



OREGON WEATHERIZATION ASSISTANCE PROGRAM

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**SINGLE FAMILY/ MANUFACTURED HOME  
SMALL MULTI-FAMILY  
ENERGY AUDIT PROTOCOL**

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## TABLE OF CONTENTS

<b>I. OVERVIEW</b> .....	<b>4</b>
<b>II. ONSITE PROCESS</b> .....	<b>5</b>
<b>1. AUDITOR CONDUCT STANDARDS AND MINIMUM CREDENTIALS</b> .....	<b>5</b>
<b>2. SCHEDULING THE SITE VISIT AND TENANT NOTIFICATION</b> .....	<b>5</b>
<b>3. SITE VISIT PREPERATION</b> .....	<b>5</b>
<b>4. SITE VISIT</b> .....	<b>6</b>
4.1 PROJECT INTERVIEW(S).....	6
4.2 SAFETY AND CODE OBSERVATIONS AT THE SITE VISIT .....	6
4.3 VISUAL INSPECTION AND DIAGNOSTIC TESTING PROTOCOLS...	7
4.4 ON-SITE AUDIT .....	7
4.5 HEALTH AND SAFETY .....	9
4.6 ENERGY EDUCATION .....	10
4.7 ONSITE INSPECTION.....	10
<b>III. ENERGY MODELING &amp; ANALYSIS PROCESS</b> .....	<b>11</b>
<b>1. ENERGY MODELING SOFTWARE REQUIREMENTS</b> .....	<b>11</b>
<b>2. SIR REQUIREMENTS</b> .....	<b>11</b>
<b>3. USER DEFINED MEASURES</b> .....	<b>12</b>
<b>4. SINGLE FAMILY (2-4 UNIT), SMALL MULTI-FAMILY MODELING CONSIDERATIONS</b> .....	<b>12</b>
<b>5. MOBILE HOME SPECIAL CONSIDERATIONS</b> .....	<b>13</b>

<b>6. MECHANICAL EQUIPMENT PROPERTIES.....</b>	<b>13</b>
<b>7. DUCT SYSTEM .....</b>	<b>13</b>
<b>8. AIR INFILTRATION .....</b>	<b>14</b>
<b>9. MODEL CALIBRATION .....</b>	<b>14</b>
<b>10. INCIDENTAL REPAIRS .....</b>	<b>14</b>
<b>11. MEASURE BUY DOWN .....</b>	<b>15</b>
<b>12. UTILITY RATES .....</b>	<b>15</b>
<b>13. REPORT GENERATION .....</b>	<b>15</b>
<b>14. MEASURES CONSIDERED .....</b>	<b>16</b>
<b>15. LIST OF GENERAL HEAT WASTE MATERIALS .....</b>	<b>16</b>
<b>APPENDIX A: PROJECT REPORT REQUIREMENTS.....</b>	<b>17</b>
<b>APPENDIX B: EFFECTIVE USEFUL LIVES .....</b>	<b>21</b>
<b>APPENDIX C: DOE APPROVED MATERIALS (10CFR440, APPENDIX A).....</b>	<b>22</b>

## **I. OVERVIEW**

The Oregon Weatherization Assistance Program (WAP) Single Family/ Mobile Home/Small Multi-family (< 25 units) Audit Protocol is a guidance document that defines the required criteria for the development of an energy audit designed to justify the cost effectiveness of energy efficient building retrofits under Oregon's WAP. This document specifically addresses the audit protocol for Single Family site built structures, manufactured homes and small multi-family projects. Underlying this protocol are the principles of transparency, consistency, and accountability: data contained in the audit must be transparent in terms of methodology of collection and calculation; report content must be consistent; and persons completing the audit must be accountable for their work by adhering to protocol requirements, maintaining professional certifications, and providing quality assurance measures.

A key objective of an energy audit is to identify feasible and relevant energy conservation measures (measure) that qualify for funding under Oregon's WAP. In addition to identifying ways to reduce the energy burden, the audit process must also conduct evaluation of the integrity of the building to identify any deficiencies that could result in health and safety issues as defined by Oregon's WAP.

The outcome of the site specific audit process is a report that identifies cost effective weatherization measures based on the:

- Location, climate zone, utility information and other relevant site information;
- Building profile, configuration and existing energy systems;
- Related health and safety checks and conditions;
- Calculated savings-to-investment ratio (SIR) of each measure including interactive effects of higher SIR measures (calculated in REM/Design™); and
- Total calculated reduction in energy usage for the recommended measures (calculated in REM/Design™).

The four main processes that constitute the Oregon WAP Single family/Manufactured Home Small Multi-Family Audit Protocol standards include:

1. The on-site audit visit
2. The energy modeling and energy savings analysis
3. Report generation
4. The on-site final inspection

For energy audit purposes, OHCS considers single family buildings to be those containing four dwelling units or less.

## **II. ON-SITE PROCESS**

The purpose of the on-site visit is to collect all necessary information to conduct an appropriate energy usage and health and safety analysis, including sufficient information to complete an energy model. The intent is to evaluate building envelope, assess building airflow, inventory HVAC and other energy systems equipment, identify ventilation systems, and perform diagnostic testing.

The following process includes manufactured home, site built and small multi-family units. In most cases, the process is similar for all housing types. Where the process will differentiate between housing types, the specific differences will be noted.

### **1. Auditor Conduct Standards and Minimum Credentials**

- All sub-grantees and their consultants shall conform to the OHCS contracts, policies, and referenced standards.
- Auditors and Inspectors conducting audits shall have the minimum skills, credentials and experience detailed under section 2.20.1 of the Oregon USDOE state plan. At a minimum, Auditors shall be capable of effectively performing the following tasks:
  - Energy modeling utilizing REM/Design™ software.
  - Building assessment (identifying safety, code, durability and energy systems issues).
  - Diagnostic testing (Blower door, duct pressure testing, pressure diagnostics etc.)
  - Combustion appliance safety testing.
  - Feasibility analysis for the installation of energy efficient building improvements.

### **2. Scheduling the Site Visit and Tenant Notification**

- Notification of the client(s), whose home(s) will be reviewed during audit site visit, will be the responsibility of sub-grantee, the property owner, or their representative.
- The Auditor shall schedule the site visit(s) with the designated person(s) at a time that is convenient for the project contact person(s). The site visit should seek to cause minimal disruption for the client.

### **3. Site Visit Preparation**

To facilitate the on-site portion of the energy audit, it is recommended that the following items be addressed prior to arrival.

- Review the income verification to verify the client(s) is/are eligible to participate in the weatherization program.
- Review 12 months of prior utility bills, if available. (Including gas and electric) to know annual utility cost by fuel type and seasonal variations.
- Review existing mechanical equipment information as available.
- Verify with contact that you will have access to all portions of the property.
- Verify that wood burning equipment will not be in use on the day of the audit if possible.

