



MULTI FAMILY ENERGY AUDIT PROTOCOL

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I. OVERVIEW

The OHCS Weatherization Assistance Program (WAP) 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 OHCS's WAP. This document specifically addresses the audit protocol for multifamily buildings, as defined by the OHCS energy audit policy. 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 format and content must be presented in a consistent manner; 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 OHCS'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 violations as defined by OHCS's WAP.

The outcome of the audit process is an assessment that clearly reports on:

- Building profile, configuration, and existing energy systems.
- Relevant health and safety checks and conditions.
- Current energy consumption profile.
- The proposed scope of work that clearly defines the measures and related costs being applied for funding.
- Any relevant supplemental funding sources and owners contributions.
- The calculated savings investment ratio of each measure including interactive effects of higher SIR measures.
- The total calculated reduction in energy usage for the recommended measures.
- The energy modeling software file and assumptions used to make the projections.
- The methodology of data collection and relevant calculations.
- A representation that the Audit meets OHCS's WAP criteria, and audit protocol as defined herein.

The three main processes that constitute the OHCS WAP Multifamily Audit Protocol standards include:

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

For energy audit purposes, OHCS considers multi-family buildings to be those containing five dwelling units or more. Approved single-family energy audits can be used in buildings with up to four dwelling units.

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.

1. Auditor Conduct Standards and Minimum Credentials

- All sub-grantees and their consultants shall conform to the OHCS contracts, policies, and referenced standards.
- Auditors conducting audits shall have the minimum skills, credentials and experience required to effectively perform the audits. In the event that a single Auditor lacks all of the required skills, a qualified team may be assembled to complete the audit. At a minimum, Auditors shall be capable of effectively performing the following tasks:
 - Energy modeling (utilizing approved software).
 - Building assessment (identifying safety, code, durability and energy systems issues).
 - Diagnostic testing
 - Combustion appliance safety testing.
 - Feasibility analysis for the installation of energy efficient building improvements.
 - Construction cost estimating.

2. Scheduling the Site Visit and Tenant Notification

- Notification of tenants, whose units will be inspected as part of the 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 to the tenants and neighbors at the project.

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 Initial Building Assessment or similar screening report which establishes the building's eligibility to participate in the program, and verify that the accrual of benefits is sufficiently justified per Weatherization Program Notice 10-15A.
- Review 12-24 months of prior utility bills (including gas, electric, and water) to know annual utility cost by fuel type and seasonal variations.

- Identify sampling of units representative of unit types, conditions, sizes and location.
- Arrange access to units to be reviewed with occupant and provide necessary formal notification of inspection.
- Verify availability of as-built drawings.
- Review any historical improvement data available.
- Review operation and maintenance (O&M) records, logs and protocols.
- Review existing mechanical equipment information as available.
- Verify availability of property representative with access to all portions of the property.
- Verify availability of O&M staff familiar with the building facilities and history.

4. Site Visit

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:

- Property Manager
- Maintenance Director or Maintenance Staff
- Owner or Owner Representative

The purpose of the interview(s) is to:

- Discuss project energy performance.
- Discuss tenant comfort, health and safety, and agree on a tenant synopsis for the site visit.
- Discuss any behavioral or other factors affecting energy performance (occupancy rates, tenant behavior patterns etc.).
- Discuss operations and maintenance procedures.
- Address any other stakeholder questions or concerns.

The interview shall include questioning on operations and maintenance issues. If any project team member 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. OHCS Policies and Procedures and Health and Safety Plan, as well as other documents referenced in OHCS contracts, 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 and applicable prior inspections as relevant to EPA & Oregon CCB RRP Rules.
- Mold and Mildew Assessment per Appendix D of this document – Mold & Mildew assessment.
- Structural, electrical and mechanical systems visual inspections
- Combustion Appliance Safety Testing

4.3 Visual Inspection and Diagnostic Testing Protocols

The site visit shall include visual inspections and diagnostic testing of the building envelope, HVAC, combustion appliances, and lighting systems. Minimum visual and diagnostic testing criteria are provided in the OHCS DOE 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. Blower Door Sampling: Blower door testing shall be conducted on a representative sample number of units in accordance with section 8 in the OHCS Site Built and Mobile Home Weatherization Specifications.

