9500 Air Sealing Window Air Conditioners

Where possible, dwelling occupants shall be encouraged to remove and store window air conditioners when not actively in use. Window air conditioners that remain installed year round shall be treated by air sealing the unit from the interior of the dwelling only, using extruded polystyrene foam board, and one-part interior grade non-expanding spray foam. Providing air conditioner covers shall also be allowed.

9600 Air Sealing Near Heat Sources

Special precautions shall be required when air sealing penetrations around chimneys, furnace flues, and heat pipes due to potential fire hazards. Air sealing measures needed where potential fire hazards exist shall comply with the following minimum standards:

A) A fire rated medium shall be installed to seal gaps or chases greater than ¼ in. in width around chimneys, flues, or heat pipes.
B) Gaps of ¼ in. in thickness or less shall be sealed with a caulking agent that meets the Underwriters Laboratory (UL) *T-rating* for fire resistance.
C) The fire stopping medium shall consist of galvanized steel sheets not less than 26 GA in thickness or a similar noncombustible sheet material not more than ½ in. in thickness.
D) Aluminum flashing or combustible sheet goods, including extruded polystyrene foam board and products made of wood, shall not be used for this purpose.
E) The fire stopping medium shall be sealed to the heat source and the surrounding framing and finish materials with a caulking agent that meets the Underwriters Laboratory (UL) *T-rating* for fire resistance.

In addition to stopping the flow of air around the heat source, insulation blocking shall also be installed per applicable blocking standards for insulation installation to restrict insulation from coming in contact with the heat source.

10000 Insulation Measures

In order to maintain the greatest energy efficiency possible, a dwelling's air barrier or pressure boundary must at all times remain in continuous contact with the dwelling's thermal barrier or insulation boundary. Therefore, to maximize the benefit of weatherization measures performed insulation shall be installed without voids or gaps, shall not be compressed (thus reducing the effectiveness of the insulation), and shall at all times be protected from moisture and air intrusion. Insulation measures shall be prioritized by first treating the dwelling attic, sidewalls, and then floors.

Where adequate insulation exists in a dwelling pre-weatherization and insulation measures are therefore not specified, related air sealing measures shall still be mandated.

10100 Attic Insulation

Attics in weatherized dwellings shall be insulated to an R-value of not less than R-38, unless located in a designated coastal county where dwellings shall be insulated to not less than R-30. Coastal counties are as follows: Beaufort, Bertie, Brunswick, Chowan, Camden, Carteret, Craven Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pender, Pasquotank, Perquimans, Tyrrell, and Washington.

Insulation shall be installed in a manner that eliminates voids and areas of inadequate coverage. Where existing insulation is present, the R-value of existing insulation shall be determined and insulation added as needed to increase the total attic insulation value to the level specified. R-value requirements withstanding, attic insulation depths shall also be adequate to ensure a uniform, settled coverage depth of not less than 2 in. above the measured height of rafter beams in contact with the ceiling.

Justification shall be required for any instance where the standard minimum attic R-value cannot be achieved and such justification (including photographs), shall be maintain in the job file.

10110 Pre-Insulation Attic Inspection

A) Prior to installing insulation, a thorough inspection of the attic area shall be performed. Inspections shall include a determination of the R-value and integrity of existing insulation, the location of air penetrations or bypasses between the conditioned space and the unconditioned attic, and the suitability of the ceiling structure for receiving insulation. Inspections shall further identify any necessary attic repair work, with an emphasis on work related to roof leaks or other moisture-related issues. Necessary repairs shall be completed prior to proceeding with work.

B) All mechanical exhaust venting shall be confirmed to terminate outside the roofline or sidewall. No exhaust vents shall terminate in the attic.

C) Electrical wiring in attic areas shall be inspected to confirm that wiring is not cracked, blistered, or deteriorated and that circuits show no evidence of overloading. Attics containing knob and tube wiring shall be treated in compliance with applicable standards for knob and tube wiring. Electrical junction boxes shall be covered.

10120 Pre-Insulation Attic Preparation

In addition to the standards for performance listed herein, weatherization service providers shall additionally ensure that all materials used to perform attic insulation measures (in particular, extruded polystyrene foam) comply with applicable local codes.

A) Duct Sealing — Ductwork located in attics shall be sealed and insulated per applicable standards for duct sealing and insulating prior to installing attic insulation.

B) Blocking — Blocking shall be installed prior to attic insulation measures to restrict insulation as needed.

Blocking shall be:

a) formed using a rigid sheet good
b) strong enough to withstand the weight of the insulation installed
c) installed at a height of 1 in. or greater above the settled depth of installed insulation
d) installed in a manner that provides for a continuous insulation depth to be uniformly achieved above conditioned space.

Blocking shall be provided where a barrier is required to restrict insulation:

a) from coming in contact with heat sources such as functional masonry chimneys, furnace flues, or heating pipes
b) from entering the operating mechanisms of devices such as whole house fans
c) to only those areas located above conditioned space (for example, to partition an attic located above both a conditioned main dwelling and an unconditioned garage)

d) to provide code compliant access to mechanical equipment located in the attic where required.

Blocking for Attic Storage – Where specifically requested by the dwelling owner, blocking shall be installed in floored attics to restrict insulation, allowing for a limited area of attic storage post-weatherization. Where established, such storage areas shall under no circumstances be larger than 50 ft^2 in total area and shall be accessible directly from the attic access. Insulation shall be installed beneath any such floored storage area per applicable standards listed herein.

Blocking for Heating Exhaust Venting – Blocking installed specifically to restrict insulation from coming in contact with potential heat sources including functional masonry chimneys, furnace flues, and heating pipes shall be formed from a galvanized steel sheet good not less than 26 GA in thickness or a similar noncombustible sheet good shall be required. Aluminum flashing shall not be used for this purpose. Blocking shall be affixed to the dwelling structure to ensure a minimum 3 in. clearance is maintained on all sides between blocking and heat sources and, where applicable, shall be notched to avoid contact with electrical wiring.

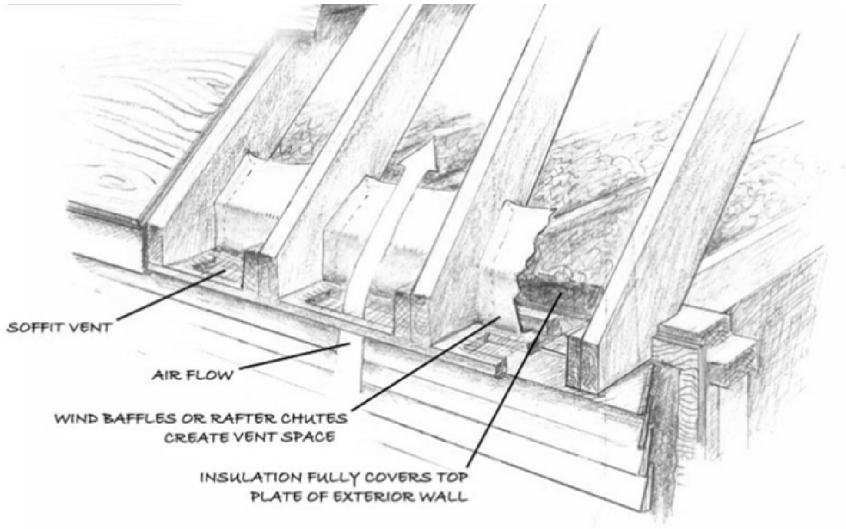
Blocking for Non-Heat Producing Mechanical Devices – Functional non-heat producing mechanical devices located in attics, including whole house attic fans, shall be blocked and covered providing a sturdy non-permanent, but still airtight, housing around the device to restrict insulation from coming in contact with the operating mechanisms. The cover shall be removable such that the device may be uncovered and operated seasonally without disturbing the adjacent insulation.