#### **4. Site Visit Field procedures**

The on-site energy audit shall be comprised of an in-person visit to the project by a qualified Auditor to complete the following tasks:

##### **4.1 Project Interview(s)**

The Auditor shall interview at least one of the following designated person(s) prior to or at the time of the site visit:

- Building Occupant/Client
- Owner or Owner Representative

The purpose of the interview(s) is to:

- Discuss the structures energy performance.
- Discuss occupant comfort, health and safety.
- Discuss any behavioral or other factors affecting energy performance.
- Address any other occupant questions or concerns.

The interview shall include questioning on site conditions and deferred maintenance issues. If an occupant wishes their responses to remain confidential, the Auditor shall respect those requests.

##### **4.2 Safety and Code Observations During the Site Visit**

Each site visit must address specific minimum health and safety checks. The Health & Safety plan contained in the Oregon USDOE state plan, as well as the Oregon Site Built and Mobile Home specifications, apply to this policy. Where not referenced specifically, the following minimum health and safety checks shall be conducted and recorded in the Energy Audit Report or supporting documentation.

- Note likelihood of lead presence based on age of building as relevant to EPA & Oregon CCB RRP Rules.
- Mold and Mildew Assessment per Exhibit 6 of the USDOE State plan.
- Structural, electrical and mechanical systems visual inspections.
- If a combustion appliance of any type is present, the following testing is required as per Appendix D, Section V – 2 of the USDOE state plan:

- Ambient CO testing
- Worst case depressurization (excludes ranges and ovens)
- Draft testing (excludes fireplaces, woodstoves, pellet stoves and sealed combustion appliances)
- Undiluted flue gas CO testing (excludes fireplaces, woodstoves, pellet stoves)

### **4.3 Visual Inspection and Diagnostic Testing Protocols**

The site visit shall include visual inspections and diagnostic testing of the building envelope, HVAC and combustion appliances. Minimum visual and diagnostic testing criteria are provided in the Oregon USDOE Health & Safety Plan and the Oregon Site Built and Mobile Home Weatherization Specifications. These standards provide the minimum required testing procedures for Combustion Appliance Safety, Blower Door and Duct Leakage Testing. *All testing, both pre and post, must be documented on a diagnostic testing form. The form must be signed and dated by the person doing the testing for both pre and post testing.* An overview of diagnostic testing protocols is listed below. For more detail refer to the referenced documents.

- Blower door testing: Pre and post blower door testing is required on all single family and mobile home projects unless conditions prohibit. All blower door tests must include zonal pressure testing of all spaces adjacent to conditioned space. On multi-family projects it is allowable to test a representative sample. See section 8.02 of the Oregon Site Built and Mobile home weatherization specifications.
- Duct leakage testing: Pre and post duct leakage testing is required on all homes with forced air heating systems unless conditions prohibit. See section 8.08 of the Oregon Site Built and Mobile Home weatherization Specifications.
- Ventilation airflow testing: All exhaust fans must have airflow measured if possible. ASHRAE compliant fans must be tested post weatherization. See section 9 of the Oregon Site Built and Mobile Home weatherization Specifications.
- Room pressure testing: Room to room pressure testing must be completed on all homes when forced air heating is present. See appendix U of the Oregon Site Built and Mobile Home weatherization Specifications.

### **4.4 On Site Audit**

The on-site energy audit shall be comprised of an in-person visit to the project by a qualified Auditor (or Audit Team) to complete the following tasks:

#### 4.4.1 Dwelling Assessment

The dwelling assessment shall be performed by a person or team qualified to perform assessments under Oregon's DOE WAP program and as described herein.

The assessment is used to ensure that all health and safety concerns are identified and the information collected during the assessment may be used in the modeling and analysis phase of the energy audit.

#### 4.4.2. On-Site Audit

In addition to the standard assessment, the information needed to populate an energy model must be collected for a REM/Design™ energy audit. This includes the information listed below.

- General Building Design Characteristics
  - Type of building. ( Mobile home, site built, multi-family)
  - Number of units in building. ( If applicable)
  - Number of floors above grade.
  - Foundation type
  - Total conditioned area
  - Conditioned area of each floor
  - Number of bedrooms
  - Ceiling height and ceiling/attic characteristics
- Building Envelope Characteristics
  - Ceiling type, area and insulation level
  - Above-grade wall type, area and insulation level
  - Foundation wall type, area and insulation level
  - Frame floor type, area and insulation level
  - Rim Joist type, area and insulation level
  - Door types, size and R-value
- Window Properties of all Windows
  - Window Area (for each window/glazed area.) Includes: sliding glass doors, glass block, etc.
  - Window Type (single pane, dual pane low-E, etc.)
  - Window Material (metal frame, wood, vinyl, metal clad etc.)
  - Window Orientation (typically associated with each wall surface)
- Mechanical Equipment Properties
  - Heating Equipment
    - Fuel Type
    - Location and Type

- Model number and manufacturer
  - Rated Output Capacity ( in KBTUH)
  - Seasonal Equipment Efficiency (AFUE, HSPF, %EFF, COP)
  - Number of units
- Cooling Equipment
  - Fuel Type
  - Location and type
  - Model number and manufacturer
  - Rated Output Capacity (In BTUh)
  - Seasonal Equipment Efficiency (SEER, EER, %EFF, COP) Note: For most AC systems, SEER or EER are the most common metrics.
  - Number of units
- Ventilation Types (if applicable)
  - Ventilation Rate (CFM)
  - Hours/Day of Operation (if known)
  - Ventilation Strategy for Passive Cooling (i.e., natural ventilation or whole house fan installed)
- Distribution Systems for HVAC Systems (When present)
  - Square footage of supply ductwork.
  - Square footage of return ductwork.
  - Location of ductwork.
  - R-value on ductwork.
- Water Heating Equipment
  - Water Heater Type
  - Location of water heating equipment
  - Fuel Type
  - Energy Factor
  - Tank Size
  - Extra Tank Insulation R-value

#### **4.5 Health & Safety**

The Oregon WAP requires that the clients' safety and well-being must be considered throughout the weatherization process. The audit process must include all aspects of Appendix D of the USDOE state plan as well as specific testing protocols contained in the Oregon Site Built Weatherization Specifications. Health & Safety repairs do not have to be included in SIR calculations.

## **4.6 Energy Education**

During the site visit both auditors and inspectors will provide basic client education to the client. At the initial audit, the auditor provides the initial information and the Inspector must provide additional energy education to reinforce the information provided at the audit. Subgrantees are required to provide client education that encourages households to reduce their home energy needs. Each Subgrantee has the latitude to develop their own client education program but they must provide at least the following.