Where OHCS standards do not address specific diagnostic tests applicable to the commercial systems, BPI standards for Multifamily Building Analyst, standards shall apply. BPI Multifamily Building Analyst Standards are available for download at BPI's website (www.bpi.org). The Auditor shall identify any building information required to complete the energy and cost analysis. At a minimum, all relevant data listed in Appendix A shall be documented. This information will be used in the energy modeling and analysis phase of the audit.

4.4 On-Site Unit Inspection Sampling Protocols

At least one in seven of every unit type (defined as having same/similar floor plan), with representation from differing building floors and including all four building orientations, shall be inspected. In no case shall the inspection of units be less than 10% of total units. Note: In the event that there are combustion appliances, all units with combustion appliances must be inspected and appliances tested, both pre and post weatherization.

4.5 Renewable Energy

The on-site inspection may also examine, evaluate and propose recommendations for the inclusion of renewable energy opportunities including, but not limited to, solar hot water. In addition, any existing renewable energy systems (wind, solar thermal, solar PV, Fuel Cell, etc.) shall be included in the audit analysis.

4.5.1 Solar Thermal Systems:

Proposed solar thermal systems shall comply with SRCC OG-3005 and 2009 Uniform Solar Energy Code 6. All installers shall be certified as a NABCEP (North American Board of Certified Energy Practitioners) solar heating and solar PV installer.

4.5.2 Photovoltaic Solar Systems:

Existing photovoltaic systems shall be fully documented in the audit. NOTE: Currently Solar PV systems are not eligible for funding under the OR Weatherization Assistance Program.

III. ENERGY MODELING AND ANALYSIS PROCESS

An energy model of the building's pre and post-retrofit performance shall be completed using building plans, initial inspection data, and diagnostic data collected during the on-site visits. TREAT energy modeling is used to estimate annual energy consumption and energy cost savings of most potential energy conservation measures for multifamily dwellings as defined in Section III, 1.1. All energy and cost savings results from the TREAT model must be verified against known conditions and usage profiles existing at the residence and against industry standard values. If results are not as generally expected and are not defensible based on information from the site visit, the TREAT model should be modified until expected results are obtained. All major assumptions used to develop the energy model and analysis must be clearly stated in the final report. Reporting emphasis should be placed on the assumptions that have the most impact on estimated energy savings.

1. Energy Modeling Software Requirements:

Two energy modeling software platforms have been approved by DOE for use in the OR WAP program. REM/Design™ (Architectural Energy Corporation) is approved for single family homes and small multifamily dwellings, and TREAT (PSD Consulting) is approved for use in all large multifamily dwellings. The energy audit software policy is provided below.

1.1 Treat Dwelling Criteria

As defined in the policy, a TREAT audit is to be used for the following building types:

- Multi-Family residential buildings 4 stories and above.
- Multi-Family residential buildings 3 stories or fewer with shared HVAC Systems.
- Multi-family residential buildings containing 5 or more units with shared HVAC systems.
- Multi-Family residential buildings containing 26 or more units.
- Multi-Family residential buildings not meeting the REM/Design™ criteria in section 1.3.

1.2 Treat Policy

For residential buildings meeting the above criteria, a “whole-building” energy audit and TREAT software based energy simulation must be conducted to determine the feasibility and cost effectiveness of all available measures.

1.3 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,
- Mobile homes, and
- Low-rise multifamily buildings:
 - Containing five to 24 dwelling units,
 - Having 3 stories or fewer and,
 - Where buildings containing 5 to 24 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. Utility Rates:

The energy consultant shall model the building using the current local utility rate schedules as verified during review of utility bills or by utilizing the current Energy Information Administration's (EIA) average Oregon electricity rates as provided by OHCS where applicable. When possible, tiered rate structures, demand charges, time of use charges and usage fees shall be included in the utility rate determination. At a minimum, energy cost shall be calculated as the total average cost of energy for the prior year based on billing data. Energy cost savings calculated outside of the modeling software shall be based on average utility and demand rates based on provided utility bills.