Heat Producing Mechanical Devices – Insulation may be installed directly over heat producing mechanical devices that are airtight and rated IC (Insulation Contact) only. No insulation, including fire rated insulation, shall be installed over non-airtight and/or non-IC rated devices.

Where non-IC rated recessed lighting fixtures must be addressed in order to provide uniform insulation coverage, replacement of the existing non-IC rated fixtures with comparable, airtight, IC rated fixtures shall be the only allowable treatment measure and shall be performed wherever cost-effective. After-market treatments intended to address noncompliant recessed lighting fixtures including, but not limited to, prefabricated flame resistant cover kits and apparatuses fashioned by weatherization personnel shall not be allowed.

C) Wind Baffles — Free circulation of air through soffit vents shall be maintained at all times through the use of rafter chutes or wind baffles designed specifically to restrict insulation moving. Where installed, baffles shall be continuous from the soffit vent to roof decking, shall be the appropriate width to align with the roof framing, and shall be secured to avoid movement.

Wind Baffle/Rafter Chute Diagram



D) Depth Markers — Depth markers shall be affixed to framing members throughout the attic space in a manner that ensures that a clear and accurate representation of the uniformly installed insulation depth is provided. Depth markers shall be located every 6-10 ft and shall face the attic access where possible.

E) Junction Flags—Junction flags shall be installed to identify the location of all electrical junction boxes and lighting fixtures prior to insulation installation.

10130 General Attic Insulation Guidelines

A) Bag Counts—Calculations based on a count of the number of bags used, as per manufacturer specifications, shall be the preferred method for determining the proper quantity and density of material that shall be installed to achieve a specified R-value.

B) Material Selection — Insulation products selected shall be appropriate for the conditions present in the dwelling and shall be installed per manufacturer specifications. Where a dwelling structure may not support the weight of a heavier insulation material such as blown cellulose insulation, a lighter weight blown insulation material shall be installed. Where existing insulation may be compressed beneath the weight of heavier blown cellulose insulation resulting in a reduction in the effective R-value of the batts, a lighter weight blown insulation material shall be installed.

C) Floored Attic Installation — Where insulation is installed in a floored attic using the drill-and-blow method, holes shall be properly plugged, secured with adhesive, and sealed. Floor planks may also be removed to allow for access to blow cavities, and then reinstalled.

D) Insulation Certificates—Insulation certificates containing the following information shall be installed at or near the attic access in every dwelling weatherized:

a) insulation type
b) density specifications

c) stated R-value
d) bag count installed (#)
e) anticipated settled depth
f) installation date
g) business name of the install firm
h) MSDS information.

10140 Attic Accesses

Access to the attic shall be provided in all dwellings weatherized for purposes of post-weatherization inspections and potential future needs of the dwelling occupants. Existing attic accesses shall comply with applicable standards listed herein or installation of a new access shall be required.

Compliant interior attic accesses shall:

A) Have existing dimensions of not less than 16 in. by 24 in., or where installed have dimensions of not less than 16 in. by 30 in.
B) Be located in area of the dwelling that allows for entry and exit from the access without disturbing major appliances or furnishings (for example, hallways or unobstructed utility rooms)
C) Have an air sealed weather-stripped (self-adhesive permissible) cover, insulated to not less than a value of R-30, which may be easily opened by dwelling occupants
D) Be strong enough to support the weight of an average sized adult entering or exiting the attic
E) Where required, insulation blocking around attic accesses shall be installed per applicable blocking standards
F) Must include a finish material (for example, 2-3 in. primed trim molding made from medium density fiberboard) which provides a workmanship-like appearance.

Attic accesses located in unconditioned space shall not be insulated or weather-stripped.

Prefabricated attic access kits or treatments which meet the minimum standards listed herein (including Energy Guardian kits) shall be allowed. Zippered attic hatch tents shall be not be allowed.

10150 Vaulted or Sloped Ceiling/Roof Cavities

Vaulted ceilings, sloped ceilings, or roof cavities shall be insulated to a value of no less than R-19, whenever possible. Where it is not possible to insulate to R-19, the limiting factor(s) shall be documented in the job file. A backing consisting of a rigid sheet good such as lauan, Thermo-ply, or Thermax shall be installed to hold insulation in the roof cavity. Extruded polystyrene foam shall not be used. Where fiberglass batt insulation is installed, the attached vapor retarder shall always face conditioned space. Where blown fiberglass insulation is installed, the material shall be filled to capacity in the vaulted or sloped ceiling or roof cavities.

10160 Knee Wall Accesses and Insulation

Access to knee wall areas shall be provided in all dwellings weatherized for purposes of post-weatherization inspections and potential future needs of the dwelling occupants. Existing knee wall accesses shall comply with the standards below or installation of an additional access shall be required.

Interior knee wall accesses shall be:

A) No less than the width of the knee wall stud cavity by 24 in. in height
B) Air sealed, weather-stripped, and insulated to no less than R-15
C) Secured with no less than one latch to ensure air tightness.

Adjacent knee wall cavities shall be air sealed and insulated to no less than R-15 using fiberglass batt or blown cellulose insulation installed at a density of 3.5- 4.5 lb/ft^3. A backing consisting of a rigid sheet good such as lauan, Thermo-ply, or Thermax shall be installed to hold insulation in the wall cavity. Extruded polystyrene foam shall not be used.

Where it is not feasible to provide permanent access to knee wall areas, the attic and/or knee wall area shall be inspected by an auditor/final inspector prior to access to the area being sealed. Measures installed in the knee wall area shall, for documentation purposes, be photographed prior to the access being sealed and justification of the need to seal the access, as well as photographic documentation of the measure performed on the interior of the knee wall space, shall be maintained in the job file.

Prefabricated knee wall access kits or treatments which meet the minimum standards above shall be allowed.

10200 Sidewall Insulation

Dense-packed sidewall insulation shall be installed where non-insulated wall sections exist, including walls that separate conditioned space from unconditioned space such as garages or unheated porches. Where incomplete sidewall insulation exists, insulation shall be added to provide complete sidewall coverage. In no case shall any wall or cavity be only partially insulated.

Applicable standards for local code compliance shall apply to the installation of sidewall insulation. Applicable standards for lead-safe work practices shall additionally apply to sidewall work on dwellings built in 1978 or before. Applicable standards for SHPO approval shall apply to dwellings 45 years or older where exterior sidewall insulation is required.

Exceptions to the requirement of installing sidewall insulation may include:

A) No wall cavity
B) Existing moisture problems which cannot be remedied
C) Presence of knob and tube wiring certified as being unsafe, where there are insufficient resources available to replace the wiring
D) Interior and/or exterior walls too weak to withstand pressure of sidewall insulation
E) Existing wall insulation
F) Refusal of the measure by the dwelling owner.

Justification for any omission of sidewall insulation shall be well documented. Exceptions shall be allowed only where reasonable justification exists and the course of action selected is clearly evidenced. Weatherization service providers shall be responsible for ensuring adequate justification and documentation for such exceptions is maintained in the job file.

10210 Pre-Insulation Sidewall Inspection

Both the interior and exterior of all dwellings shall be inspected prior to installation of sidewall insulation. Repairs required as a result of the inspection shall be performed prior to insulation work commencing. All deficiency conditions observed and the manner in which each was resolved shall be documented in the job file.