- Written information that describes energy saving behavioral adjustments that will decrease the energy consumption of the household;
- Discuss the importance of indoor air quality, the purpose and benefits of the ASHRAE 62.2 requirement and the importance of using and maintaining ventilation equipment.
- Information in the use and maintenance of any equipment installed including but not limited to, CO Alarms, furnaces and ventilation equipment. This must be provided verbally as well as any users/maintenance manuals must be provided to clients.
- Any health and safety issues identified must be discussed with the client and appropriate actions taken as stated in the Appendix D of the USDOE H&S plan.
- Discuss the benefits that can be expected of the weatherization measures to be installed and how to maximize the effect of each measure.

## **4.7 On-Site Inspection**

100% of all completed units must be inspected by the subgrantee. A thorough on-site inspection and documentation of each dwelling unit including pre and post weatherization blower door testing, pre and post duct blaster testing when a forced air system is in use, pre and post health and safety testing results, ASHRAE compliant fan flows measured and review of all installed measures for compliance with the standards set forth in the Oregon Site Built and Mobile Home Weatherization Specifications. Inspection results must be documented on an inspection form listing all measures installed signed and dated by the inspector. Diagnostic and H&S testing must be documented on a diagnostic testing form signed and dated by the inspector.

Allowances are made for a representative sample of blower door test to be completed on buildings with 5 or more units. See section 8.02 of the Oregon Mobile Home and Site Built Weatherization Specifications.

OHCS QA inspectors will perform inspections of the installed weatherization measures on a minimum of 5% percent of completed projects. These inspections will be comprised of a statewide random sampling of the homes weatherized. Diagnostic tests will be re-performed on a sampling of dwellings to ensure that the tests are being properly conducted.

### **III. ENERGY MODELING AND ANALYSIS PROCESS**

An energy model of the building's pre and post-retrofit performance shall be completed using initial inspection data and diagnostic data collected during the on-site visits.

REM/Design™ energy modeling is used to estimate annual energy consumption and energy cost savings of most potential energy conservation measures for dwellings as defined in Section III, 1.1. All energy and cost savings results from the REM/Design™ model must be verified against known conditions and usage profiles existing at the residence. All REM/Design™ models must be trued to actual metered usage to the greatest extent possible.

#### **1. Energy Modeling Software Requirements:**

The REM/Design™ energy modeling software platform has been approved by DOE for use in the OR WAP program for single family, manufactured and small multifamily dwellings. The energy audit software policy is provided below.

##### **REM/Design™ Dwelling Criteria**

As defined in the policy, REM/Design™ audit is to be used for the following building types:

- Single-family dwellings up to 4-plexes,
- Manufactured homes, and
- Low-rise multifamily buildings:
  - Containing five to 25 dwelling units,
  - Having 3 stories or fewer and,
  - Where buildings containing 5 to 25 dwelling units are heated and cooled independently.

The REM/Design™ energy audit process requires a physical inspection of the home, specific diagnostic tests, and proper data input into the software program. An energy profile of the existing home is compared to a set of improvements recommended for installation. Each measure is then evaluated and a report is generated with the cost-effectiveness of each measure listed by SIR (Savings to Investment Ratio).

#### **2. SIR Requirements**

- All measures must be interacted.
- Mortgage discount rate must be set at 3.0
- Measure costs modeled must include the cost of materials, labor and on-site supervision.
- Individual measures, except air sealing (see section 8), must have an SIR 1.0 or greater by themselves.
- All cost effective measures, including air sealing costs, must have a grouped SIR of 1.0 or greater.

### **3. User Defined Measures**

REM/Design™ allows that users may define measures that are not included the existing libraries. Any user defined entries must be reviewed for accuracy by a person certified by OHCS in the use of REM/Design™. User defined entries must follow criteria listed in the OHCS REM/Design™ Technical Policies.

Compliance in the use of user defined measures will be ensured through the monitoring process. Projects will be randomly selected for the monitoring process. Agencies are required to supply the REM/Design™ electronic files to be reviewed to OHCS for all aspects of modeling including user defined measures.

### **4. Single family (2-4 UNIT), Small Multi-family Modeling Considerations**

These considerations apply to all small multi-family dwellings as well as any single-family dwelling composed of more than one individual unit.

<b>Parameter</b>	<b>Requirement</b>
REM/Design™ Input Mode	Detailed
Housing Type	Multi-family whole building
Walls	Account for all walls adjacent to unconditioned space such as garages or outdoors. (Do not model walls between units)
Floors	Account for all floors adjacent to unconditioned space such as garages, ground, crawlspace, etc. Do not include floors adjacent to other apartments or common areas.
Ceilings	Account for all ceilings adjacent to unconditioned space such as attics or vaulted ceilings adjacent to outdoors. Do not include any ceilings adjacent to other apartments or conditioned space.
Number of Bedrooms	Include all bedrooms in the building
Mechanical Equipment	Each model of similar equipment types must be accounted for. Instances of similar models may be input as increases quantities of that model.

As seen in the specifications above, all interior walls and ceilings are omitted. When inputting the number of bedrooms the model must account for the TOTAL number of bedrooms in the entire building, not just the number of bedrooms per dwelling. The model must also account for all mechanical equipment in the building. When inputting mechanical equipment each piece can be manually created or if all pieces of equipment are identical the number of units can be increased on the “Mechanical Equipment Properties Summary” page in REM/Design™.

## **5. Mobile Home Special Considerations**

Although REM/Design™ allows for modeling shell measures using “quick fill mobile home”, it is allowable and encouraged to model mobile home shell measures using “quick fill site built”.

## **6. Mechanical Equipment Properties**

Whenever possible, actual equipment information indicated on the mechanical equipment, or made available by manufacturer or professional web site, are to be input as existing properties, e.g., AFUE, SEER and EF, for the furnace, air conditioner, and hot water heater, respectively. Further, a performance adjustment of 100% (functions as new) is used when modeling mechanical equipment for the building. Reducing the performance adjustment is only allowed when actual energy usage justifies a reduction **and** the equipment is in need of repair. Any time a performance adjustment is used, the equipment must be repaired and the cost justified with an SIR of 1.0 or better. Default properties are to be used ONLY when values are unavailable from equipment nameplates, equipment tags, etc. Using the REM/Design™ energy audit for change out of mechanical equipment is strictly for “efficiency” purposes. However, before a faulty furnace may be replaced as a health and safety measure, the existing furnace to new furnace upgrade must be proven non-cost effective with an SIR of less than 1.0.

## **7. Duct System**

The duct system may be sealed and insulated during weatherization. Energy savings must be based on leakage measured through the use of the Duct Blaster. Both a pre and post test must be performed when duct sealing is completed. If the final duct leakage reduction does not achieve 75% of the targeted reduction, the post duct leakage rate must be input into the REM/Design™ model and an updated SIR produced.

Example:	Pre leakage	300 cfm
	Estimated Post leakage	100 cfm
	Targeted reduction	200 cfm

200 cfm x 75% = 150 cfm minimum reduction is required.