3. Model Calibration:

The energy model for all buildings shall be calibrated to actual utility billing data based on mastered metered data or aggregation of individual unit energy bills. When individual unit energy bills are used billing data should be collected from as many units as possible. Modeled baseline energy consumption shall be calibrated to monthly utility bills for a minimum of twelve months. The intent is to qualify the energy model by demonstrating similarity to the metered energy usage over a 12 month time frame.

- The energy model estimates of electricity and natural gas should calibrate to actual monthly consumption within $\pm 10\%$.
- Typical Meteorological Year (TMY) 30 year average weather data must be used in energy modeling.
- Any adjustments made to the building description inputs used to calibrate the simulated building to actual energy usage shall be justified with explicit, transparent information and documented in this section of the audit report.

- In the event that the building is served by more than one meter, the bills for those meters shall be aggregated against the building calculated consumption as a whole.

4. Exceptional Calculations:

Energy conservation measures not directly modeled with TREAT or REM/Design™ energy modeling software can be calculated outside of the program provided that generally accepted engineering calculations and methodologies are used. Interactive effects must be accounted for in exceptional calculations. The methodologies, assumptions, and constants used in the exceptional calculations must be clearly documented in the final report. Sources of deemed savings must be referenced.

5. Savings Investment Ratio (SIR) Calculations:

When using TREAT or REM/Design™, the measure and package SIR may be calculated automatically by the software. In the event that a proposed measure requires exceptional calculations, the measure and package SIRs shall be calculated using the methods outlined below.

5.1 Measure SIR

Measure SIR shall be calculated as the ratio of present value of the measure energy savings compounded annually over the life of the measure divided by the total installed cost of the measure given by equation 1. When calculating measure SIR, all interactive effects of other measures in the improvement package shall be accounted for.

eq. 1 $SIR\ measure = S * ((1+i)^n - 1) / (i(1+i)^n) / C$

Where:

S = 1st year savings of measure (\$)

i = discount rate (%)

n = estimated useful life of measure (years)

C = installed cost of measure (\$)

Note: Water savings or other non-energy savings shall not be included in the SIR Calculation.

5.2 Package SIR

Package SIR shall be calculated as the ratio of present value of the package energy savings compounded annually over the life of the package divided by the total installed cost of the package. Present value of package savings shall be calculated as the sum of the present value of individual measures divided by the cost of the package (the sum of the cost of all measures). The present value of an individual measure is shown in equation 2.

eq. 2 $PV\ measure = S * ((1+i)^n - 1) / (i(1+i)^n)$

Where:

S = 1st year savings of measure

i = discount rate (%)

n = estimated useful life of measure

Note: Water savings or other non-energy savings shall not be included in the package SIR Calculation.

Discount rate used for present value calculations shall be the lesser of 3% or the percentage increase in the Consumer Price Index (all items, United States city average) for the most recent calendar year completed before the beginning of the year for which the determination is being made. Note: Energy escalation and inflation are not included in this calculation.

First year savings of a single measure shall be calculated based on the energy usage profile of a building after all measures with higher SIR have been implemented. All savings calculations should be adjusted for “interaction between architectural and mechanical weatherization materials by using generally accepted engineering methods to decrease the estimated fuel cost savings for a lower priority weatherization material in light of fuel cost savings for a related higher priority weatherization material.”

Maximum Estimated Useful Life (EUL) of measure shall be determined using values published in Appendix B. In the event that a proposed EUL is greater than those listed in Appendix B justification must be provided for review by OHCS

Installed cost of measure should reflect the cost to install a measure as closely as possible. In cases where the cost to install a measure changes after approval of the scope of work due to extenuating circumstances, the updated cost must be reported and the measure will be reimbursed as follows:

- 1) If the updated cost is less than the reported cost, OHCS will reimburse for the actual cost of the measures.
- 2) If the updated cost is greater than the reported cost, OHCS will reimburse for the reported cost of measure. The full amount of the installed cost of the measure may be reimbursed if an updated SIR calculation reveals that the measure and package SIR remain greater than 1.0 based on the updated cost, and the package has not exhausted the available funds for the property.
- 3) If the updated cost is greater than the reported cost and the increased cost reduces the measure SIR < 1.0, the additional funding source must be identified and must not be federal funds.