A) Interior Inspection — At minimum, interior wall inspections shall identify and document:

   a) presence of existing sidewall insulation, as evidenced by manually testing at least three stud bays
   b) any areas of the interior wall surface which are weak or not securely fastened
   c) location of all exterior wall-mounted switches and outlets, chases, utility runs, duct runs, wall heaters, vent fan penetrations, etc.
   d) any interior soffit areas, pocket doors, or other structural details that may need preparation prior to insulating
   e) critical framing junctures which impact the ability of the wall to contain high-density insulation.

B) Exterior Inspection — At minimum, exterior wall inspections shall identify and document:

   a) type(s) of siding material present, especially siding material that may contain asbestos and/or lead-based paint
   b) best drilling strategy, including whether siding may be lifted or temporarily removed to drill subsiding or sheathing
   c) severely deteriorated window or door components or damaged, rotted, or deteriorated siding which requires replacement to ensure the integrity of the insulation
   d) the source of any moisture in wall cavities
   e) structural additions and critical junctures which impact the ability of the wall to contain high-density insulation
   f) any obstructions near the perimeter of the dwelling which must be removed to provide access to the wall cavity during installation.

10220 Pre-Insulation Sidewall Preparation

A) Air Sealing — Walls shall be air sealed prior to installation of sidewall insulation, including the sealing of top and bottom wall plates, particularly in dwellings with balloon framing.

B) Blocking — Construction details that allow insulation to escape from sidewall cavities (such as balloon framed walls) shall be blocked or packed with insulation or other material in a manner that effectively retains the insulation.

C) Plugging, Patching, and Finishing

Exterior

a) Where exterior lap siding is removed and holes drilled in the sheathing and/or subsiding for the installation of insulation, holes in the exterior subsiding may be patched using wood plugs, plastic plugs, or spray foam insulation and, where applicable, shall be sealed using construction adhesive.
b) Where holes are drilled through exterior siding, plugs installed and any wood or siding replaced shall be compatible with the exposed surface that has been drilled and shall be sealed and primed.

Interior

a) Where possible, holes drilled during interior applications shall be drilled in a manner such that they may be covered using primed medium-density fiberboard chair rail molding of not less than 4 in. in width. Compatible plugs shall not be required in such applications.

b) Where holes must be drilled in interior wall surfaces where covering them with molding is impractical, plugs installed shall consist of a material which is compatible to the existing interior wall surface. Compatible plugs shall be sealed and primed as applicable depending on the material type to achieve a workmanship-like finish to the wall surface post-installation.

10230 General Sidewall Insulation Guidelines

Sidewall insulation shall be installed according to the manufacturer recommendations for density and in a manner that does not allow the material to settle. Cellulose is the preferred material for dense-pack sidewall insulation. When insulating sidewalls with blown cellulose, it shall be installed at a density of 3.5 – 4.5 lbs/ft^3 using the tubing method. Blown fiberglass shall be installed against chimneys or certain electrical fixtures. Where blown fiberglass is required, it shall be installed at a density of 1.6 lb/ft^3.

The quality and quantity of sidewall insulation installed shall be assessed post-installation using an infrared camera and by using the calculation method based on dwelling square footage and cavity depth. Additional inspection techniques may be used in conjunction with prior methods, including inspection of core samples or using a test wire.

10300 Floor Insulation

Floors in weatherized dwellings shall be insulated to a value of not less than R-11. Where floor insulation measures are performed, installed insulation materials shall have a rated R-value of not less than R-19. Where existing floor insulation is present, insulation shall be installed only to correct damaged areas creating voids or gaps in coverage.

Exceptions limiting the performance of floor insulation measures shall include:

A) Presence of knob and tube wiring certified as being unsafe, where there are insufficient resources available to replace the wiring

B) Inaccessibility or inadequate crawlspace clearance spanning greater than 40% of the crawlspace. Crawlspace clearances and joist depths adequate to allow for installation of R-19 insulation over

60% or more of the total floor area shall be considered sufficient to achieve the minimum cost-effective R-value rating of R-11. Where such conditions exist, floor insulation measures shall not be installed.

Weatherization service providers shall be responsible for ensuring that adequate justification and documentation for any exception is maintained in the job file.

10310 Pre-Insulation Floor Inspection

All dwellings crawlspaces and floors shall be inspected prior to installation of floor insulation. All repairs required as a result of the inspection shall be performed prior to insulation work commencing.

At minimum, crawlspace and floor inspections shall identify and document:

A) Presence, condition, and R-value of existing floor insulation
B) Presence and source of any existing or potential moisture problems
C) Decayed, broken, or damaged structural components, critical framing junctures, and/or any areas of the floor which are weak
D) Location of all heat sources, chases and floor penetrations, utility runs, ductwork, etc.
E) Presence of large obstructions, and/or personal property that must be removed in order for the floors to be insulated effectively.

All deficiency conditions observed and the manner in which each was resolved shall be documented in the job file.

10320 Pre-Insulation Floor Preparation

A) Floors shall be air sealed prior to installing insulation as per applicable standards for air sealing listed here. Emphasis shall be placed on air sealing penetrations beneath bathtubs and open bottom plates.
B) Where floor insulation is installed in an enclosed crawlspace, a properly functioning crawlspace door including a clasp closure shall be required. A vapor barrier shall be installed per applicable standards prior to floor insulation installation.
C) Where a combustion appliance or flue is present, insulation and other combustible materials shall be kept at a minimum clearance of 6 in. from any such heat source.

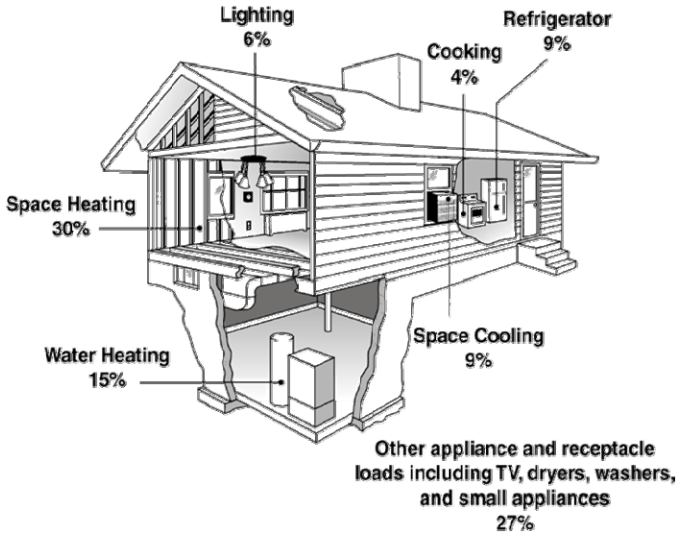
10330 General Floor Insulation Guidelines

A) Insulation with a value of R-19 shall be installed unless prohibited by the depth of the floor joists. In no instance shall insulation have a value of less than R-11.
B) Insulation shall be installed without voids or gaps and shall fit tightly around cross bracing, framing members, and other obstructions.
C) Insulation shall be fastened securely in place with wire fasteners, nylon mesh, or other appropriate fastener. Friction fitting or stapling floor insulation shall not be permitted.
D) Insulation shall be installed in a manner which ensures continuous contact with the underside of the subfloor and with the rim or band joists.
E) Fiberglass insulation with an attached vapor retarder shall be installed with the retarder facing upward toward the conditioned space.

11000 Baseload Reduction and General Heat Waste

Baseload reduction measures are designed to reduce the energy consumed by inefficient or outdated appliances and can make a substantial difference in household utility consumption. General heat measures typically have little or no impact on energy savings, yet often serve to increase client comfort.