## **8. Air Infiltration**

The building envelope must be sealed during weatherization. Air infiltration, as an individual conservation measure, is not required to have an SIR of 1.0 or better. However, when all cost effective measures are packaged together with the infiltration measure, the overall job cost must have a SIR of 1.0 or greater.

Energy savings for air infiltration in Manufactured and single family homes must be based on actual measured flow using a blower door. Both a pre and post weatherization blower door test must be completed. If the final blower door results do not achieve 75% of the targeted reduction, the post blower door measured flow must be input into the REM/Design™ model and an updated grouped SIR produced.

Example:

Pre Blower door	2000 cfm
Estimated post blower door	1500 cfm
Targeted reduction	500 cfm

500 cfm x 75% = 375 cfm minimum reduction is required.

As Multi-family buildings present difficulties and accurately applying blower door results due to leakage between units, it is allowable to utilize a visual inspection to determine a user's estimate in the REM/Design™ model. A reasonable reduction in infiltration based on the auditors experience may be used to determine energy savings.

## **9. Model Calibration:**

The energy model for all buildings shall, when possible, be calibrated to actual utility billing data. Modeled baseline energy consumption shall be calibrated to monthly utility bills for a minimum of twelve months when billing data is available. The intent is to qualify the energy model by demonstrating similarity to the metered energy usage over a 12 month time frame.

1. The energy model estimates of electricity and natural gas should calibrate as close as possible to actual annual energy consumption.
2. Baseload and heating load ratios shall be calculated using the OHCS utility consumption analysis spreadsheet or other calculator as approved by OHCS.
3. Typical Meteorological Year (TMY) 30 year average weather data must be used in energy modeling.
4. In the event that a building is served by more than one meter, the bills for those meters shall be aggregated and the consumption calculated for the building as a whole.

## **10. Incidental Repairs**

Incidental repairs necessary for the effective performance or preservation of weatherization materials are allowed. When a repair activity is a component of an energy efficiency measure that is being installed then the installation and materials are part of the efficiency measure and are classified as incidental repair. The cost of

incidental repairs must be included in the cost of the package of measures. The entire package of measures installed on a project, including incidental repair costs, must be cost justified with an SIR of 1.0 or better. See the Oregon USDOE State plan Appendix D Section VIII – 1 for details.

### **11. Measure Buy Down**

In the event that non-federal financial resources are leveraged to buy down a particular measure, the following criteria must be met:

- 1) The SIR of the discounted measure must be 1.0 or greater when SIR is calculated with only the WAP funds contribution.
- 2) The file must contain a funding summary sheet clearly identifying which measures needed to be discounted using non-WAP funds, the type of funding used and the amount of funds necessary to accomplish the buy-down.
- 3) Discounted measures may not be installed before non-discounted measures and are only to be installed when all other available cost effective measures not requiring buy-down have been installed. In no case shall measures with higher SIRs be skipped or “leapfrogged” for measures with lower SIRs.
- 4) The cost effective portion of measures may be calculated by:
  1. by adjusting the cost entered in REM/Design™ until an SIR or 1.0 is achieved or;
  2. Entering the full measure cost into REM/Design™ and subtracting the present value from the full cost to determine the cost effective portion.Note: When using this method, when creating the grouped report, only the cost effective portion should be included.

### **12. Utility Rates:**

Actual utility rates in use at the time of the computer modeling of the project must be used. Metered utilities (electric & natural gas) must include all rate tiers as well as any monthly service charges. Metered utility rates must be updated, at minimum, annually. For Non-metered fuel sources such as propane, wood, pellets or fuel oil local rates at the time of the energy audit must be used.

### **13. Report Generation**

The following Reports must be generated and included in the building file:

- Improvement analysis Reports showing:
  - Measures and SIR’s listed individually.
  - All cost effective measures as well as air infiltration and any incidental repair costs grouped for an overall SIR.
- Fuel summary report
- Performance summary report: A two building report comparing the improved building to the unimproved building.

## **14. Measures Considered**

All materials/measures considered by the audit must conform to requirements contained in 10CFR440, Appendix A (See Appendix C)

Measures considered by the audit include:

- Ceiling Insulation;
- Primary window replacements;
- Storm window installation;
- Primary door replacement;
- Wall insulation;
- Floor insulation;
- Rim Joist Insulation;
- Heating duct Insulation;
- Heating duct sealing;
- Water heater replacements;
- Heating system replacements;
- Mechanical equipment performance adjustments;
- Air infiltration;
- LED Lighting
- Energy related incidental repairs

## **15. List of General Heat Waste Materials**

The following measures are determined to be generally cost effective and do not have to be cost justified in a site specific energy audit. The total cost of all general heat waste items, including labor, must not exceed \$250.

- Water heater insulation;
- Water pipe wrap (On the first 6 feet of water pipe on an existing water heater)
- Low flow showerheads and faucet aerators;
- Limited weather-stripping and caulking to increase comfort
- Furnace filters;
- Compact fluorescent light bulbs where fixtures are used more than three hours a day.

## **APPENDIX A: PROJECT REPORT CONTENT REQUIREMENTS**

This section identifies the scope and level of detail that should be included in all project files.

### **Section 1: General Information**

- 1) General information
  - a. Project Description
    - i. Address of project
    - ii. Building configuration. Include a general description of the following:
      1. Type of structure(s)
      2. Number of stories
      3. Heating source/fuel type.
  - b. Measures completed/ funding summary. List the following:
    1. Description of measure
    2. Cost of measure
    3. Funding sources utilized and amounts for each measure
    4. Identify measure as health & safety, incidental repair or energy improvement measure
    5. If non-federal dollars were utilized to buy down the cost of a measure, provide an explanation of the cost effective amount of the measure and the amount of non-federal funding necessary to accomplish the buy down of the measure.
  - c. Summary of site visit (dates, participants, any relevant notes)

### **Section 2: Existing Conditions**

The audit documentation should guide the reviewer through the steps taken to conduct the energy audit and analysis. The audit form must identify the auditor completing the audit as well as the date the audit was performed. When applicable, labeled photos should be included in the appropriate sections.

