



# State of Ohio Weatherization Program Standards

10th Edition



# WEATHERIZATION PROGRAM STANDARDS

10th Edition

April 2006

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# OHIO WEATHERIZATION PROGRAM STANDARDS

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 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Effective Date</b>

*EFFECTIVE DATE 101*

All weatherization measures performed or completed by the grantees on or after the date specified in the cover letter to these standards shall comply with these standards. **measures**  
101-1.1

All dwelling units completed after the effective date shall comply with these standards. **completed units**  
101-1.2



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Scope</b>

### *SCOPE 102*

For the purpose of these standards, the term grantee applies to all HWAP providers, whether direct grantee or delegate. **grantee**  
102-1

The standards shall apply to all weatherization and/or health and safety measures completed by grantees provided any cost of the retrofit is paid for, in part or in full, by the Ohio Department of Development, Office of Energy Efficiency (ODOD/OEE) for the Home Weatherization Assistance Program (HWAP). **all measures**  
102-2

The grantee is required to comply with every provision of the standards, unless a waiver of full or partial compliance is granted in writing by the ODOD/OEE. **all provisions**  
102-3

The waiver process is intended to document and substantiate the factual and/or legal basis for routine or continuous noncompliance with the provision(s) of these standards. The waiver process is intended to notify ODOD/OEE, in advance, that the grantee cannot comply with the provisions of the standards. **waiver**  
102-3.1

Grantees will ensure that delegate agencies and subcontractors will comply in every way with these standards, unless a written waiver of full or partial compliance is granted by ODOD/OEE. **delegates and subcontractors**  
102-3.2

Specific provisions of the standards subsequently amended or rescinded by administrative, legislative or judicial action shall not negate the force and effect of the remaining provisions of the standards. **amendments/ rescissions**  
102-4



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Enforcement</b>

*ENFORCEMENT 103*

Costs associated with weatherization measures paid for by the grantee, delegate agencies or subcontractors on or after the effective date of these standards, but which do not conform to such applicable standards, are considered disallowed costs by the ODOD/OEE.

**disallowed costs**  
103-1

Continued grantee inability or refusal to comply with applicable standards are grounds for the ODOD/OEE to suspend, terminate, or otherwise apply special condition(s) to the grantee’s agreement to provide HWAP services.

**noncompliance**  
103-2



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Changes to the Standards</b>

### *AMENDMENTS 104*

The standards may be amended to reflect changes in state and federal regulations, state-of-the-art technology, wisdom of energy efficiency in existing buildings, and for clarification or corrections. Changes can be prompted by a necessity or as a result of regularly scheduled amendment proposal reviews by all interested parties. The amendment process is explained in Section 105.

**changes**  
104-1

Amendments that do not substantially change the installation of weatherization measures or program policy may be instituted by the ODOD/OEE and shall become effective as directed in writing by the ODOD/OEE.

**nonsubstantial changes**  
104-2

Amendments and/or revisions that propose substantial change to the installation of weatherization materials or to program policy shall be open to grantee review and comment for a period of not less than thirty (30) calendar days. This is to be consistent with section 105-3.1.

**substantial changes**  
104-3

Amendments and/or revisions shall become effective immediately under the following conditions:

**immediately effective changes**  
104-4

State or Federal law or regulations changes mandate immediate implementation; or

**legal/regulatory mandates**  
104-4.1

The ODOD/OEE determines that an emergency situation exists (such as a potential threat to life, limb or personal property) and that the proposed amendment and/or revision is necessary for the protection of the health and welfare of Ohio's citizens.

**emergency situations**  
104-4.2



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Amendment Proposal/Review/ Adoption Cycle</b>

### *REVIEW/ADOPTION CYCLE 105*

Amendment proposals for substantial change require being open to grantee review and comment (see Section 104) therefore a regular cycle of amendment proposal, proposal review/discussion, hearing and approval shall be followed to implement changes to the WPS.

**regular cycle**  
105-1

During every third program year (2006, 2009, 2012...), the ODOD/OEE will collect proposed amendments to the WPS. All interested parties will be allowed to submit proposals. The proposal shall provide:

**even numbered years**  
105-2.1

a. The existing standard and all related appendices that are proposed to be changed;

**proposed amendments**  
105-2.2

b. A supporting statement, including any referenced studies or data; and

c. The proposed amendment and all proposed changes to associated appendices.

During the year following the collection of amendments (2007, 2010, 2013...), the ODOD/OEE will compile all proposed amendments along with supporting documentation and will make the compilation available to all interested parties for review for a period of thirty (30) calendar days.

**odd numbered years**  
105-3.1

Challenges to the proposed amendments will be accepted in writing and will be heard on a date set by ODOD/OEE. All proposals and challenges will be heard by the Policy Advisory Committee (PAC) established by the ODOD/OEE (or a sub-committee designated by the PAC). This sub-committee will determine changes and submit proposed text for final consideration to the HWAP Network, the PAC, and any interested parties for a thirty (30) calendar day review of all proposed changes.

**challenges**  
105-3.2

**Policy Advisory  
Committee (PAC)**  
105-3.3

If the PAC elects to appoint a sub-committee, that sub-committee, in collaboration with the ODOD/OEE, will present the proposed, final changes to the WPS to the full PAC. The full PAC will have thirty (30) calendar days to review the proposed, finalized changes and any challenges, prior to deciding whether to accept or reject the changes.

**effective date**  
105-4

Amendments shall become effective as directed in writing by the ODOD/OEE.