Energy Use in a Typical Low-Income Household



11100 Refrigerator Evaluation

Allowable refrigerators located in weatherized dwellings shall be evaluated for potential replacement based on energy consumption.

Refrigerator evaluation criteria shall include the following:

A) Only standard, full-size, residential refrigerators or refrigerator/freezer combinations that are actively in use shall be considered for replacement.
B) The cost-effectiveness of replacing a refrigerator shall be determined by using the annual kW usage of the appliance to calculate the SIR.
C) For each refrigerator replaced one or more existing refrigeration appliances must be determined to contribute to a combined SIR of 1.0 or greater.
D) Multiple refrigeration appliances operating in a single dwelling may contribute to a combined SIR of 1.0 or greater; therefore, where present multiple appliances should be evaluated.
E) Every appliance contributing to a combined SIR of 1.0 or greater resulting in a replacement must be permanently removed from service and appropriately demanufactured per applicable federal regulations.
F) Replacement appliances shall comply with applicable federal energy efficiency standards.
G) Replacement appliances shall not have through-the-door ice or water features.
H) An effective economic life of 15 years shall be used for evaluation purposes.
I) A minimum of 10% of all appliances replaced shall be evaluated using the metering method, rather than using a database.
J) Under no circumstances shall a stand-alone freezer be replaced.
K) Under no circumstances shall a refrigerator that is nonfunctioning be replaced.
L) Under no circumstances shall a refrigerator be replaced based solely on age or appearance.
M) Under no circumstances shall a refrigerator be replaced based solely on an operating malfunction not related to energy consumption.

11110 (2-for-1) Refrigerator Replacement Option

Households where multiple refrigeration appliances consume energy year round may benefit greatly from a reduction in the number of appliances in use. Clients should be encouraged to discontinue use of any appliance that is not in active use or that consumes a large amount of energy.

Where a refrigerator-only evaluation results in an SIR of less than 1.0, the annual kW usage of an additional refrigeration appliance may be considered to achieve a combined SIR of 1.0 or greater qualifying the household for a refrigerator replacement.

Example:

> *Household (A) actively uses one 18 ft^3 refrigerator that is 14 years old. Household (A) also actively uses one stand-alone freezer that is 9 years old. Household (A) additionally has a compact or mini refrigerator in the basement that is rarely used but stays on year round. Under this scenario, the 2-for-1 Replacement Option should be considered for Household (A).*

Eligibility for the 2-for-1 Replacement Option would be determined by comparing the cost effectiveness of providing one larger, more efficient refrigerator/freezer combination to replace the existing, inefficient refrigerator/freezer combination and the stand-alone freezer.

Where the combined annual kW usage of the one 18 ft^3 refrigerator/freezer combo and the one stand-alone freezer, when compared to the purchase price and annual energy consumption of one new, energy efficient 21 ft^3 refrigerator/freezer combination results in an SIR of 1.0 or greater, then the 2-for-1 Replacement Option is appropriate. The inefficient refrigerator/freezer combo and the stand-alone freezer must both be removed and appropriately demanufactured.

Though it may not be considered as part of the 2-for-1 Replacement Option, client education shall additionally be provided encouraging Household (A) to discontinue use of the compact refrigerator located in the basement as a means of further reducing household energy consumption.

11120 Refrigerator Evaluation Methods

Refrigerator evaluation shall occur in two stages:

A) Refrigerators Less Than 10 Years Old

a) weatherization personnel shall determine the manufacture date of the appliance (when possible) by checking the service tag generally located inside the unit .
b) the model number, serial number, manufacture date, and method of determination shall be documented in the job file.
c) for appliance determined to be less than 10 years, no further action shall be required.

B) Refrigerators 10 Years Old or Older (or where age cannot be determined)

a) complete steps a) through c) above.
b) annual kW usage shall be determined by either metering or obtaining estimated annual kW usage from an approved appliance database.
c) using annual kW usage data, the cost-effectiveness of replacing the appliance shall be determined by calculating the SIR.
d) refrigerators determined to have an SIR of 1.0 or greater shall be replaced per applicable standards.
e) the SIR, evidence of calculation method, specification data for replacement appliance, and photographic documentation of the appliance removed shall be maintained in the job file.
f) refrigerators with an SIR of less than 1.0 shall not be replaced, except where the 2-for-1 Replacement Option is applicable.

11200 Compact Fluorescent Lamps (CFLs)

Incandescent bulbs in use two hours or more per day shall be replaced with compact fluorescent lamps (CFLs). Installed CFLs shall have a lumen rating equivalent to or higher than the incandescent bulb being replaced to maintain equivalent light output levels wherever possible.

No limit shall be placed on the quantity of CFLs installed, so long as usage is evaluated on a case-by-case basis and replacement is supported by the two-hours-or-more daily usage criteria or by a documented SIR of 1.0 or greater. Providing an unsubstantiated quantity of CFLs per dwelling or failing to install CFLs in locations used two hours or more hours per day shall not be allowed.

Client education shall be provided explaining the differences between CFLs and incandescent bulbs, including proper disposal methods, and shall be repeated as needed during the installation process.

11300 Water Heat Loss Measures

Water heaters and associated hot and cold water pipes shall be insulated to reduce conductive heat loss in all dwellings weatherized.

Water heaters shall be insulated to an insulation value of R-5 or greater using either foil bubble reflective insulation (including a minimum of three spacers located at the top, middle, and bottom) or mineral fiber insulation with an attached protective backing installed facing outward. The first 5 ft of the hot and cold water line leading into and out of the unit shall also be insulated.

Exceptions to water heater insulation standards shall include:

A) Cabinet style water heaters and units labeled with instructions indicating “Do Not Wrap”
B) Water heaters located within 3 ft of any type of furnace or stove, regardless of fuel source.

Pressure relief valves shall be present on all units and associated valve piping shall terminate not more than 6 inches above the floor or, depending on local code specifications, terminate outside the perimeter of the dwelling. Where outdoor termination is required, valve piping shall have an air gap located in the same room as the water heater, prior to the discharge entering into piping terminating outdoors. Exceptions to the installation of a pressure relief standards shall include:

A) Cabinet style water heaters
B) Water heater located in underpinned/dugout/excavated basement
C) Water heater located in the center of a dwelling on the first floor of slab on grade
D) Water heater located in stand alone structure.

Client education shall be provided explaining potential energy savings related to reducing the temperature and quantity of household hot water usage.

Wherever possible, weatherization service providers shall obtain verbal client authorization to adjust water heater thermostat settings to a temperature of 110°- 120°F. Where the client chooses to decline the measure, written documentation shall be maintained in the job file.

A) Electric Water Heater Insulation

The following standards shall apply to electric water heater insulation measures:

a) insulation shall be applied to the top and sides of the water heater.
b) overlapped ends of the protective backing material shall be sealed and banded in order to provide an adequate seal.
c) the pressure relief valve and piping shall not be covered.
d) thermostat controls shall be clearly marked and panels shall be insulated but readily accessible.

B) Fuel-Fired Water Heater Insulation

The following standards shall apply to natural gas and liquid propane water heater insulation measures:

a) insulation shall be applied to only the sides of the water heater.
b) overlapped ends of the protective backing shall be sealed and banded in order to provide an adequate seal.
c) a clearance of not less than 3 in. shall be maintained between insulation and the base of the appliance.
d) a clearance of not less than 5 in. shall be maintained between pipe insulation and the draft hood.
e) insulation shall not cover the pilot light, cut-off valve, the access panel to the thermostat or heating elements, operating instructions, the pressure relief valve or piping, the drain, any electrical service wiring, or the high-limit switch.