5.3 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 as the ratio of present value of the measure savings compounded

annually over the life of the measure divided by the WAP funds applied to the measure.

- 2) The package SIR shall be calculated as the ratio of present value of the package savings compounded annually over the life of the package divided by the total installed cost of the package including all WAP funds and all non-WAP funds. The package SIR shall include all measure buy down costs.
- 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.

APPENDIX A: PROJECT REPORT REQUIREMENTS

This format is provided as a suggested template to aid in Project Report Generation and identifies the scope and level of detail that should be included in all reports.

PROJECT REPORT FORMAT

Section 1: Project Summary

The purpose of the project summary is to summarize the main points of the project.

- 1) General Overview
 - a. Project Description
 - i. Address of project
 - ii. Building configurations. Include a general description of the following:
 1. Number of buildings
 2. Number of stories and units in each building
 3. Common area description
 4. Heating source/fuel type
 - iii. Breakdown of work needed/work completed
 - iv. Project client demographics
 - v. Verification of Eligibility of the property
 1. Income eligibility criteria
 - a. Property appears on HUD/DOE or USDA/DOE eligibility list or;
 - b. at least 66% of the units in the building are income qualified or;
 - c. the project eligibility falls within the requirements of section 2.19.2 of the Oregon USDOE state plan.
 2. Accrual of benefits
 - a. Measures will result in a direct reduction of the clients energy costs or;
 - b. Demonstrated benefit to tenant as outlined in WPN 10-15A if energy costs for a particular measure are not paid directly by the tenant.
 3. Maximum allowable DOE benefit for property based on the number of eligible units per unit expenditure limit
 - 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 narrative section of the report should guide the reviewer through the steps taken to conduct the energy audit and analysis. When applicable, labeled photos should be included in the appropriate sections.

- 1) Existing building conditions. Provide a detailed description of the following:
 - a. Site layout
 - b. Number of 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. Lighting
 1. Common area lighting. Note: this does not have to be included if it is determined there is no accrual of benefits to the tenants.
 - a. Fixture type
 - b. Lamp & ballast type
 - c. Number of lamps per fixture
 - d. Fixture wattage
 - e. Spaces served

- f. Annual/daily hours used
 - g. Photos as relevant
 - 2. Individual unit lighting (Include all that applies)
 - a. Fixture type
 - b. Lamp & Ballast
 - c. Number of lamps per fixture
 - d. Fixture wattage
 - e. Annual/Daily hours used
 - f. Photos as relevant
- 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 or rated capacity if possible (note which)
 - c. Ability of ventilation equipment to provide adequate ventilation
 - d. Notes of any special circumstances
 - e. Photos if relevant
- vii. Water Heating Systems
 - 1. Make, model, type, capacity and age of all 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.
 - 3. Describe the applicable end uses for each type of fuel at the project and show a breakdown of the annual energy usage and energy cost by fuel type

Section 3: Evaluated Measures

- 1) Recommended energy efficiency measures
 - a. A short narrative of each recommended energy efficiency measure shall include all replacement measure parameters.
 - b. Recommended replacement specifications
 - c. Installed cost summary of the measure
 - d. Projected annual monetary savings
 - e. 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 including description and cost.

Section 4: Cost Benefit Analysis

- 1) Energy Model for either REM/Design or TREAT
 - a. TREAT Reports
 - i. Actual Model to Billing Report
 - ii. Model Energy Comparison Report
 - iii. Weatherization SIR - Interacted
 - b. REM/Design Reports
 - i. Fuel summary report
 - ii. Improvement analysis report

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. Blower doors: When blower testing is required, include test results, both pre and post for all units in the required sample. Results must include an identifying unit number.
 - b. Duct testing: include test results, both pre and post for all units requiring a duct test. Results must include an identifying unit number.
 - c. Combustion testing: Results, both pre and post, must include an identifying unit number.
 - i. Worst Case Draft (WCD) Combustion Appliance Zone (CAZ) pressures
 - ii. Draft pressures under worst case. Include outdoor temperature at the time of the testing.