	Section	<b>ADMINISTRATION</b>
	Subject	<b>Prioritization Standards</b>

### *PRIORITIZATION 106*

Grantees are required to apply weatherization measures that have been prioritized based on cost-effectiveness. **prioritization**  
106-1

Authorized providers shall install measures funded by the Universal Service Fund (USF) based upon the USF building prioritization list and the USF required measures list, as identified and developed by the ODOD. **USF measures**  
106-1.1

Grantees shall determine the cost-effectiveness of HWAP-funded weatherization measures based upon the required measures list for each building type, as identified and developed by the ODOD/OEE, unless any of the situations described in 106-2.1 and exist. If the building meets the definition of a High-Rise/Multi-Family Building (4 or more stories above grade, or centrally-heated buildings with 5 or more units), reference WPS Administration Section 900. **HWAP measures**  
106-1.2

Specific retrofits may **not** be performed without first determining that the Savings-to-Investment Ratio (SIR) of the retrofit is equal to or greater than 1 (one) as determined by the NEAT in the following situations: **NEAT**  
106-2.1

Any instance where the following optional measures will be added: **optional measures**  
106-2.1a

- storm windows
- intermittent ignition devices
- burner replacements
- clock thermostats
- vent dampers

Any instance where additional insulation will be added to an attic with existing insulation equal to or greater than R-19. **existing insulation**  
106-2.1b

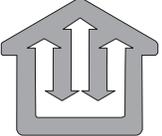
Any instance where a furnace will be replaced for efficiency improvements. **furnace replaced for inefficiency**  
106-2.1c

**additional repairs  
exceed \$150**  
106-2.1d

Any instance when material costs for additional repairs associated with a specific retrofit exceed \$150.

**MHEA**  
106-2.2

(RESERVED)

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Cost-Effectiveness</b>

*COST EFFECTIVENESS 107*

Grantees will make every effort to direct HWAP resources towards weatherizing the greatest number of dwelling units. **greatest number of units**  
107-1

Grantees will make every effort to limit the nature and extent of the HWAP investment in a dwelling unit to only those measures that are critical to the efficiency of the structure and their effect on the health and safety of the occupants. **limit investment**  
107-2

Grantees will ensure that weatherization measures resulting in the greatest energy SIR will be completed as frequently as possible. **greatest SIR**  
107-2.1

Grantees will ensure that the cost of the weatherization materials and application techniques are as low as possible while achieving results consistent with the standards. **lowest cost**  
107-2.2





State of Ohio  
Weatherization Program  
Standards

Section

**ADMINISTRATION**

Subject

**Weatherization Work**

*WEATHERIZATION WORK 108*

Grantees will ensure that all weatherization work on a dwelling unit is based upon proven energy conservation/efficiency principles that are accepted and incorporated into the WPS.

**sound principles**  
108-1

Grantees will make every effort to limit weatherization work on a dwelling unit to those measures which significantly improve the energy efficiency of the structure.

**limit work**  
108-2

Grantees will make every effort to base the nature and extent of weatherization upon the accepted use of diagnostic equipment.

**diagnostic equipment**  
108-2.1

Grantees will perform only air leakage sealing work that significantly reduces air leakage rates. Air sealing work shall be directed by blower door diagnostics at every opportunity.

**limit air leakage work**  
108-2.2

Grantees will make every effort to thoroughly insulate attics, sidewalls and floors over non-conditioned spaces whenever possible.

**thorough insulation**  
108-2.3



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section <b>ADMINISTRATION</b>
	Subject <b>Weatherization Related Repairs</b>

*WEATHERIZATION RELATED REPAIRS 109*

Grantees will ensure that repairs made to a dwelling unit and its mechanical systems are critical to the health and safety of the occupants and the effectiveness of significant weatherization measures.

**critical repairs**  
109-1.1

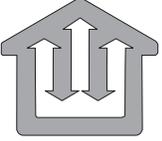
Weatherization related repairs in excess of \$150.00 in material costs shall be tested for cost effectiveness by including the repair in the cost of the proposed retrofit and then performing NEAT. Only those retrofits determined to have an SIR equal to or greater than 1 (one), including repair costs, are allowable.

**\$150 repair limit** **NEAT**  
109-1.2

Grantees will make every effort to avoid replacing repairable structural or mechanical systems or components of a dwelling unit.

**repair rather than replace**  
109-1.3



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Work Quality</b>

*WORK QUALITY 110*

Grantees will complete weatherization measures and repairs in a professional manner.

**professional work**  
110-1



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Completed Unit</b>

*COMPLETED UNIT 111*

The definition and description of a completed unit applies in the case of all units weatherized in whole or in part with HWAP funds unless a waiver has been granted by the ODOD/OEE.

**applicability**  
111-1

The following list of procedures, retrofits and documentation must be accounted for (consistent with sections 106 and 112) before a dwelling unit can be reported as complete:

**required procedures, retrofits**  
111-2

All dwelling units shall have received an initial inspection/estimate by certified personnel;

**initial inspection**  
111-2.1

Note: Non-Grantee personnel may conduct a complete inspection/estimation provided it complies with the procedures and requirements of these standards. Prior written approval from ODOD/OEE is required when non-grantee personnel conduct or complete initial inspections/estimates. To the greatest extent practical, grantees shall seek and use information collected and documented by other energy conservation/efficiency programs.

Initial inspections/estimates shall be documented with a complete

**documentation**  
111-2.2

a. Data Collection Form; or

b. printout of the NEAT audit results; or

c. alternate energy audit form approved by DOE/ODOD/OEE;

All dwelling units shall have received the applicable required weatherization measures in accordance with the approved energy audit procedure, all applicable program regulations and policies, and these standards;

**measures**  
111-3

**final inspection  
required**  
111-4

All dwelling units shall have received a final inspection by grantee personnel.

**documentation**  
111-4.1

Final inspections shall be documented with the signature of the inspector and the date of the inspection on the Building Weatherization Report (BWR).

**final inspection  
ensures**  
111-4.2

Final inspections shall ensure the following:

a. All materials reported on the BWR and listed on the composite sheet, or other ODOD/OEE approved inspection/work order forms, are present on the dwelling units.

b. All weatherization measures performed or completed are safe and effective.

c. All weatherization measures identified by the approved energy audit procedure that are required and allowed by applicable program requirements have been accounted for or completed.

d. The customer/homeowner/authorized agent acknowledges and documents that all weatherization measures have been completed. Grantees shall not seek or gain customer/homeowner/authorized agent sign-off on the BWR before the unit passes final inspection.

e. All applicable final diagnostic tests have been performed prior to, or as a part of, the final inspection.

**file documentation**  
111-5

All dwelling units and multifamily buildings shall have complete client file documentation. Refer to HWAP Policies and Procedures Manual, Volume II, C.1 for file documentation requirements.