- 1) Existing building conditions. Provide a detailed description of the following:
  - a. Building diagram
  - b. Site layout and number of units for Multi-family Units
  - c. Building construction types
  - d. Number of stories
  - e. Year Built
  - f. Total building area identified by use. ( residential, common, commercial)
  - g. Other significant building/project features

- h. Include photos of buildings to document existing conditions
- 2) Existing building components and energy systems
  - a. Building envelope
    - i. Wall construction: List the following for wall sections by type (exterior, buffered, foundation etc.)
      - 1. Construction type (concrete, brick, wood framed etc.)
      - 2. Existing R-value
      - 3. Gross wall area
      - 4. Net wall area
    - ii. Roof construction: List the following for all ceiling sections.
      - 1. Construction type (vaulted, flat roof, attic space etc.)
      - 2. Existing R-value
      - 3. Ceiling area for each identified type
    - iii. Floor/basement construction: List the following for all floor types
      - 1. Crawlspace/ basement
      - 2. Conditioned or unconditioned
      - 3. Existing R-value
      - 4. Floor area for each identified type
    - iv. Windows:
      - 1. Types of windows for each orientation of the building
      - 2. Area of glazing for each window type broken down by orientation.
    - v. Doors:
      - 1. Types of doors
      - 2. Location of doors
    - vi. HVAC Systems
      - 1. Heating system description for all heating equipment
        - a. Make, model, type and age of equipment
        - b. Required testing results
        - c. Characterization of the distribution system if applicable
        - d. Notes of any special circumstances
        - e. Photos if relevant
      - 2. Cooling system description for all cooling equipment
        - a. Make, model, type and age of equipment
        - b. Required testing results
        - c. Characterization of the distribution system if applicable
        - d. Notes of any special circumstances
        - e. Photos if relevant
      - 3. Ventilation systems
        - a. Type of ventilations system
        - b. Measured capacity if possible
        - c. Notes of any special circumstances

- d. Photos if relevant
- vii. Water Heating Systems
  - 1. Make, model, type, capacity, energy factor and age of equipment
  - 2. Required testing results of any fuel fired water heaters
  - 3. Notes of any special circumstances
  - 4. Photos if relevant
- viii. Utility Bill Breakdown
  - 1. One year's utility bill data for all fuel types utilized on the project.
  - 2. Analysis of the utility bills to break out baseload and heating load.

### **Section 3: Evaluated Measures**

- 1) Recommended energy efficiency measures
  - a. A short narrative of each recommended energy efficiency measure
  - b. Recommended replacement specifications
  - c. Projected annual monetary savings
  - d. SIR
- 2) Energy efficiency measures not recommended
  - a. A short narrative of any measures that were evaluated, but not completed. Narrative should explain any special circumstances that prevented the installation of the measure.
- 3) Recommended health & safety measures
  - a. A Short narrative of recommended health and safety measures.

### **Section 4: Report Generation**

- 1) Energy Model reports for REM/Design™
  - a) Fuel summary report
  - b) Performance summary report
  - c) Improvement analysis report
    - i) One copy with all measures run individually
    - ii) One copy with all cost effective measures as well as air infiltration and any incidental repair costs grouped for an overall SIR of 1.0 or better.

### **Section 5: Notifications and Documentation**

- 1) Lead Notifications:
  - a) Confirmation of receipt of lead pamphlet for each tenant and landlord
  - b) Photo documentation of lead safe practices
  - c) Copy of the test kit documentation form if any testing is completed
  - d) Completed and signed renovator checklist

- 2) Testing Documentation: A diagnostic testing form must document the following:
  - a) Blower doors: Include test results, for both pre and post testing.
  - b) Zonal pressure testing of all spaces adjacent to conditioned space.
  - c) Duct testing: include test results, both pre and post for all units requiring a duct test.
  - d) Combustion testing: Results for both pre and post testing.
    - i) Worst Case Combustion Appliance Zone (CAZ) pressures (excludes ranges)
    - ii) Draft pressures under worst case. Include outdoor temperature at the time of the testing. (Excludes sealed combustion appliances, woodstoves, ranges and pellet stoves)
    - iii) CO testing results. Include ambient CO for unit and measured CO in each combustion appliance.
  - e) ASHRAE 62.2 Documentation: Include documentation of final fan settings and flow measurements on all fans installed for ASHRAE 62.2 compliance.

Note: The Diagnostic testing form must identify the auditor/inspector completing the testing both pre and post weatherization. The form must be signed and dated by the auditor/inspector completing the testing.

- 3) Mold & Mildew:
  - a) Completed copy of the mold & mildew checklist.
  - b) If mold & mildew problems are identified, provide documentation of steps taken to resolve the problem.
  - c) Documentation of mold & mildew pamphlet being delivered.  
See exhibit 6 of the Oregon USDOE State plan
- 4) Health & Safety Hazard form: If health & safety hazards are identified, a health & safety form must be included in the file. See Appendix D, section V in the Oregon USDOE state plan for details.

**Appendix B: Effective useful Lives**

<b>Effective Useful Lives</b>		
<b>Measure</b>	<b>Mobile Homes</b>	<b>Site Built</b>
Ceiling Insulation	25	45
Floor Insulation	25	45
Wall Insulation	25	45
Rigid Insulation	25	45
Steel Doors	20	20
Mobile Home Doors	15	NA
Rim Joist Insulation	NA	45
Windows	25	25
Storm Windows	20	20
CFL Lighting	7	7
LED Lighting	12	12
Water Heaters	15	15
Duct Sealing	20	20
Duct Insulation	20	20
Refrigerators	20	20
Infiltration	20	20
Furnace Replacement	20	20
Ductless Heat Pump	20	20
Ducted Heat Pump	20	20

## APPENDIX C: DOE APPROVED MATERIALS (10CFR440, APPENDIX A)

### ***Standards for Weatherization Materials***

The following Government standards are produced by the Consumer Product Safety Commission and are published in title 16, Code of Federal Regulations:

Thermal Insulating Materials for Building Elements Including Walls, Floors, Ceilings, Attics, and Roofs Insulation—organic fiber—conformance to Interim Safety Standard in 16 CFR part 1209;

Fire Safety Requirements for Thermal Insulating Materials According to Insulation Use—Attic Floor—insulation materials intended for exposed use in attic floors shall be capable of meeting the same flammability requirements given for cellulose insulation in 16 CFR part 1209;

Enclosed spaces—insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smoldering combustion requirements in 16 CFR part 1209.

The following standards which are not otherwise set forth in part 440 are incorporated by reference and made a part of part 440. The following standards have been approved for incorporation by reference by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on April 5, 1993 and a notice of any change in these materials will be published in the Federal Register. The standards incorporated by reference are available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

The standards incorporated by reference in part 440 can be obtained from the following sources:

Air Conditioning and Refrigeration Institute, 1501 Wilson Blvd., Arlington, VA 22209; (703) 524-8800.

American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209; (703) 841-8400.

American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018; (212) 642-4900.

American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017; (212) 705-7800.

American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103; (215) 299-5400.

American Architectural Manufacturers Association, 1540 East Dundee Road, Palatine, IL 60067; (708) 202-1350.

Federal Specifications, General Services Administration, Specifications Section, Room 6654, 7th and D Streets, SW, Washington, DC 20407; (202) 708-5082.

Gas Appliance Manufacturers Association, 1901 Moore St., Arlington, VA 22209; (703) 525-9565.

National Electrical Manufacturers Association, 2101 L Street, NW, Suite 300, Washington, DC 20037; (202) 457-8400.