11310 Water Flow Reduction Measures

Allowable water flow reduction measures in weatherized dwellings shall include installation of low flow showerheads and faucet aerators.

Flow reducers shall be composed of durable materials and shall be as similar in design and finish to the associated fixture as possible.

Water flow reducers that are installed shall be rated to provide a maximum flow rate of:

A) Showerheads - equal to or less than 2.0 gallons per minute (gpm)
B) Faucets - equal to or less than 1.5 gpm.

Where the condition of the plumbing is such that damage could result from this installation, this optional measure shall be attempted only by a licensed plumber.

11400 Weatherstripping and Door Sweep Installation

These low-cost items target client comfort and shall only be allowed after all other cost-effective energy efficiency measures are complete.

Where weatherstripping or door sweeps are installed, only durable high quality materials shall be used. Universal weatherstripping kits constructed of vinyl or wrapped foam with metal or wood flanges shall be allowed. Self-adhesive or open cell foam weatherstripping shall be allowed where use of a more durable product is not feasible for a particular application, but under no circumstances shall it be installed on doors.

Allowable Universal Weatherstripping Kits

12000 Incidental Repairs

Incidental repairs are those repairs necessary for the effective performance or preservation of weatherization materials. Such repairs include, but are not limited to, framing or repairing windows and doors which could not otherwise be caulked or weather-stripped, and providing protective materials, such as paint, used to seal materials installed under WAP. Except where explicitly cited, dwellings that require incidental repairs must have a site-specific computerized audit to ensure that the package of measures do not reduce the overall SIR to less than 1.0. Incidental repairs must be included in the SIR calculation. If the projected incidental repairs drop the SIR below 1.0 and there are no other non-federal funds to leverage, the dwelling must be deferred. The following repairs must cost justified through a properly executed computerized audit:

A) Replacing deteriorated window or doors
B) Repairing minor roof leaks
C) Minor floor reinforcement

Please note that this list is not exhaustive and if clarification of activities is needed, contact the state weatherization office before action is taken.

12100 Window and Door Assessment

Before the era of cost-effective weatherization, energy savings through air infiltration reductions could not be quantified and as result window and door treatments were high on the priority list of measures. Reglazing windows, replacing windows, and adding exterior storm windows were popular with clients because the improvements were visible and related to the client's perception of comfort.
Years of weatherization research and the introduction of blower door-directed air sealing favor building shell air sealing and insulation measures, duct sealing, and other mechanical improvements. Overall, window and door replacements are found to have a low SIR, and shall are generally *not* considered a measure to reduce air leakage.

Where allowable, window and door measures shall comply with applicable standards listed herein governing lead-safe work practices and SHPO project review guidelines as well as with applicable local codes.

Under no circumstances shall storm windows or storm doors be installed on site-built dwellings.

12200 Window and Door Egress

The following egress minimums shall apply to window and door adjustments and repairs:

A) All functioning egress windows (as defined by local code) shall remain functional.
B) Non-egress windows may be permanently closed with written authorization from the dwelling owner.

C) Where there are two or more existing egress doors on the ground floor, at least two doors shall remain functional.
D) Additional exterior doors may be permanently closed where conditions warrant, with written authorization from the dwelling owner.
E) At least one egress door on a second or higher floor (where applicable) shall remain functional.

12300 Window and Door Repair

Window and door repair measures shall comply with the following:

A) Wherever practicable, windows and doors shall be repaired rather than replaced.
B) Missing, broken, or severely damaged panes of glass shall be replaced as needed to maintain building durability.
C) Window glazing with the an appropriate acrylic caulk shall only be replaced where the existing glazing is deteriorated to the point the panes are in jeopardy of falling out of the sash.
D) Window and door repairs shall not extend beyond those measures required to enable the window or door to close properly.
E) Improperly functioning, non-egress, jalousie windows located in site-built dwellings may be permanently closed from the exterior using screws and a clear exterior grade adhesive, with written authorization from the dwelling owner.
F) Permanently closed windows and doors shall not be made functional.
G) Replacement of window or door hardware shall not be allowed. Labor expended to adjust or re-install existing hardware shall be allowed.

12400 Window and Door Replacement

Window or door replacement work shall be defined as an "incidental repair" as per DOE regulation CFR 440.3, and shall be considered only as a last resort, where the existing window or door is weathered or damaged beyond repair, or poses a hazard to building durability.

Window or door replacement measures shall be allowable only where expenses associated with the replacements can be supported (or cost-justified) based upon maintaining a cumulative SIR attributable to the entire proposed scope of work for the project of 1.0 or greater.

Limited exceptions to cost justification requirements may apply to mobile home window or door replacements. Where cost-justified, replacement *doors* may include a single lite where the door replaced had a single lite.

Under no circumstances shall requests by the client, comfort concerns, aesthetic issues, or statements made by medical professionals, serve as justification for window or door replacements. Window and door replacement measures which are improperly documented, or that are not cost-justified may be disallowed.

Mobile Home Section

This section provides guidance and requirements pertaining to mobile homes. For any processes, procedures or requirements not specifically mentioned in this section, the processes, procedures, and requirements referred to in the current Installation Standards shall also apply to mobile homes.

20000 Workflow Documentation

20100 Weatherization Assistant Energy Audit Software

The Mobile Home Energy Audit (MHEA) portion of the Weatherization Assistant shall be used for manufactured dwellings. Measures requiring the use of the Weatherization Assistant software shall include, but not be limited to:

A) Incidental repairs lacking a direct relationship to priority list measures
B) Replacing windows or doors
C) HVAC sizing for system installations required to establish adequate primary heat sources.*

Dwellings in which no air sealing is needed, and in which adequate insulation in the roof cavity, sidewalls, and belly is already present shall require a Weatherization Assistant audit in order to ensure that the entire job will still be cost-effective.

The Weatherization Assistant software tools may additionally be used to cost-justify refrigerator replacements and to assess the cost-effectiveness of certain health and safety measures, where applicable, to support the leveraging and efficient management of program resources.

One or more weatherization personnel members employed by each weatherization service provider shall possess a thorough working knowledge of the Weatherization Assistant software packages.

*MHEA software cannot be used in the sizing of a cooling load for a mobile home. A Manual J or comparable load calculation software shall be used for this function.

20200 State Historic Preservation Office Authorization

Mobile homes are exempt from SHPO requirements. Even in a historic district, they are considered noncontributing structures.

21000 Priority List of Measures

Whenever possible, measures shall be completed on mobile homes in the order prioritized below. If a specific measure is skipped without proper documentation or justification, any measures lower on the priority list that are performed may result in disallowed cost.

21100 Priority List of Measures for Mobile Homes

1. **Duct Air Sealing and House Pressure Reduction**
   (Chapter 25000 – Duct Air Sealing and Insulating)

2. **Roof Cavity Insulation with Associated Air Sealing**
   (Chapter 26000 – Insulation)

3. **Floor Insulation**
   (Chapter 26000 – Insulation)

4. **Furnace Cleaning and Tune Up**
   (Chapters 7000 & 24000 – Heating, Ventilation, and Cooling Systems)

5. **Water Heating Packages**
   (Chapters 11000 & 27000 – Baseload Reduction and General Heat Waste)

6. **Baseload Electricity Reduction**
   (Chapters 1100 & 27000 – Baseload Reduction and General Heat Waste)

7. **Air Sealing the Building Shell**
   (Chapter 9000 – Air Sealing)

8. **Side Wall Insulation**
   (Chapter 26000 – Insulation)

22000 Health and Safety Provisions

22110 Vapor Barriers

Vapor barriers in mobile home applications shall not be sealed to perimeter skirting, but shall be installed using the same process as site-built units in all other respects. It is recommended that extra landscaping pins be used to secure the perimeter of the vapor barrier.