	<b>State of Ohio Weatherization Program Standards</b>	Section <b>ADMINISTRATION</b>
		Subject <b>Completion Standards</b>

## COMPLETION STANDARDS 112

Grantees shall apply weatherization measures per the documented energy audit procedure until: **apply measures**  
112-1

All weatherization measures identified by the audit procedure that are required and allowed by applicable program requirements are performed or completed; or **all measures done**  
112-1.1

Any applicable dollar expenditure limit is reached; or **dollar limit reached**  
112-1.2

All weatherization measures unable to be performed or completed due to pre-existing health, safety, or technical reasons are accounted for and clarified with documentation in the client file. **measures accounted for**  
112-1.3

Grantees shall not remove, replace, or duplicate effective pre-existing weatherization measures which meet the requirements under the appropriate section of the standards. **no removal/duplication**  
112-2

Grantees shall not avoid completing the necessary range of required weatherization measures by “documenting away” a measure. The grantee shall never seek or gain a signed release from the customer to deliberately avoid a weatherization measure or procedure. **no "documenting away"**  
112-3

If a customer agent refuses to allow a required weatherization measure to be performed or completed, the grantee shall determine if safe, effective and meaningful weatherization services can still be provided. In any case, customer refusal and the date of refusal must be documented in the client file. **customer refusal**  
112-3.1

If, while the unit is in progress, the eligibility of the household changes so that the household is no longer eligible, complete only the weatherization measures in progress to secure the property from possible damage. Do not begin new weatherization measures. The reason for, and date of, the household’s ineligibility must be documented in the client file. **eligibility changes**  
112-4

<b>denial of services</b> 112-5	If grantee personnel determine that conditions exist which make safe, effective and meaningful weatherization services impossible to perform, the grantee may deny services to the household until such time that the conditions are remedied. In this event, the grantee must:
<b>written determination</b> 112-5.1	Make a written determination of exactly what repairs or changes must be made to allow weatherization to continue;
<b>information to customer</b> 112-5.2	Provide the customer with the list of repairs/changes along with a Grantee Denial of Services Form and copy of the Agency Appeals Procedure;
<b>reapplication</b> 112-5.3	Make the customer aware that when the repairs are completed, the customer may request that weatherization resume under the original application. Income update procedures could, however, be necessary if the date of denial and the date of reapplication are separated by more than one year; and
<b>other resources</b> 112-5.4	By virtue of its advocacy role for low-income persons, make a good faith effort to secure other resources on the customer's behalf to complete any repairs.
<b>codes and regulations</b> 112-6	Grantees shall comply with all applicable state and local building codes and regulations.

	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Training and Technical Assistance</b>

*TRAINING AND TECHNICAL ASSISTANCE 113*

Grantees will ensure that employees and contractors have access to appropriate information and training that is provided by the ODOD in support of the HWAP.

**access to training**  
113-1

Grantees will ensure that employees and contractors will seek appropriate training and, when necessary, attend training as required by the ODOD.

**obtain training**  
113-2

Grantees will ensure that knowledge and skills gained from training will be applied to the operation of the HWAP.

**apply training**  
113-3

Grantees will ensure that employees and contractors, as weatherization professionals, will seek and use training and technical assistance in order to stay current with up-to-date weatherization knowledge and skills.

**continuing education**  
113-4

Employees and contractors are required to complete the updates or training courses following the schedule listed here: Inspector Refresher every 3 years, and Heating Technician Refresher every 3 years.

All heating contractors must be either state-certified or locally-certified by an equivalent state test, or have completed the Furnace Maintenance and Repair or Combustion for Heating Contractors course from the Ohio Weatherization Training Center (OWTC).

**contractor training requirements**  
113-5

All weatherization contractors must have blower door training and must follow the WPS for pressure diagnostics testing (worst case draft, pressure pan, room-to-room pressure testing, and series leakage (zone) testing).



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Health and Safety</b>

### *INTRODUCTION 114-1.1*

The purpose of this section is to identify Health and Safety requirements.

**purpose**  
114-1.1

### *OSHA REQUIREMENTS 114-1.2*

Grantees shall comply with Occupational Safety and Health Administration (OSHA) requirements for all activities which involve staff personnel.

**OSHA**  
114-1.2a

Related costs to train and equip staff personnel in order to comply with OSHA requirements shall be charged to the Support or Training and Technical Assistance budget categories, as appropriate.

**T/TA expenditures**  
114-1.2b

Grantees must comply with OSHA regulations concerning administrative procedures directing the collection, maintenance and dissemination of information concerning exposure to, and handling of, hazardous materials.

**administrative  
procedures**  
114-1.2c

Contractors employed by grantees are expected to comply with OSHA requirements. Costs associated with compliance shall be part of the bid price or job cost.

**contractors**  
114-1.2d

Grantees' costs for complying with OSHA health and safety requirements may be charged to Administrative or Training and Technical Assistance budget categories, as appropriate.

**costs**  
114-1.2e

### *HEALTH AND SAFETY BUDGET 114-1.3*

With the exception of Section 114-1.2 above, all costs shall be applied to the Health and Safety budget category for allowable health and safety activities that are necessary to abate health and safety hazards before, or because of, the installation of weatherization measures. This includes:

**health & safety budget**  
114-1.3

The cost to eliminate the presence of hazardous levels of combustion by-products in the living space from a heating or water heating appliance that cannot be otherwise eliminated through routine tune-up or repairs.