National Fire Protection Association, Batterymarch Park, P.O. Box 9101, Quincy, MA 02269; (617) 770-3000.

National Standards Association, 1200 Quince Orchard Blvd., Gaithersburg, MD 20878; (301) 590-2300. (NSA is a local contact for materials from ASTM).

National Wood Window and Door Association, 1400 East Touhy Avenue, Des Plaines, IL 60018; (708) 299-5200.

Sheet Metal and Air Conditioning Contractors Association, P.O. Box 221230, Chantilly, VA 22022-1230; (703) 803-2980.

Steel Door Institute, 712 Lakewood Center North, 14600 Detroit Avenue, Cleveland, OH 44107; (216) 899-0100.

Steel Window Institute, 1230 Keith Building, Cleveland, OH 44115; (216) 241-7333.

Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591; (914) 332-0040.

Underwriters Laboratories, Inc., P.O. Box 75530, Chicago, IL 60675-5330; (708) 272-8800.

More information regarding the standards in this reference can be obtained from the following sources:

Environmental Protection Agency, 401 M Street, NW, Washington, DC 20006; (202) 554-1080.

National Institute of Standards and Technology, U.S. Department of Commerce, Gaithersburg, MD 20899, (301) 975-2000

Weatherization Assistance Programs Division, Conservation and Renewable Energy, Mail Stop 5G-023, Forrestal Bldg, 1000 Independence Ave, SW, Washington, DC 20585; (202) 586-2207.

**Thermal Insulating Materials for Building Elements Including Walls, Floors, Ceilings, Attics, and Roofs**

[Standards for conformance]

<b>Insulation—mineral fiber:</b>	
Blanket insulation	ASTM <sup>1</sup> C665-88.
Roof insulation board	ASTM C726-88.
Loose-fill insulation	ASTM C764-88.
<b>Insulation—mineral cellular:</b>	
Vermiculite loose-fill insulation	ASTM C516-80 (1990).
Perlite loose-fill insulation	ASTM C549-81 (1986).
Cellular glass insulation block	ASTM C552-88.
Perlite insulation board	ASTM C728-89a.
<b>Insulation—organic fiber:</b>	
Cellulosic fiber insulating board	ASTM C208-72 (1982).
Cellulose loose-fill insulation	ASTM C739-88.
<b>Insulation-organic cellular:</b>	
Preformed block-type polystyrene insulation	ASTM C578-87a.
Rigid preformed polyurethane insulation board	ASTM C591-85.
Polyurethane or polyisocyanurate insulation board faced with aluminum foil on both sides	FS <sup>2</sup> HH-I-1972/1 (1981).
Polyurethane or polyisocyanurate insulation board faced with felt on both sides	FS HH-I-1972/2 (1981). And Amendment 1, October 3, 1985.
<b>Insulation—composite boards:</b>	
Mineral fiber and rigid cellular polyurethane composite roof insulation board	ASTM C726-88.
Perlite board and rigid cellular polyurethane composite roof insulation	ASTM C984-83.
Gypsum board and polyurethane or polyisocyanurate composite board	FS HH-I-1972/4 (1981).
Materials used as a patch to reduce infiltration through the building envelope	Commercially available.

<sup>1</sup>ASTM indicates American Society for Testing and Materials.

<sup>2</sup>FS indicates Federal Specifications.

Thermal Insulating Materials for Pipes, Ducts, and Equipment Such as Boilers and Furnaces

[Standards for conformance]

<b>Insulation—mineral fiber:</b>	
Preformed pipe insulation	ASTM <sup>1</sup> C547–77.
Blanket and felt insulation (industrial type)	ASTM C553–70 (1977).
Blanket insulation and blanket type pipe insulation (metal-mesh covered) (industrial type)	ASTM C592–80.
Block and board insulation	ASTM C612–83.
Spray applied fibrous insulation for elevated temperature	ASTM C720–89.
High-temperature fiber blanket insulation	ASTM C892–89.
Duct work insulation	Selected and applied according to ASTM C971–82.
<b>Insulation—mineral cellular:</b>	
Diatomaceous earth block and pipe insulation	ASTM C517–71 (1979)
Calcium silicate block and pipe insulation	ASTM C533–85 (1990).
Cellular glass insulation	ASTM C552–88.
Expanded perlite block and pipe insulation	ASTM C610–85.
<b>Insulation—Organic Cellular:</b>	
Preformed flexible elastomeric cellular insulation in sheet and tubular form	ASTM C534–88.
Unfaced preformed rigid cellular polyurethane insulation	ASTM C591–85.
<b>Insulation skirting</b>	Commercially available.

<sup>1</sup>ASTM indicates American Society for Testing and Materials.

Fire Safety Requirements for Insulating Materials According to Insulation Use

[Standards for conformance]

Attic floor	Insulation materials intended for exposed use in attic floors shall be capable of meeting the same smoldering combustion requirements given for cellulose insulation in ASTM <sup>1</sup> C739–88.
Enclosed space	Insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smoldering combustion requirements in ASTM C739–88.
Exposed interior walls and ceilings	Insulation materials, including those with combustible facings, which remain exposed and serve as wall or ceiling interior finish, shall have a flame spread classification not to exceed 150 (per ASTM E84–89a).
Exterior envelope walls and roofs	Exterior envelope walls and roofs containing thermal insulations shall meet applicable local government building code requirements for the complete wall or roof assembly.
Pipes, ducts, and equipment	Insulation materials intended for use on pipes, ducts and equipment shall be capable of meeting a flame spread classification not to exceed 150 (per ASTM E84–89a).

<sup>1</sup>ASTM indicates American Society for Testing and Materials.

Storm Windows

[Standards for conformance]

Storm windows:	
Aluminum insulating storm windows	ANSI/AAMA <sup>1</sup> 1002.10–83.
Aluminum frame storm windows	ANSI/AAMA 1002.10–83.
Wood frame storm windows	ANSI/NWWDA <sup>2</sup> I.S. 2–87. (Section 3)
Rigid vinyl frame storm windows	ASTM <sup>3</sup> D4099–89.
Frameless plastic glazing storm	Required minimum thickness windows is 6 mil (.006 inches).
Movable insulation systems for windows	Commercially available.

<sup>1</sup>ANSI/AAMA indicates American National Standards Institute/American Architectural Manufacturers Association.

<sup>2</sup>ANSI/NWWDA indicates American National Standards Institute/National Wood Window & Door Association.

<sup>3</sup>ASTM indicates American Society for Testing and Materials.

**Storm Doors**

[Standards for conformance]

Storm doors—Aluminum:	
Storm Doors	ANSI/AAMA <sup>1</sup> 1102.7–89.
Sliding glass storm doors	ANSI/AAMA 1002.10–83.
Wood storm doors	ANSI/NWWDA <sup>2</sup> I.S. 6–86.
Rigid vinyl storm doors	ASTM <sup>3</sup> D3678–88.
Vestibules:	
Materials to construct vestibules	Commercially available.
Replacement windows:	
Aluminum frame windows	ANSI/AAMA 101–88.
Steel frame windows	Steel Window Institute recommended specifications for steel windows, 1990.
Wood frame windows	ANSI/NWWDA I.S. 2–87.
Rigid vinyl frame windows	ASTM D4099–89.