22120 Moisture Diversion

Installation of gutters in the form of J-channel shall be allowed if existing J-channel is damaged in the process of insulating the mobile home roof cavity. Minor leaks in the J-channel and between the J-channel and the mobile home shall be sealed with butyl putty.

22130 Ventilation

At least one full bathroom in every mobile home shall be equipped with a continuous-use or timer-equipped local exhaust ventilation fan with a noise rating equal to or less than 1.5 sones and an installed airflow rate of not less than 50 CFM. To increase the probability of uniform compliance with this standard, devices installed in bathrooms shall have a rated airflow specified by the device manufacturer of not less than 70 CFM.

22140 Lead-Safe/Renovate Right

Mobile homes are exempt from this requirement.

23000 Diagnostic Testing Source

23100 Zonal Pressure Diagnostics

ZPDs shall be performed in a manner similar to that of site-built homes. Due to differences in construction techniques, zonal pressures of less than 45 Pascals shall be acceptable. ZPDs shall be used to detect deficiencies in the belly and roof cavity.

In doublewide mobile homes, ZPDs WRT the conditioned space shall be taken in the roof cavity on both sides of the center beam, or ridge, of the mobile home. ZPDs WRT the conditioned space shall also be taken on both sides of the belly in a doublewide mobile home.

24000 Heating, Cooling, and Ventilating Systems

24100 Fuel-Fired Heat Source Requirements

Mobile homes shall adhere to the requirements listed in the HUD Mobile Home and Safety Standards (3280.709, G), including, but not limited to:

A) All fuel-fired appliances, excepting ranges, clothes dryers, and solid-fuel burning fireplace stoves, shall be installed to provide for the complete separation of the combustion system from the interior atmosphere of the mobile home. This shall be accomplished by installing a sealed combustion direct-vent system.

B) All fuel-fired appliances, excepting ranges and clothes dryers, shall be equipped with code compliant venting systems capable of close clearances with combustible materials.

C) Solid-fuel burning fireplaces or fireplace stoves shall be equipped with integral door(s) or shutter(s) designed to close the fire chamber opening, and shall include complete means for venting through the roof, combustion air inlet, hearth extension, a spark arrestor installed on the chimney cap, and means to securely attach the fireplace or fireplace stove to the mobile home structure.

D) Fireplaces or fireplace stoves shall *not* be allowed in a sleeping area.

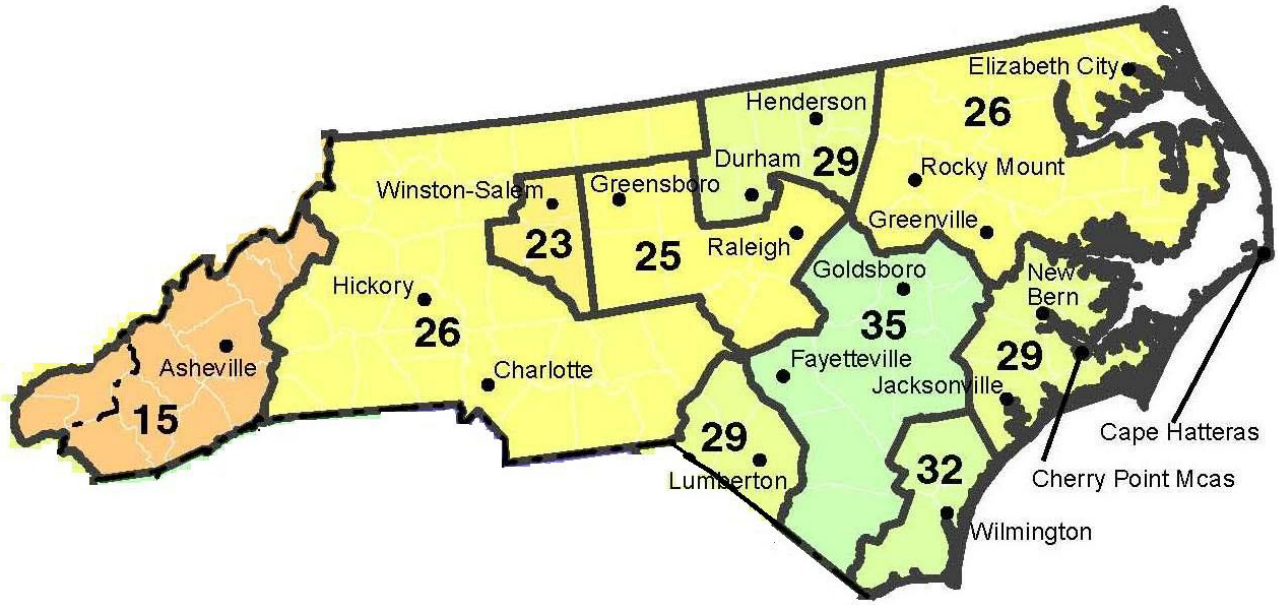
24220 Replacement System Sizing

All installed systems shall be specifically designed for mobile homes. At the time of this publication, MHEA is not designed to calculate the sizing of a cooling load for a mobile home. The chart and diagram below can be used to compare a third-party Manual J or comparable equipment-sizing software results.

Sizing Chart for Cooling Area for Mobile Homes

Floor Area (square feet)	1 - 840	841 - 1,120	1,121 - 1,280	1,281 - 1,440	1,441 - 1,680	1,681 - 1,960	1,961 - 2,240	2,241 - 2,520	2,521 - 2,760	2,761 - 3,000
15	1.5	1.5	2	2	2.5	2.5	3	3	3.5	3.5
23	1.5	2	2	2.5	3	3	3.5	4	4	4.5
25	1.5	2	2.5	2.5	2.5	3	3.5	4	4	4.5
26	1.5	2	2.5	2.5	3	3	3.5	4	4.5	4.5
29	2	2	2.5	2.5	3	3.5	4	4	4.5	5
32	2	2.5	2.5	2.5	3	3.5	4	4.5	4.5	5
35	2	2.5	2.5	3	3	3.5	4	4.5	5	5

Adapted chart from the Manufactured Housing Research Alliance



24300 Heat Pump Water Heaters

At the time of this publication, the size and space requirements for heat pump water heaters make them highly unlikely to achieve an SIR equal to or greater than 1.

25000 Duct Air Sealing and Insulation

25100 Duct Air Sealing

The end of the duct plenums shall be sealed with rigid board insulation, an insulation-filled plastic bag, or a mastic-coated hog hair filter and placed at least 12 in. beyond the last register opening in order to retain balanced airflow. Gaps between the walls of the plenum must be sealed with mastic. When using rigid board insulation, mesh tape shall be used to seal gaps exceeding ¼ in.

The connection between the plenum and the furnace shall be sealed. This connection is typically located underneath the furnace. This connection can sometimes be accessed from interior space; if not it will be necessary to cut open the belly liner and access it from beneath the mobile home. Photographic documentation is required if this measure cannot be performed.

Duct systems in mobile homes do not require insulation that is separate from that of the belly insulation.

25200 Distribution System Repair and Replacement

Every effort shall be made to repair the existing distribution system components before replacement is considered. If register boots are damaged to the point where adequate air sealing is neither possible nor cost-effective, new boots may be constructed using aluminum coil stock or a comparable material. Prefabricated register boots may be purchased and installed if available.