**combustion by-  
products**  
114-1.3a

<b>non-operational heating units</b> 114-1.3b	The cost to repair or replace a non-operational heating or water heating appliance.
<b>none exists</b> 114-1.3c	The cost to provide a heating or water heating appliance where none exists.
<b>gas cook stoves</b> 114-1.3d	The cost to test and repair a gas cook stove to eliminate or reduce the production of carbon monoxide (CO).
<b>electrical systems</b> 114-1.3e	The cost to correct the presence of electrical system hazards, such as inadequately sized service, improperly grounded service, hazardously placed service, inadequately sized or insufficient number of circuits, poor condition (i.e. live bare wires, etc.) and wiring inappropriate to its location.
<b>introducing fresh air</b> 114-1.3f	The installation of exhaust fans, ducting, controls and passive air intakes that are designed to introduce fresh air to provide a safe and healthy level of air exchange.
<b>smoke alarms/CO alarms</b> 114-1.3g	The installation of smoke alarms and CO alarms.
<b>repair sewage lines</b> 114-1.3h	Minor repairs to sewage lines necessary prior to weatherization.
<i>ADDITIONAL HAZARD ABATEMENT 114-1.4</i>	
<b>limited allowability</b> 114-1.4	In addition to the hazard corrections identified in 114-1.3, other hazards may be abated under the circumstances identified below. Costs for these activities shall be charged to the Health and Safety Budget line item.
<b>asbestos</b> 114-1.4a	The cost of removing and/or abating asbestos is generally prohibited. Where grantees work on large heating and distribution systems, including related piping, the cost of asbestos removal (or less costly approaches such as encapsulation) is allowable to the extent that documented energy savings resulting from the measure will demonstrate a cost effective SIR. In all cases, compliance with all codes and EPA regulations is required. Cutting asbestos-containing siding material remains prohibited. Removal of cementitious siding by a person trained in safe working practices is allowable.

The cost of removal or mitigation of odors, viruses, bacteria, unsanitary conditions and rotting wood is allowable to the extent that removal or mitigation is necessary to allow effective weatherization work and/or to provide for the immediate or future health of workers or clients. Whole house extermination of pests is not allowed.

**biological agents**

114-1.4b

The cost of correcting existing indoor air quality problems due to these chemicals is prohibited. However, care should be taken not to exacerbate a known existing condition.

**formaldehyde and VOCs**

114-1.4c

The cost of treating an existing occupant health problem is prohibited. However, care should be taken to assess if health problems exist and, consequently, to avoid weatherization work or materials that may exacerbate any such problem.

**existing occupant health problems**

114-1.4d

The cost of lead paint abatement is prohibited. However, the cost to test a building for the presence of lead paint and the cost of precautions to prevent causing a lead paint contamination problem while installing weatherization materials is allowable.

**lead paint**

114-1.4e

The intent of Federal Regulations regarding lead-based paint (LBP) hazard reduction efforts is to eliminate lead poisoning in children. In accordance with that intent, specifically the Pre-Renovation Lead Information Rule (Toxic Substances Control Act, Section 406b), each weatherization service provider shall provide the pamphlet entitled *Protect Your Family From Lead in Your Home* to an adult resident of each pre-1978 residential building to be weatherized, and obtain from that adult resident a written acknowledgement that the adult resident has received the pamphlet, or certify in writing that a pamphlet has been delivered to an adult resident and the provider has been unsuccessful in obtaining a written acknowledgement, as directed in the publication *Lead: Requirements for Hazard Education Before Renovation*, reference 40 CFR Section 745.80-745.88.

Lead-based paint was used on the majority of houses built before 1978. It is probable that LBP is present on houses weatherized by the HWAP that were built before 1978. If lead-based paint is disturbed (cut, scraped, sawn, drilled, etc.) during the weatherization work, that work shall be done in a “lead-safe” manner.

**lead paint (cont'd)**

114-1.4e

If the homeowner, landlord, or another person notifies you that there is lead present in the home or that lead poisoning has occurred to a member of the household, then all weatherization work must stop. No other weatherization work can take place until the home is declared lead safe. WPS section 112 (denial of services) must be followed when work is stopped and all documentation must be placed in the client file.

In response to a suspected lead paint hazard, follow the guidelines published in the EPA handbook, *Reducing Lead Hazards When Remodeling Your Home* (publication #: EPA 747-R-94-002).

Please refer to the Health and Safety section of the HWAP State Plan for additional information.

**radon gas**

114-1.4f

The cost of abating radon is prohibited. However, the cost to test a building for the presence of radon gas is allowable if the potential for its presence is believed to be high. Routine weatherization measures that help abate and/or mitigate the existence of radon are allowable as weatherization measures.

*LANDLORD CONTRIBUTIONS 114-1.5***landlord contributions**

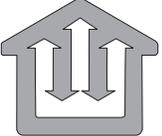
114-1.5

Non-HWAP eligible landlords must contribute financially an amount equal to 50% of the material and labor cost of abatement of hazards found in their building.

*HEALTH AND SAFETY CONCERNS 114-1.6***customers and crew members**

114-1.6

Weatherization measures that could potentially affect the health and safety of clients or crew members shall be undertaken only after steps are taken to minimize or eliminate risks associated with the retrofit. Those risks include absorption, inhalation or ingestion of hazardous materials. Source control shall be the first approach.

	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Energy Density Analysis</b>

### *ENERGY DENSITY ANALYSIS 115*

Energy density analysis means using actual metered energy consumption data from a large pool of metered, low-income, utility customers to determine how much energy a customer uses in relation to other metered, low-income, utility customers. The purpose of this analysis is to allow providers to prioritize high-use, high-payment arrearage homes for the installation of cost-effective energy efficiency measures and intensive customer energy management education.

**definition**  
115

### *UNIVERSAL SERVICE FUND (USF) AND PUBLIC HOUSING AUTHORITY (PHA) PROGRAMS 115-1*

Actual metered energy consumption data may be used to normalize the annual energy consumption of large samples of low income customers in order to target customers for services or to help determine a theoretical level of the energy efficiency measures (EEMs) investment.

**Actual metered consumption**  
115-1

The energy density analysis must include all customers in the sample. Only buildings with metered energy sources may use energy density analysis in place of 100% on-site auditing. Extrapolation of results to units with no metered consumption data is not allowed.

**all customers**  
115-1.1

Energy density analysis must be determined from actual metered energy consumption data provided by the utility, or from check metering, for a minimum of 1 full heating season and 1 calendar year which includes 1 full cooling season (expressed in energy units and cost per energy unit).

**actual consumption data**  
115-1.1a

At least 12 months metered energy consumption data with data points for each month must be used in the energy density analysis.