- iii. House Depressurization Limit (HDL) testing results for fireplaces and woodstoves.
 - iv. CO testing results. Include ambient CO for unit and measured CO in each combustion appliance.
 - d. ASHRAE 62.2 Documentation: Include documentation of final fan settings on all multi-family projects that fall under the scope of ASHRAE 62.2
- 3) Mold & Mildew: See Appendix D
- 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 by one of the paths described in Appendix D.

APPENDIX B: MAX ALLOWABLE ESTIMATED USEFUL LIFE (EUL) OF COMMON MEASURES

The EULs in this section are suggested maximum useful lives of measures. If the values are exceeded, justification shall be provided and is subject to review. In the event a product is used with a shorter useful life than published below the actual useful life shall be reported and used in SIR calculations.

<u>SCOPE</u>	<u>APPLICATION</u>	<u>MEASURE</u>	<u>EUL</u>
Non-Residential	Building Envelope	Cool Roof	15
Non-Residential	Building Envelope	Roof/Ceiling Insulation	25
Non-Residential	HVAC - Boilers	High Efficiency Boiler	30
Non-Residential	HVAC - Chillers	High Efficiency Chillers	20
Non-Residential	HVAC - Miscellaneous	Clean Condenser Coils	3
Non-Residential	HVAC - Miscellaneous	Duct Insulation Material	30
Non-Residential	HVAC – Miscellaneous	Duct Sealing – Single Zone Package System	20
Non-Residential 18	HVAC - Miscellaneous	High Efficiency Furnace	
Non-Residential	HVAC – Miscellaneous	High Efficiency Water Source Heat Pump	18
Non-Residential	HVAC - Miscellaneous	Hydronic Heat Pump Variable Flow Valve	10
Non-Residential	HVAC - Miscellaneous	Refrigerant Charge	8
Non-Residential	HVAC - Miscellaneous	Setback Programmable Thermostats	18
Non-Residential	HVAC - Miscellaneous	Time Clocks (heating/cooling)	11
Non-Residential	HVAC - Miscellaneous	VSD Supply Fan Motors	12
Non-Residential	HVAC - Other Central Plant	Cooling Tower for Packaged System	15
Non-Residential	HVAC - Split/Package	Air Conditioners / Heat Pumps (split and unitary)	18
Non-Residential	Motors	HVAC Fan Motors	13
Non-Residential	Motors	Premium-Efficiency Motors	15

<u>SCOPE</u>	<u>APPLICATION</u>	<u>MEASURE</u>	<u>EUL</u>
Non-Residential	Motors	Water Loop Pumps	13
Non-Residential	Outdoor Lighting	HID Lighting - High Pressure Sodium	16
Non-Residential	Outdoor Lighting	HID Lighting - Metal Halide	16
Non-Residential	Outdoor Lighting	HID Lighting (T-5)	11
Non-Residential	Refrigeration	Insulation for Bare Suction Lines	11
Non-Residential	Refrigeration	Retro-commissioning	10
Non-Residential	Water Heating	Circulation Pump Time clock Retrofit	15
Non-Residential	Water Heating	High Efficiency Central Water Heater	15
Non-Residential	Water Heating	High Efficiency Commercial Storage Water Heater	15
Non-Residential	Water Heating	Tankless Water Heater	19
Non-Residential	Water Heating	Pipe Insulation - Electric Water Heater	11
Non-Residential	Water Heating	Pipe Insulation - Gas Water Heater	11
Non-Residential	Water Heating	Water Heater Tank Wrap	7
Residential	Appliances	High Efficiency Refrigerator	15
Residential	Building Envelope	Floor Insulation	25
Residential	Building Envelope	High Performance Windows	25
Residential	Building Envelope	Weather-stripping	10
Residential	Building Envelope	Roof/Ceiling Insulation	25
Residential	Building Envelope	Wall Insulation	25
Residential	HVAC	Thermostatic Radiator Valve (TRV)	8
Residential	HVAC	Constant Airflow Regulator	10
Residential	HVAC	Clean Condenser Coils	3
Residential	HVAC	Evaporative Cooler	15