<sup>1</sup>ANSI/AAMA indicates American National Standards Institute/American Architectural Manufacturers Association.

<sup>2</sup>ANSI/NWWDA indicates American National Standards Institute/National Wood Window & Door Association.

<sup>3</sup>ASTM indicates American Society for Testing and Materials.

**Replacement Doors**

[Standards for conformance]

Replacement doors—Hinged doors:	
Steel doors	ANSI/SDI <sup>1</sup> 100–1985.

Wood doors:	
Flush doors	ANSI/NWWDA <sup>2</sup> I.S. 1–87. (exterior door provisions)
Pine, fir, hemlock and spruce doors	ANSI/NWWDA I.S. 6–86.
Sliding patio doors:	
Aluminum doors	ANSI/AAMA <sup>3</sup> 101–88.
Wood doors	NWWDA I.S. 3–83.

<sup>1</sup>ANSI/SDI indicates American National Standards Institute/Steel Door Institute.

<sup>2</sup>ANSI/NWWDA indicates American National Standards Institute/National Wood Window & Door Association.

<sup>3</sup>ANSI/AAMA indicates American National Standards Institute/American Architectural Manufacturers Association.

**Caulks and sealants:**

[Standards for conformance]

Caulks and sealants:	
Putty	FS <sup>1</sup> TT–P–00791B, October 16, 1969 and Amendment 2, March 23, 1971.
Glazing compounds for metal sash	ASTM <sup>2</sup> C669–75 (1989).
Oil and resin base caulks	ASTM C570–72 (1989).
Acrylic (solvent types) sealants	FS TT–S–00230C, February 2, 1970 and Amendment 2, October 9, 1970.
Butyl rubber sealants	FS TT–S–001657, October 8, 1970.
Chlorosulfonated polyethylene sealants	FS TT–S–00230C, February 2, 1970 and Amendment 2, October 9, 1970.
Latex sealing compounds	ASTM C834–76 (1986).
Elastomeric joint sealants (normally considered to include polysulfide, polyurethane, and silicone)	ASTM C920–87.
Preformed gaskets and sealing materials	ASTM C509–84.

<sup>1</sup>FS indicates Federal Specifications.

<sup>2</sup>ASTM indicates American Society for Testing and Materials.

**Weatherstripping**

[Standards for conformance]

Weatherstripping	Commercially available.
Vapor retarders	Selected according to the provisions cited in ASTM <sup>1</sup> C755–85 (1990). Permeance not greater than 1 perm when determined according to the desiccant method described in ASTM E96–90.
Items to improve attic ventilation	Commercially available.
Clock thermostats	NEMA <sup>2</sup> DC 3–1989.

<sup>1</sup>ASTM indicates American Society for Testing and Materials.

<sup>2</sup>NEMA indicates National Electrical Manufacturers Association.

**Heat Exchangers**

[Standards for conformance]

Heat exchangers, water-to-water and steam-to-water	ASME <sup>1</sup> Boiler and Pressure Vessel Code, 1992, Sections II, V, VIII, IX, and X, as applicable to pressure vessels. Standards of Tubular Exchanger Manufacturers Association, Seventh Edition, 1988.
Heat exchangers with gas-fired appliances <sup>2</sup>	Conformance to AGA <sup>3</sup> Requirements for Heat Reclaimer Devices for Use with Gas-Fired Appliances No. 1–80, June 1, 1980. AGA Laboratories Certification Seal.
Heat pump water heating heat recovery systems	Electrical components to be listed by UL. <sup>4</sup>

<sup>1</sup>ASME indicates American Society of Mechanical Engineers.

<sup>2</sup>The heat reclaimer is for installation in a section of the vent connector from appliances equipped with draft hoods or appliances equipped with powered burners or induced draft and not equipped with a draft hood.

<sup>3</sup>AGA indicates American Gas Association.

<sup>4</sup>UL indicates Underwriters Laboratories.

**Boiler/Furnace Control Systems**

[Standards for conformance]

Automatic set back thermostats	Listed by UL. <sup>1</sup> Conformance to NEMA <sup>2</sup> DC 3–1989.
Line voltage or low voltage room	NEMA DC 3–1989.

thermostats	
Automatic gas ignition systems	ANSI <sup>3</sup> Z21.21–1987 and Z21.21a-1989. AGA <sup>4</sup> Laboratories Certification Seal.
Energy management systems	Listed by UL.
Hydronic boiler controls	Listed by UL.
Other burner controls	Listed by UL.

<sup>1</sup>UL indicates Underwriters Laboratories.

<sup>2</sup>NEMA indicates National Electrical Manufacturers Association.

<sup>3</sup>ANSI indicates American National Standards Institute.

<sup>4</sup>AGA indicates American Gas Association.

#### Water Heater Modifications

[Standards for conformance]

Insulate tank and distribution piping	(See insulation section of this appendix).
Install heat traps on inlet and outlet piping	Applicable local plumbing code.
Install/replace water heater heating elements	Listed by UL. <sup>1</sup>
Electric, freeze-prevention tape for pipes	Listed by UL.
Reduce thermostat settings	State or local recommendations.
Install stack damper, gas-fueled	ANSI <sup>2</sup> Z21.66–1988, including Exhibits A&B, and ANSI Z223.1–1988.
Install stack damper, oil-fueled	UL 17, November 28, 1988, and NFPA <sup>3</sup> 31–1987.
Install water flow modifiers	Commercially available.

<sup>1</sup>UL indicates Underwriters Laboratories.

<sup>2</sup>ANSI indicates American National Standards Institute.

<sup>3</sup>NFPA indicates National Fire Prevention Association.

#### Waste Heat Recovery Devices

[Standards for conformance]

Desuperheater/water heaters	ARI <sup>1</sup> 470–1987.
Condensing heat exchangers	Commercially available components and in new heating furnace systems to manufacturers' specifications.
Condensing heat	Commercially available (Commercial, multi-story building, with

exchangers	Teflon-lined tubes institutional) to manufacturers' specifications.
Energy recovery equipment	Energy Recovery Equipment and Systems Air-to-Air (1978) Sheet Metal and Air-Conditioning Contractors National Association (SMACNA). <sup>2</sup>

<sup>1</sup>ARI indicates Air Conditioning and Refrigeration Institute.

<sup>2</sup>SMACNA denotes Sheet Metal and Air Conditioning Contractors' National Association.