**12 months data**  
115-1.1b

<b>actual building size</b> 115-1.1c	Actual building size in consistent units, such as square feet of conditioned living area, must be used across all buildings sampled in the energy density analysis to determine energy use per square foot.
<b>actual local weather information</b> 115-1.1d	Actual local weather information (heating and cooling degree-days), corresponding to fuel metering dates (not yearly averages), must be used in the energy density analysis. Long term heating and cooling degree-day data will be used to normalize the energy use to factor out abnormally warm or cold weather conditions that occur in a particular year.
<b>PRISM-consistent</b> 115-1.2a	The analysis must be consistent with data requirements of the Princeton Scorekeeping Method (PRISM). The metered energy consumption data analysis must cover all units in the sample population.
<b>space conditioning/ base load energy use disaggregation</b> 115-1.2b	Energy density analysis must consider space conditioning (heating and cooling) energy use separately from base load energy use. The following data requirements in 115-1.2c apply to each customer data set.
<b>energy intensity index (EEI)</b> 115-1.2c	<p>The energy intensity index is a number used to compare a sample of buildings for their energy use in a manner that normalizes buildings by energy usage, building size (such as conditioned floor area) and local long term weather conditions. To calculate the EEI, divide Btu by square feet of conditioned area, and then divide that number by the heating degree-days. The resulting number is the EEI. The following assumptions apply:</p> <ol style="list-style-type: none"><li>i. All energy must be converted to British thermal units (Btu),</li><li>ii. Energy consumption must be disaggregated into heating load, cooling load and base load to account for customer versus building energy usage,</li><li>iii. Square feet of conditioned living area must be used for evaluation (others, such as volume or shell area may also be used at the analyst's discretion),</li><li>iv. Heating (rather than cooling) energy intensity must be used for all benchmarking,</li><li>v. Base load energy intensity (all non-heating, non-cooling energy consumption) will be analyzed separately.</li><li>vi. Actual local heating and cooling degree-day data that corresponds to the energy consumption period shall be appended to historical temperature data for the analysis.</li></ol>

*PRIORITIZATION 115-2*

After all of the metered energy consumption data has been collected and normalized, the authorize provider will perform on-site inspections of a sub-set of each range of units (based on EEI). The sample may be sorted into several workable ranges for further analysis.

**on-site inspections**  
115-2.1

For the range of high energy users, all units (100%) must have on-site inspections and full energy audits to determine energy efficiency measures that have an SIR of 1 or greater.

**high energy users**  
115-2.1a

If the object of the energy density analysis is to determine a group of customers that will not receive any, or all, benefits due to low energy consumption and low potential for cost-effective energy savings, then the authorized provider must inspect no less than 5% of the low energy user population on-site to verify the results of the analysis.

**low energy users**  
115-2.1b

If the object of the sampling is to determine a group of customers that will receive reduced benefits because of moderate energy consumption, then any authorized provider planning to serve the moderate-use range(s) must perform at least 20% on-site verification and auditing of the 20% of the sample population.

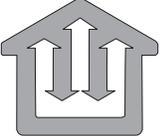
**moderate energy users**  
115-2.1c

*COST-EFFECTIVENESS 115-3*

As cost-effectiveness applies to Section 115-2, the cost-effectiveness of the EEMs that could be performed and decisions of which buildings will be cost-effective on a large scale, based on the energy density analysis, is dependant on many variables. These variables include: the cost of fuel, the cost of the retrofits, the heating and cooling degree-days, the amount and type of existing EEMs, and the effectiveness of the work that is performed. For these reasons, prioritizing units or setting threshold criteria is the responsibility of the authorized providers. The cost-effectiveness will, however, be based upon an SIR of 1 or greater.

**cost-effectiveness testing**  
115-3.1



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Quality Assurance</b>

### *QUALITY ASSURANCE 116*

Any agency, local government, for-profit, or not-for-profit company which, as a part of their services, are installing energy efficiency measures on residential buildings and which references or requires that work be performed in accordance with these Weatherization Program Standards (WPS) must also have a quality assurance program that documents that completed work truly meets the spirit of these standards.

**service provider**  
116-1

A quality assurance protocol must assure the following:

- a. This section (116) of the administrative requirements of the program have been met.
- b. Completed buildings meet the WPS.
- c. Completed buildings are operating safely within the confines of the WPS.
- d. Completed buildings have received a final inspection.
- e. Deficiencies discovered during final inspections have been resolved.
- f. Invoices or other billings have been completed.

**quality assurance  
elements at the local  
level**  
116-2

Any organization or company that funds an energy efficiency conservation program that is to comply with the Weatherization Program Standards (WPS) should also have a quality assurance program and ultimately be responsible for adherence to these standards by the service providers.

**funding organization**  
116-3

A quality assurance plan must provide the following:

- a. The administrative requirements of the funding organization's program have been met.
- b. A sample of completed buildings have received a third-party, arms-length inspection.
- c. Funds have been expended in an appropriate manner.

**quality assurance  
elements at the funding  
organization level**  
116-4

Since this is a public document, any agency or program may use any part of these standards as it sees fit. Partial use of these standards does not constitute compliance with the entire WPS and the program can not be advertised as meeting the spirit of the Weatherization Program Standards.

**selective use of the  
WPS**  
116-5





State of Ohio  
Weatherization Program  
Standards

Section **MECHANICAL SYSTEMS  
INSPECTION**

Subject **Heating Units**

*NON-OPERATIONAL UNITS 201-1.1*

**No weatherization work may be done until a non-operational primary heating unit is repaired or replaced.**

**repair/replace**  
201-1.1a



If the heating unit must be replaced, a NEAT audit must be performed if weatherization funds are used to replace the heating unit.

**cost-effectiveness**  
201-1.1b



All unvented, fuel-fired primary heating units, unvented fuel-fired water heaters, or unvented, gas, clothes dryers present in a dwelling which cannot be vented, must be removed or replaced with properly-vented units before proceeding with any weatherization work. Notify the client/owner/authorized agent and arrange to have the unit replaced/removed.

**unvented primary  
heating units**  
201-1.1c

In dwellings where an unvented, secondary heating unit is present, inform the client/owner/authorized agent verbally and in writing of the potential health hazards of operating an unvented appliance in the post-weatherized dwelling and provide information on safe alternatives. Document the presence of the unvented, secondary heating unit in the HWAP client file. Install a carbon monoxide detector.

**unvented secondary  
heating units**  
201-1.1d

*FUEL SUPPLY 201-1.2*

Fuel must be available (except for solid fuel units) to begin the inspection process.