<u>SCOPE</u>	<u>APPLICATION</u>	<u>MEASURE</u>	<u>EUL</u>
Residential	HVAC	High Efficiency Air Conditioner (package and split systems)	18
Residential 18	HVAC	High Efficiency Furnace	
Residential	HVAC	High Efficiency Heat Pump	18
Residential	HVAC	Programmable Thermostat	18
Residential	HVAC	Refrigerant Charge	10
Residential	HVAC	Room AC - Energy Star	14
Residential	HVAC – Miscellaneous	Duct sealing	20
Residential	HVAC – Miscellaneous	Duct insulation	15
Residential	Indoor Lighting	CFL Fixtures	16
Residential	Indoor Lighting	CFL Lamps - 10,000 Hour	7
Residential	Indoor Lighting	CFL Lamps - 12,000 Hour	8
Residential	Indoor Lighting	CFL Lamps - 6,000 Hour	4
Residential	Indoor Lighting	CFL Lamps - 8,000 Hour	5
Residential	Indoor Lighting	Linear Fluorescents - MF Common Area	10
Residential	Miscellaneous	0.3 W LED Night Light	11
Residential	Outdoor Lighting	CFL Fixtures	16
Residential	Outdoor Lighting	CFL Lamps - 10,000 Hour	4
Residential	Outdoor Lighting	CFL Lamps - 12,000 Hour	5
Residential	Outdoor Lighting	CFL Lamps - 6,000 Hour	3
Residential	Outdoor Lighting	CFL Lamps - 8,000 Hour	4
Residential	Outdoor Lighting	HID Lighting	16
Residential	Water Heating	Faucet Aerators	9
Residential	Water Heating	Heat Pump Water Heater	10
Residential	Water Heating	High Efficiency Electric Water Heater	10
Residential	Water Heating	High Efficiency Gas Water Heater	10

<u>SCOPE</u>	<u>APPLICATION</u>	<u>MEASURE</u>	<u>EUL</u>
Residential	Water Heating	Instantaneous Water Heater	20
Residential	Water Heating	Low-Flow Showerhead	10
Residential	Water Heating	Pipe Insulation - Electric Water Heater	13
Residential	Water Heating	Pipe Insulation – Gas Water Heater	13
Residential	Water Heating	Solar Water Heating	15

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.

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]

Insulation—mineral fiber:	
Blanket insulation	ASTM ¹ C665-88.
Roof insulation board	ASTM C726-88.
Loose-fill insulation	ASTM C764-88.
Insulation—mineral cellular:	
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.
Insulation—organic fiber:	
Cellulosic fiber insulating board	ASTM C208-72 (1982).
Cellulose loose-fill insulation	ASTM C739-88.
Insulation-organic cellular:	
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 ² 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.
Insulation—composite boards:	
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.

¹ASTM indicates American Society for Testing and Materials.

²FS indicates Federal Specifications.

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

[Standards for conformance]

Insulation—mineral fiber:	
Preformed pipe insulation	ASTM ¹ 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.
Insulation—mineral cellular:	
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.
Insulation—Organic Cellular:	
Preformed flexible elastomeric cellular insulation in sheet and tubular form	ASTM C534–88.
Unfaced preformed rigid cellular polyurethane insulation	ASTM C591–85.
Insulation skirting	Commercially available.

¹ASTM 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 ¹ 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).

¹ASTM indicates American Society for Testing and Materials.

Storm Windows

[Standards for conformance]

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

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

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

³ASTM indicates American Society for Testing and Materials.

Storm Doors

[Standards for conformance]

Storm doors—Aluminum:	
Storm Doors	ANSI/AAMA ¹ 1102.7–89.
Sliding glass storm doors	ANSI/AAMA 1002.10–83.
Wood storm doors	ANSI/NWWDA ² I.S. 6–86.
Rigid vinyl storm doors	ASTM ³ 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.

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

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

³ASTM indicates American Society for Testing and Materials.

Replacement Doors

[Standards for conformance]

Replacement doors—Hinged doors:	
Steel doors	ANSI/SDI ¹ 100–1985.
Wood doors:	
Flush doors	ANSI/NWWDA ² 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 ³ 101–88.
Wood doors	NWWDA I.S. 3–83.

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

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

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

Caulks and sealants:

[Standards for conformance]

Caulks and sealants:	
Putty	FS ¹ TT–P–00791B, October 16, 1969 and Amendment 2, March 23, 1971.
Glazing compounds for metal sash	ASTM ² 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.