**Boiler Repair and Modifications/Efficiency Improvements**

[Standards for conformance]

Install gas conversion burners	ANSI <sup>1</sup> Z21.8–1984, (for gas or oil-fired systems) ANSI Z21.17–1984, ANSI Z21.17a-1990, and ANSI Z223.1–1988. AGA <sup>2</sup> Laboratories Certification seal.
Replace oil burner	UL <sup>3</sup> 296, February 28, 1989 Revision and NFPA <sup>4</sup> 31–1987.
Install burners (oil/gas)	ANSI Z223.1–1988 for gas equipment and NFPA 31–1987 for oil equipment.
Re-adjust boiler water temperature or install automatic boiler temperature reset control	ASME <sup>5</sup> CSD–1–1988, ASME CSD–1a-1989, ANSI Z223.1–1988, and NFPA 31–1987.
Replace/modify boilers	ASME Boiler and Pressure Vessel Code, 1992, Sections II, IV, V, VI, VIII, IX, and X. Boilers must be Institute of Boilers and Radiation Manufacturers (IBR) equipment.
Clean heat exchanger, adjust burner air shutter(s), check smoke no. on oil-fueled equipment. Check operation of pump(s) and replacement filters	Per manufacturers' instructions.
Repair combustion chambers	Refractory linings may be required for conversions.
Replace heat exchangers, tubes	Protection from flame contact with conversion burners by refractory shield.
Install/replace thermostatic radiator valves	Commercially available. One pipe steam systems require air vents on each radiator; see manufacturers' requirements.
Install boiler duty cycle control system	Commercially available. NFPA 70, National Electrical Code (NEC) 1993 and local electrical codes provisions for wiring.

<sup>1</sup>ANSI indicates American National Standards Institute.

<sup>2</sup>AGA indicates American Gas Association.

<sup>3</sup>UL indicates Underwriters Laboratories.

<sup>4</sup>NFPA indicates National Fire Prevention Association.

<sup>5</sup>ANSI/ASME indicates American National Standards Institute/American Society of Mechanical Engineers.

Heating and Cooling System Repairs and Tune-ups/Efficiency Improvements

[Standards for conformance]

Install duct insulation	FS <sup>1</sup> HH-I-558C, January 7, 1992 (see insulation sections of this appendix).
Reduce input of burner; de-rate gas-fueled equipment	Local utility company and procedures if applicable for gas-fueled furnaces and ANSI <sup>2</sup> Z223.1-1988 (NFPA <sup>3</sup> 54-1988) including Appendix H.
Repair/replace oil-fired equipment	NFPA 31-1987.
Replace combustion chamber in oil-fired furnaces or boilers	NFPA 31-1987.
Clean heat exchanger and adjust burner: adjust air shutter and check CO <sub>2</sub> and stack temperature. Clean or replace air filter on forced air furnace	ANSI Z223.1-1988 (NFPA 54-1988) including Appendix H.
Install vent dampers for gas-fueled heating systems	Applicable sections of ANSI Z223.1-1988 (NFPA 54-1988) including Appendices H, I, J, and K. ANSI Z21.66-1988 and Exhibits A & B for electrically operated dampers.
Install vent dampers for oil-fueled heating systems	Applicable sections of NFPA 31-1987 for installation and in conformance with UL <sup>4</sup> 17, November 28, 1988.
Reduce excess combustion air:	
A: Reduce vent connector size of gas-fueled appliances	ANSI Z223.1-1988 (NFPA 54-1988) Part 9 and Appendices G & H.
B: Adjust barometric draft regulator for oil fuels	NFPA 31-1987 and per manufacturers' (furnace or boiler) instructions.
Replace constant burning pilot with electric ignition device on gas-fueled	ANSI Z21.71-1981, Z21.71a-1985, and Z21.71b-1989.

furnaces or boilers	
Readjust fan switch on forced air gas or oil-fueled furnaces	Applicable sections and Appendix H of ANSI Z223.1–1988 (NFPA 54–1988) for gas furnaces and NFPA 31–1987 for oil furnaces.
Replace burners	See power burners (oil/gas).
Install/replace duct furnaces (gas)	ANSI Z223.1–1988 (NFPA 54–1988).
Install/replace heat pumps	Listed by UL.
Replace air diffusers, intakes, registers, and grilles	Commercially available.
Install/replace warm air heating metal ducts	Commercially available.
Filter alarm units	Commercially available.

<sup>1</sup>FS indicates Federal Specifications.

<sup>2</sup>ANSI indicates American National Standards Institute.

<sup>3</sup>NFPA indicates National Fire Prevention Association.

<sup>4</sup>UL indicates Underwriters Laboratories.

#### Replacement Furnaces, Boilers, and Wood Stoves

[Standards for conformance]

Chimneys, fireplaces, vents and solid fuel burning appliances	NFPA <sup>1</sup> 211–1988.
Gas-fired furnaces	ANSI <sup>2</sup> Z21.47–1987, Z21.47a–1988, and Z21.47b–1989. ANSI Z223.1–1988 (NFPA 54–1988).
Oil-fired furnaces	UL <sup>3</sup> 727, August 27, 1991 Revision and NFPA 31–1987.
Liquefied petroleum gas storage	NFPA 58–1989.
Ventilation fans:	
Including electric attic, ceiling, and whole house fans	UL 507, August 23, 1990 Revision.

<sup>1</sup>NFPA indicates National Fire Prevention Association.

<sup>2</sup>ANSI indicates American National Standards Institute.

<sup>3</sup>UL indicates Underwriters Laboratories.

**Air Conditioners and Cooling Equipment**

[Standards for conformance]

<b>Air conditioners:</b>	
Central air conditioners	ARI <sup>1</sup> 210/240–1989.
Room size units	ANSI/AHAM <sup>2</sup> RAC–1–1982.
<b>Other cooling equipment:</b>	
Including evaporative coolers, heat pumps and other equipment	UL <sup>3</sup> 1995, November 30, 1990. <sup>4</sup>

<sup>1</sup>ARI indicates Air Conditioning and Refrigeration Institute.

<sup>2</sup>AHAM/ANSI indicates American Home Appliance Manufacturers/American National Standards Institute.

<sup>3</sup>UL indicates Underwriters Laboratories.

<sup>4</sup>This standard is a general standard covering many different types of heating and cooling equipment.

**Screens, Window Films, and Reflective Materials**

[Standards for conformance]

Insect screens	Commercially available.
Window films	Commercially available.
<b>Shade screens:</b>	
Fiberglass shade screens	Commercially available.
Polyester shade screens	Commercially available.
<b>Rigid awnings:</b>	
Wood rigid awnings	Commercially available.
Metal rigid awnings	Commercially available.
<b>Louver systems:</b>	
Wood louver systems	Commercially available.
Metal louver systems	Commercially available.
Industrial-grade white paint used as a heat-reflective measure on awnings, window louvers, doors, and exterior duct work (exposed)	Commercially available.