**fuel availability**  
201-1.2a

When no fuel is available for solid fuel units, check for:

**solid fuel**  
201-1.2b

- i. Heat exchanger leakage and corrosion.
- ii. Unsafe and/or improper wiring, if applicable.
- iii. Unsafe and/or improper venting and clearances.

**fuel leakage, gas**  
201-1.2c

Use a combustible gas leak detector to check for liquefied petroleum (LP) or natural gas leaks from all accessible gas supply lines and gas-fired appliances. Verify every suspected leak with a commercial leak detector solution. Determine the source and severity of the problem and corrective actions.

**major gas leaks**  
201-1.2d



If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the owner/occupant and leave the dwelling. Contact the fuel vendor, and have the problem corrected. Document all actions taken in the customer file.



**No weatherization work may be done until major gas leaks are corrected.**

**minor gas leaks**  
201-1.2e

If the gas leak is minor (see 1504, Appendices and References), inform the owner/occupant and have the problem corrected.

**fuel leakage, oil**  
201-1.2f

Visually check for fuel leakage in kerosene and fuel oil heating units. Visually check the fuel oil storage tank for leaks.



**No weatherization work may be done until oil or kerosene leaks are corrected.**

**Btu input**  
201-1.2g

When appropriate, test to determine if the heating unit is over- or under-fired by clocking the meter on natural gas units and calculating the actual Btu input. On propane units, the heating technician/heating contractor may take a gas pressure test, measure the orifice, and calculate the actual Btu input. Determine corrective actions.

### *ELECTRICAL POWER SUPPLY 201-1.3*

**main power safety**  
201-1.3a

Inspect the main electrical power supply to the heating unit to determine whether it is safe.

**dedicated circuit**  
201-1.3b

Inspect the wiring to the heating unit. Determine whether the electrical circuit to the heating unit is in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

If no dedicated circuit exists, it is not necessary to install one unless the wiring is in poor condition, or there is a history of circuit failure, or a new heating unit is to be installed.

Visually inspect all wiring at, or in, the heating unit to detect charred, frayed, or missing wire insulation, and improper or loose connections.

**hazardous wiring**  
201-1.3c



**If the wiring is hazardous, inform the customer of the problem and have it corrected before doing any weatherization work.**



*HEATING UNIT CLEARANCES 201-1.4*

Visually inspect the heating unit to determine whether clearances from combustibles are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

**heating unit clearances**  
201-1.4a

*VENT SYSTEM VISUAL INSPECTION 201-1.5*

Determine whether the vent system is in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). Visually inspect the vent system to determine that it extends from the heating unit to the outside of the dwelling. Look for excessive corrosion or rust, cracks, holes and loose, unsealed, or disconnected sections. Repair of an existing problem is mandatory.

**clearance and termination**  
201-1.5a

Inspect the vent/chimney connections to determine whether they are securely fastened.

**vent connections**  
201-1.5b

Determine whether the vent connector is installed with no dips or sags, and rises at least 1/4" per foot of run.

**vent slope**  
201-1.5c

Determine whether the number of elbows exceeds that allowed in the codes cited in Table 201-1.5.

**vent elbows**  
201-1.5d



Determine whether any chimney in use is in sound condition. Determine whether existing liners, bricks or blocks and mortar are in good condition.

**chimney condition**  
201-1.5e

**chimney liner**  
201-1.5f

Determine whether chimney repair or a new liner is needed. All fan-assisted appliances shall vent into a properly-sized lined chimney.

*DRAFT TESTING 201-1.6*

**draft, "worst case"**  
201-1.6a

Set up the "worst case scenario" for draft testing (see 1506-4). All draft tests must be taken under "worst case scenario" conditions.

**Table 201-1.6 Draft Test Locations and Acceptable Readings**

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

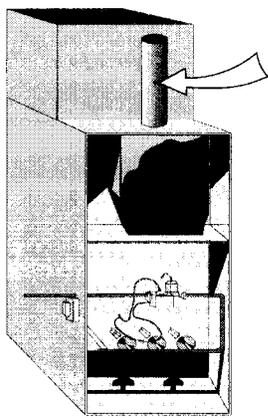
**draft**  
201-1.6b

Start the heating unit. Insert the draft probe into the appropriate location listed in Table 201-1.6 and illustrated in Figure 201-1.6. At two minutes, measure the draft and determine whether the draft reading is within the acceptable ranges identified in Table 201-1.6.

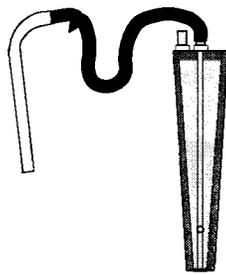
*COMBUSTION SAFETY AND EFFICIENCY TESTING 201-1.7*

**carbon monoxide (CO)**  
201-1.7a

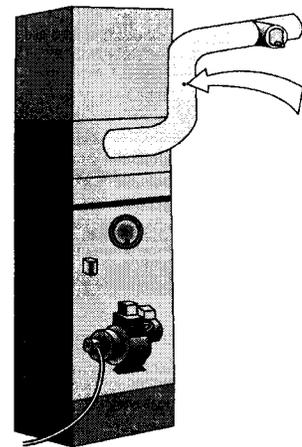
With the heating unit operating in winter operating condition, insert the sampling probe into the appropriate location listed in Table 201-1.7a and illustrated in Figure 201-1.7. Measure and record the amount of CO in the flue gasses. The low reading must be 100 ppm or less.