¹FS indicates Federal Specifications.

²ASTM indicates American Society for Testing and Materials.

Weatherstripping

[Standards for conformance]

Weatherstripping	Commercially available.
Vapor retarders	Selected according to the provisions cited in ASTM ¹ 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 ² DC 3–1989.

¹ASTM indicates American Society for Testing and Materials.

²NEMA indicates National Electrical Manufacturers Association.

Heat Exchangers

[Standards for conformance]

Heat exchangers, water-to-water and steam-to-water	ASME ¹ 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 ²	Conformance to AGA ³ 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. ⁴

¹ASME indicates American Society of Mechanical Engineers.

²The 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.

³AGA indicates American Gas Association.

⁴UL indicates Underwriters Laboratories.

Boiler/Furnace Control Systems

[Standards for conformance]

Automatic set back thermostats	Listed by UL. ¹ Conformance to NEMA ² DC 3–1989.
Line voltage or low voltage room thermostats	NEMA DC 3–1989.
Automatic gas ignition systems	ANSI ³ Z21.21–1987 and Z21.21a-1989. AGA ⁴ Laboratories Certification Seal.
Energy management systems	Listed by UL.
Hydronic boiler controls	Listed by UL.
Other burner controls	Listed by UL.

¹UL indicates Underwriters Laboratories.

²NEMA indicates National Electrical Manufacturers Association.

³ANSI indicates American National Standards Institute.

⁴AGA 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. ¹
Electric, freeze-prevention tape for pipes	Listed by UL.
Reduce thermostat settings	State or local recommendations.
Install stack damper, gas-fueled	ANSI ² Z21.66–1988, including Exhibits A&B, and ANSI Z223.1–1988.
Install stack damper, oil-fueled	UL 17, November 28, 1988, and NFPA ³ 31–1987.
Install water flow modifiers	Commercially available.

¹UL indicates Underwriters Laboratories.

²ANSI indicates American National Standards Institute.

³NFPA indicates National Fire Prevention Association.

Waste Heat Recovery Devices

[Standards for conformance]

Desuperheater/water heaters	ARI ¹ 470–1987.
Condensing heat exchangers	Commercially available components and in new heating furnace systems to manufacturers' specifications.
Condensing heat exchangers	Commercially available (Commercial, multi-story building, with 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). ²

¹ARI indicates Air Conditioning and Refrigeration Institute.

²SMACNA denotes Sheet Metal and Air Conditioning Contractors' National Association.

Boiler Repair and Modifications/Efficiency Improvements

[Standards for conformance]

Install gas conversion burners	ANSI ¹ Z21.8–1984, (for gas or oil-fired systems) ANSI Z21.17–1984, ANSI Z21.17a-1990, and ANSI Z223.1–1988. AGA ² Laboratories Certification seal.
Replace oil burner	UL ³ 296, February 28, 1989 Revision and NFPA ⁴ 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 ⁵ 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.

¹ANSI indicates American National Standards Institute.

²AGA indicates American Gas Association.

³UL indicates Underwriters Laboratories.

⁴NFPA indicates National Fire Prevention Association.

⁵ANSI/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 ¹ 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 ² Z223.1-1988 (NFPA ³ 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 ₂ 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 ⁴ 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 furnaces or boilers	ANSI Z21.71-1981, Z21.71a-1985, and Z21.71b-1989.
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.

¹FS indicates Federal Specifications.²ANSI indicates American National Standards Institute.³NFPA indicates National Fire Prevention Association.⁴UL indicates Underwriters Laboratories.

Replacement Furnaces, Boilers, and Wood Stoves

[Standards for conformance]

Chimneys, fireplaces, vents and solid fuel burning appliances	NFPA ¹ 211-1988.
Gas-fired furnaces	ANSI ² Z21.47-1987, Z21.47a-1988, and Z21.47b-1989. ANSI

	Z223.1–1988 (NFPA 54–1988).
Oil-fired furnaces	UL ³ 727, August 27, 1991 Revision and NFPA 31–1987.
Liquified petroleum gas storage	NFPA 58–1989.
Ventilation fans:	
Including electric attic, ceiling, and whole house fans	UL 507, August 23, 1990 Revision.