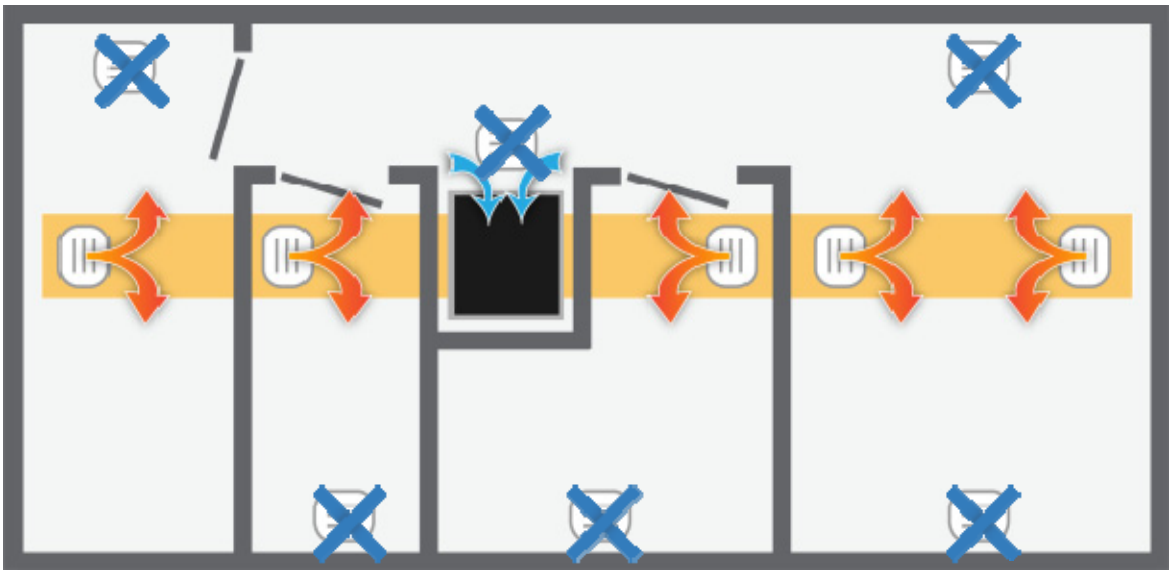
The plenum may be repaired and/or patched for the purposes of air sealing ducts by using aluminum or steel sheets that are not less than 30 GA in thickness. The patch must be attached to the trunk line using stainless or galvanized screws 1 in. or less in length and sealed with duct mastic. All duct air sealing and repairs done from beneath the mobile home must be completed prior to insulating the mobile home belly.

25210 Belly Return Conversions

Under no circumstances shall the belly of a mobile home be used as a return plenum. If such a circumstance is discovered, a central return must be created by:

A) Replacing the solid furnace door with a louvered door or retrofitting the existing door with an appropriately sized return grill. In either case, an appropriately sized filter grill must be supplied.

B) Air sealing the belly return grilles in the floors of bedrooms, bathrooms, kitchen, living area, etc. and in the floor of the furnace closet, if one exists. Air sealed return grills must be tested and readings must be 0.5 Pa or less.



In mobile homes with belly returns, room pressures may increase significantly once the system has been converted to a central hallway return system. Retest the room pressures after the belly return conversion and take the appropriate measures if the room pressures are greater than +/- 3 Pa WRT the outdoors.

25220 Crossover Ducts

Crossover ducts shall be inspected for integrity and repaired or replaced if any part of the insulation or inner liner is brittle or damaged. The duct must be replaced if the inner liner is composed of a mesh material. If replacement is required, either rigid metal ductwork or foil-wrapped flex duct with a minimum insulation R-value of R-8 shall be installed. Crossover duct runs, whether rigid or flexible, shall be as straight and short as possible and suspended off the ground.

26000 Insulation Measures

Insulation in mobile homes is typically inadequate to maintain either thermal comfort or energy efficiency. Due to structural limitations and manufacturing techniques, nearly all mobile homes weatherized will require that additional insulation be added. Cellulose insulation is not approved for any insulation application in mobile homes.

26100 Roof Cavity Insulation

Unvented roof cavities in weatherized mobile homes shall be insulated to capacity. Soffit-vented roof cavities shall be insulated according to Site-Built Installation Standards. Under no circumstances shall roof cavities be dense packed. Cellulose insulation is not a permissible material. In cases where an additional roof has been retrofitted over the original roof, only the original roof cavity shall be insulated.

Justification shall be required for any instance where roof cavity insulation could not be achieved, and such justification (including photographs) shall be maintained in the job file.

26110 Pre-Roof Cavity Insulation Inspection and Preparation

Roof cavities shall be inspected to determine the amount of existing insulation, if any, and to note any structural problems by drilling inspection holes in inconspicuous locations. Plastic plugs shall be used to repair the drill holes created during interior inspection. The client's written consent must be secured prior to drilling any inspection holes into the mobile home. Exterior inspection holes are also permissible, but may only be drilled if the auditor has the appropriate materials to either reseal the roof or patch the inspection hole.

The electrical wiring shall be inspected to confirm that wiring is not cracked, blistered, or deteriorated and that circuits show no evidence of overloading. The client shall be asked about any known existing electrical problems.

Blocking shall be installed to maintain a minimum distance of 3 in. from vent piping and non-IC rated light and ceiling fan fixtures.

Metal roofs shall be cleaned of dirt, leaves, and loose roofing material.

26120 General Roof Cavity Insulation Guidelines

There are three typical types of mobile home roofs: bowstring, flat, and peaked. Each type of roof has at least two acceptable methods for insulating. Polyvinyl Chloride (PVC) pipe creates static electricity and, therefore, shall not be used as an extension for the purposes of blown insulation. Rigid extension pipes of other materials, such as a painter's extension pole, may be attached to the side of the insulation hose.

In the case of sloped or vaulted ceilings, a combination of these methods may be needed and is allowed. Insulating from the interior of the mobile home is not recommended, but is allowable. Plastic plugs are available to repair the holes drilled in the ceiling if this method becomes necessary.

26121 Roof Cavity Fill Method

The following procedure is appropriate for metal unvented mobile home roof types. Sloped or vaulted roofs may also be insulated using this method.

1. Cut 10 in.^{2} holes in the roof on one or both sides of the ridge vent, or peak of the roof, above every second truss. Each hole should be able to access two truss cavities simultaneously.

2. Insert a fill hose that is 2-2 ¼ in. in diameter and tapered to a 45° angle into the access hole toward the edge of the roof cavity and insulate to capacity, moving the hose in all four horizontal directions. As the cavity is filled, the insulation should "push" the hose back toward the installer, indicating that the cavity is sufficiently insulated. Existing roof vents may be used to apply insulation in lieu of cutting new access holes; however, additional roof or vent caps shall not be added as an alternative to sealing roof patches after insulating.

3. Patch the roof using a 14 in.^{2} stiff, galvanized steel patch screwed into the existing roof with hex-head screws set every 2 in. and seal it with roofing cement. It may be necessary to clean around the access holes to ensure proper adhesion.

4. Cover the first galvanized steel patch with an 18 in.^{2} patch consisting of foil-faced butyl rubber. In colder temperatures, it may be necessary to heat this patch around the edges to ensure proper adhesion.

5. The entire roof shall be carefully inspected and all potential leak sites shall be patched and coated as needed to protect against moisture issues, such as wet insulation.

The following procedure is appropriate for shingled unvented mobile home roof types.