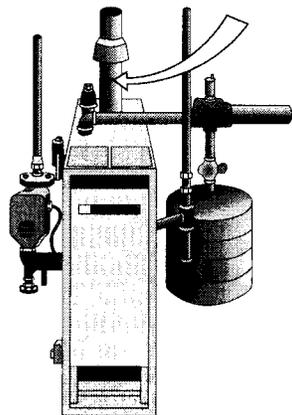
Atmospheric Furnace



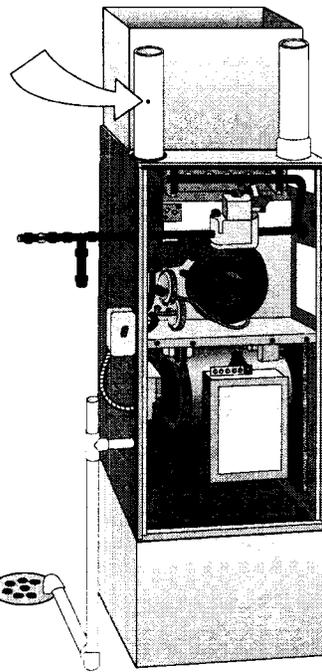
PROPER PROBE  
PLACEMENT FOR  
DRAFT TESTING



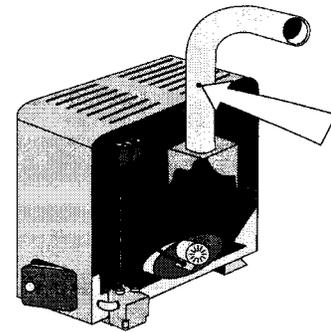
Fuel Oil Furnace



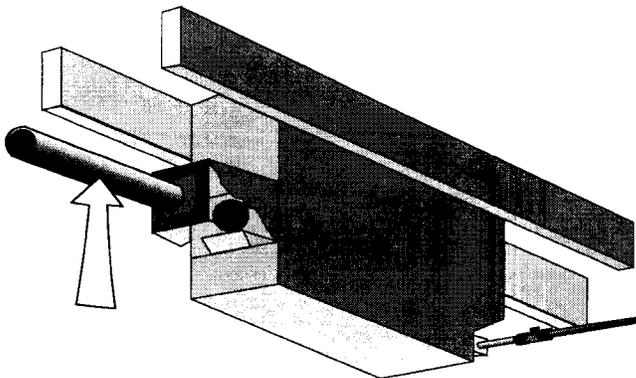
Atmospheric Boiler



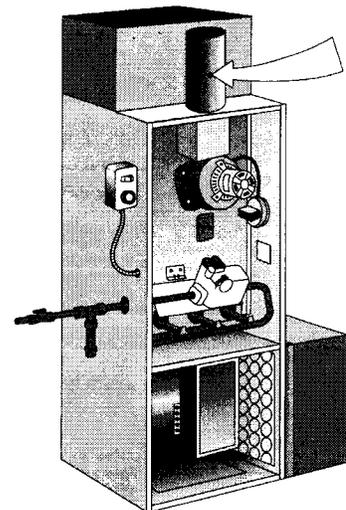
90+ Condensing Furnace



Space Heater



Floor Furnace



80+ Induced-draft Furnace

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Figure 201-1.6

Table 201-1.7a CO and Combustion Analyzer Probe Placement Locations

Heating Unit Types	Probe Location
Gas-fired Central Furnaces and Direct Heating Equipment	Each heat exchanger port
Oil-fired Central Furnaces and Direct Heating Equipment	Twice the diameter of the vent pipe down stream from any elbow and ½ the diameter of the vent pipe before the single acting barometric draft control
Gas-fired Boilers	Vent pipe before draft diverter
Sealed Combustion Units/Fan-assisted appliances	Exhaust vent pipe

Table 201-1.7b Acceptable Combustion Test Analysis Measurements

Heating Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
<b>GAS</b> (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
Fan-assisted	4-9%	300-480° F	N/A	100
Condensing	PMI	PMI	N/A	100
Space Heaters	5-15%	300-650° F	N/A	100
Standard Power Burner	4-9%	275-550° F	N/A	100
<b>OIL</b>				
Standard Oil Burner	4-9%	325-600° F	1 or less	100
Flame Retention	4-7%	325-600° F	1 or less	100
Condensing	PMI	PMI	1 or less	100