¹NFPA indicates National Fire Prevention Association.

²ANSI indicates American National Standards Institute.

³UL indicates Underwriters Laboratories.

Air Conditioners and Cooling Equipment

[Standards for conformance]

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

¹ARI indicates Air Conditioning and Refrigeration Institute.

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

³UL indicates Underwriters Laboratories.

⁴This 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.
Shade screens:	
Fiberglass shade screens	Commercially available.
Polyester shade screens	Commercially available.
Rigid awnings:	
Wood rigid awnings	Commercially available.
Metal rigid awnings	Commercially available.
Louver systems:	
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.

Appendix D

Multifamily Mold & Mildew Assessment

The Oregon Low Income Weatherization Assistance Program does not encompass mold remediation. DOE funds are not to be used to test, abate, remediate, purchase insurance or alleviate existing mold conditions identified during the assessment, the work performance period or the quality control inspection. Where multiple funding sources are used, the performance of any of the aforementioned activities **must** be expensed to a non-DOE funding source. However, DOE funds may be used to correct energy-related conditions and/or to assure the immediate health of workers and clients. Weatherization of a multifamily project and air-sealing in particular could potentially increase the risk of moisture and mold in a home, thereby causing structural damage and/or health risk to the inhabitants. As well, existing mold could pose a health risk to both the inhabitants and the weatherization crew.

Moisture Assessment

A representative sample of at least one in seven of every unit type (defined as having same/similar floor plan), with representation from differing building floors and including all four building orientations, shall be inspected. If, during inspection of the representative sample, mold is found, then an additional sample of an equal number of units must be inspected. In no case shall the inspection of units be less than 10% of total units be checked for previous or existing moisture problems.

- A. Mold in dwellings arise from conditions of excess moisture. During initial inspection, field auditors are to assess the units with special attention to the following signs:
 1. Evidence of condensation on windows and walls indicated by stains or mold;
 2. Standing water, open sumps, open wells, dirt floors, water stains, etc. in basements.
 3. Leaking supply or waste pipes;
 4. Attic roof sheathing shows signs of mold or mildew.
- B. Identification of existing or potential moisture problems shall be documented in the project file. Any moisture problems found **must** be pointed out and discussed with the landlord/property manager. The multifamily mold and mildew checklist **must** be filled out at the time of the audit, signed, and dated by the landlord/property manager.
- C. A copy of the pamphlet, *A Brief Guide to Mold, Moisture, and Your Home*, **must** be made available to each tenant. This can be accomplished by:
 1. Providing pamphlets in a common area of the project and include in the project file, a signed statement from the agency staff person confirming the location and timeframe of the distribution and the number of pamphlets provided.
 2. Mailing pamphlets via certified mail to each tenant and including the confirmation of delivery in the project file.
- D. If existing moisture problems are found, no air sealing should be done unless the source of the moisture can be substantially reduced or effective mechanical ventilation can be added to cost-effectively remove the moisture. In some cases, air sealing **must** be done in order to reduce the source of the moisture (i.e. sealing off crawlspace from the house, or sealing attic leakage to eliminate condensation on the roof deck).

- E. Because air tightening may cause an increase in relative humidity, client education should include information about moisture problems and possible solutions.
- F. In the course of weatherization, any low-cost measures that help reduce the humidity levels in the house should be installed. Examples of these activities are venting dryers, venting existing bath or kitchen exhaust fans or installing moisture barriers on dirt floors.

For more information on repair or elimination of moisture problems, refer to exhibit 6 of the Oregon DOE state plan.

Sample
Multifamily Dwelling Inspection: Moisture and Mold Checklist

Addresses of units Inspected: _____

Total units in the project: _____ **Number of units inspected:** _____

Percentage of units inspected: _____

Items for Inspection

Y/N Explanation, if necessary:

Were any signs of water damage noted in any units? _____

Are there any objectionable odors? (Mold & mildew) _____

Is the ventilation system adequate to meet the project needs? _____

Is there ventilation in each bathroom? _____

Are there any signs of mildew growth? _____

Are all combustion appliances properly vented? _____

Are common areas free of mold & mildew? _____

Comments: _____

Landlord/Property Manager _____ **Date** _____