1. The shingles shall be removed with a flat bar and reused if possible. If new shingles must be purchased for replacement a similar type and color will be secured. The owner must authorize the use of similar shingles before weatherization work begins.

2. Cut 10 in.^{2} holes in roof on one or both sides of the ridge vent, or peak of the roof above every second truss. Each hole should be able to access two truss cavities simultaneously. If a ridge cap is present, it may be used for access instead of cutting access holes.

3. Insert a fill hose that is 2-2 ¼ in.^{2} in diameter and tapered to a 45° angle into the access hole toward the edge of the roof cavity and insulate to capacity, moving the hose in all four horizontal directions. As the cavity is filled, the insulation should "push" the hose back toward the installer, indicating that the cavity is being sufficiently insulated. Existing roof vents may be used in lieu of cutting new access holes to apply insulation; however, additional roof or vent caps shall not be added as an alternative to sealing roof patches after insulating.

4. Drilled holes shall be plugged with a material similar to the roof deck or a flat plastic plug. The plug shall be sealed prior to reinstalling the shingles.

26122 Side Lift Method

The following procedure is appropriate for metal unvented mobile home roof types. Sloped or vaulted roofs may also be insulated using this method.

1. Remove the J-channel guttering along the edge of the roofline along with any staples and putty tape.

2. Pry up the roof enough to accommodate a 45° angled 10-14 ft rigid hose extension. The roof can be propped open while insulating with a small section of pipe or lumber. Work in small 6-8 ft sections.

3. The extension should be inserted as close to center of roof cavity as possible and filled to capacity. As cavity is filled, insulation should "push" the hose back toward the installer, indicating that cavity is being sufficiently insulated. Ensure that the cavity is not overfilled.

4. Reattach the lip of the roof and use self-tapping aluminum hex head screws and butyl putty tape to secure and seal the J-channel gutter.

26123 Gable End Method

The following procedure is appropriate for metal unvented mobile home bowstring and peaked roof types. This method is best used in combination with other methods, as it may not be possible to insulate the entire length of the mobile home from the ends.

1. Remove the gable vents or the entire gable end siding.

2. Attach a 45° angled 10-14 ft rigid extension to the end of the insulation hose and insert it into the mobile home roof cavity, taking care to insulate around and under any structural beams or obstructions and to fill it to capacity.

3. Reinstall the gable end vents or siding.

26130 Cool Sealing

Cool roof coatings are an allowable measure as they can reduce cooling costs as well as providing additional moisture protection for the installed roof cavity insulation. The cool roof coating shall be an Energy Star®-qualified elastomeric material. Application should follow the manufacturer's recommendation. Preparation for the cool sealing shall include the following:

A) Sand any rusted areas down to sound metal. If the rusted areas are greater than 10% of the roof or if any of the roof has rusted through, the mobile home must be deferred.

B) Reinforce any open joints around skylights, pipe flashings, roof drains, and wall transitions with a mesh roof fabric and roof coating. Dip the fabric patches in the roof coating and spread them over the existing roof or lay dry fabric onto a layer of wet coating on the roof. Smooth the patch down with a broad knife or squeegee to remove any wrinkles or bubbles and allow at least 24 hours for curing before applying the coating.

C) Protect windows, siding, and vehicles from splatters and overspray.

26200 Belly Insulation

The belly cavity shall be filled to capacity regardless of existing insulation value. Belly cavities should be blown to resistance, and not dense-packed. Batt insulation is not allowable.

26210 Pre-Belly Insulation Inspection Preparations

Carefully inspect the interior of the mobile home prior to insulating in order to prevent infiltration of belly insulation into the interior of the dwelling. Ensure that all appropriate air sealing and duct sealing has been performed. Secure all ducts and water piping to the floor where possible. Address any missing or deteriorated belly liner and belly board as follows:

A) Holes in the belly liner up to 24 in. in diameter shall be patched using a self-adhesive belly patch (e.g. *Flex-mend*) and shall be reinforced with stitch (or butterfly) staples.

B) Holes in the belly liner that are 24 in. and larger in diameter shall be patched with replacement belly fabric and with stitch staples and shall be covered with adhesive belly repair material with a minimum overlap width of 4 in. Stitch staples alone are not adequate, as they can fail once the belly liner has been properly insulated to capacity.

C) For a severely deteriorated belly liner, full replacement may be warranted. Replacement shall proceed as follows:

    a) remove the remains of the old liner.

    b) fasten the house wrap between the center I-beams with staples along the length of the home, ensuring that the liner is fitted securely around penetrations and appropriately sealed.

    c) reinforce with furring or lathe strips screwed into the bottom of the floor joists every 10-15 ft, or as the mobile home condition warrants. This shall be done with care to avoid damaging the duct trunk line and water lines in the belly.

Rigid board insulation shall be used for patching or otherwise repairing the wings on either side of the mobile home, but it is not recommended for the larger center section due to the larger area and lack of support beams.

26220 Belly Insulation Installation Guidelines

A) Cut holes in each outer rigger and in the center between the I-beams. Center the holes for the outer rigger between the outer rim joists.

B) Insert a 45° angled 10-14 ft rigid extended insulation hose and blow insulation to resistance.

C) Patch holes as instructed in chapter 26210 of the Mobile Home Installation Standards.

26230 Belly Insulation Protection

Replacement or installation of mobile home skirting in order to protect weatherization measures from pests is not an allowable expense. The use of chicken wire around the perimeter is allowed for this purpose where no barrier exists, provided this measure does not constitute code violation in the applicable city or county.

26300 Sidewall Insulation

Sidewall insulation is the lowest measure on the Priority List of Measures for Mobile Homes. Sidewalls shall be insulated provided there is more than 1 in. of depth in a wall that has no insulation and an area equal to one long wall (excluding doors and windows) can be insulated. Due to the structural limitations of mobile home walls, blown insulation shall not be allowed. Only high-density, unfaced, R-13 fiberglass batt insulation shall be installed.

26310 Pre Sidewall Insulation Inspections & Preparation

Inspect all interior walls for holes and seal them prior to insulating. Weak or damaged walls shall be reinforced or repaired prior to insulating. Inspect walls to detect blocking which may impede sidewall insulation stuffing.

26320 Sidewall Insulation Guidelines

1. Open the siding at the band joist by removing the fastening screws from the bottom of the wall panels. It may also be necessary to remove staples with a long pry bare from underneath the wall panels. If the mobile home is partially insulated, pull out the existing insulation before installing new batts.

2. Stuff the un-faced insulation into the cavity using a ¼ in. polycarbonate sheet or a galvanized stuffing tool of appropriate width and length to safely stuff the batt insulation into the cavity. Polycarbonate may be heated to create a 5° bend, 12 in. from one end, which can ease installation of the insulation past obstructions.

3. Repeat Steps 1. and 2. for all wall cavities and refasten the siding.

27000 Base Load Reductions

27100 Water Heater Reduction Measures

Water heaters located in exterior closets shall have ZPDs taken to determine if the closet should be considered outside or inside the conditioned space. If it is determined to be outside, all wall surfaces between the closet and the inside shall be insulated and air sealed. If it is determined to be inside, only the exterior access door shall be insulated. Fuel-fired water heaters must have an appropriate louvered access door installed to allow for combustion air.

28000 Incidental Repairs

28100 Window and Door Replacement

Limited exceptions to cost justification requirements may apply to mobile home window and door replacements allowing for cost justified replacement as an energy efficiency measure. All replacements, regardless of how they are budgeted, shall require both a site specific MHEA audit and photographic documentation.