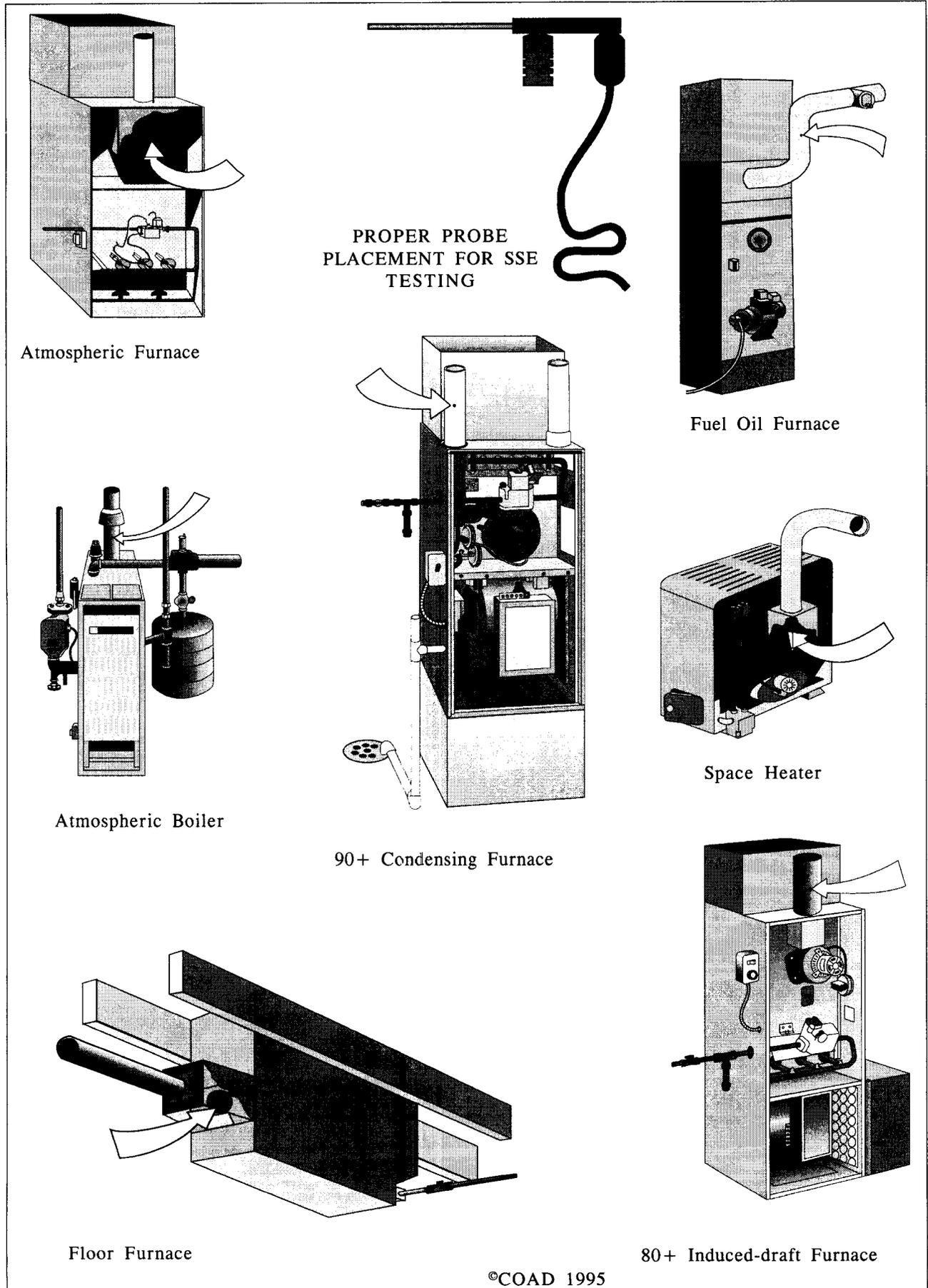


Figure 201-1.7

With the heating unit operating in winter operating condition, insert the sampling probe of a calibrated digital combustion analyzer into the appropriate location listed in Table 201-1.7a and illustrated in figure 201-1.7.

**combustion analysis**  
201-1.7b

After the stack temperature stabilizes, measure and record the O<sub>2</sub> and the stack temperature readings. Determine whether the readings are within the acceptable limits listed in Table 201-1.7b or PMI.

Determine whether the combustion air requirements are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). (See 1506-11 Combustion Air/Specifically Engineered Systems). If the requirements are met, and carbon deposits and corrosion exist around the draft diverter, recheck for proper venting and backdrafting potential.

**combustion air**  
201-1.7c

### *HEAT EXCHANGER INTEGRITY 201-1.8*

Visually inspect the heat exchanger for evidence of deterioration and cracks or holes. Inspect for water leakage in boilers. Inspect for air leakage between boiler sections.

**visual inspection**  
201-1.8a

With the heating unit operating, use a CO tester sensitive to at least 10 parts per million to test for CO in the distribution system and in the ambient air. If the source of CO is not the heating unit, then look for other possible sources of CO.

**carbon monoxide (CO)**  
201-1.8b



During the combustion efficiency tests on forced-air systems, measure and record any change in the O<sub>2</sub> reading when the furnace blower motor comes on. If there is a change in the reading, reinspect the heat exchanger. Other industry accepted tests may be performed to confirm the problem.

**oxygen fluctuation,  
forced air systems**  
201-1.8c

If a crack in the heat exchanger is verified, then the heat exchanger or the heating unit must be replaced.

**verified crack**  
201-1.8d

No weatherization work may be performed on a building until any cracked heat exchanger is repaired or replaced.

**cracked heat  
exchanger**  
201-1.8e

*TEMPERATURE RISE 201-1.9*

With the heating unit and blower operating, measure the temperature in a duct within 12 inches of the supply and return plenums. Determine whether the temperature rise is PMI, or within the acceptable range of 40° F - 70° F for mid to high efficiency furnaces, or if a data plate is not present on an atmospheric unit, within the acceptable range of 60° F and 90° F.

**measurement**  
201-1.9



*CONTROLS 201-1.10*

Determine whether the fan is activated properly by the fan control.

**fan control, forced-air units**  
201-1.10a

Check the high limit setting on forced-air heating units. Determine whether it is working correctly.

**high limit control, forced-air units**  
201-1.10b

Determine whether the blower motor, belt, and fan are clean and operating properly. Determine if the blower motor needs lubrication.

**blower operation/condition**  
201-1.10c



Determine whether there is an aquastat on the boiler and whether it is working correctly.

**aquastat, boiler**  
201-1.10d

Determine whether the water pump is operating properly.

**water pump, boiler**  
201-1.10e

Inspect the operating condition of the thermostat. Determine whether the thermostat will properly activate the heating unit.

**thermostat**  
201-1.10f



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Electric Heat Pump/ Central Air Conditioning</b>

*NON-OPERATIONAL UNITS 201-2.1*

A dwelling unit may not be weatherized until a non-operational, electric heat pump unit that is the primary heating unit is repaired or replaced.

**repair/replace**  
201-2.1a



If the unit must be replaced, a NEAT audit must be performed if weatherization funds are used to replace the unit.

**cost-effectiveness**  
201-2.1b



Do not test heat pumps when the exterior air temperature is above 70° or below 30°.

**heat pump test**  
201-2.1c

Do not test air conditioning units when the exterior air temperature is below 70°.

**air conditioner test**  
201-2.1d

*THERMAL FLUID LEAKAGE 201-2.2*

Use a refrigerant leak detector to inspect for thermal fluid leakage. If leakage is detected, promptly contact an EPA-certified technician to correct the problem.

**thermal fluid  
leakage test**  
201-2.2a

*ELECTRICAL POWER SUPPLY 201-2.3*

Inspect the main electrical power supply to the unit to determine that it is safe.

**main power safety**  
201-2.3a

Inspect the wiring to the heat pump/AC unit. Determine whether the heat pump/AC unit has a dedicated circuit that is properly sized and fused.

**dedicated circuit**  
201-2.3b

Determine whether there is an operational disconnect switch on outdoor units.

**disconnect switch**  
201-2.3c

Visually inspect all wiring at, or in, the heat pump/AC unit to detect charred, frayed or missing wire insulation, and for improper or loose connections.

**hazardous wiring**  
201-2.3d



**If a hazard exists, inform the customer and have the problem corrected before performing weatherization work.**



*HEATING/COOLING UNIT CLEARANCES 201-2.4*

**unit clearances,  
indoors**  
201-2.4a

Visually inspect the unit to determine whether clearances from combustible surfaces are PMI.

**unit clearances,  
outdoors**  
201-2.4b

CEE

Visually inspect the outside unit to determine that clearances are PMI. Make sure that the cooling fins are not obstructed or dirty. Determine whether access to the unit is blocked. Explain to the customer why this is important.

*BACK-UP SYSTEM INSPECTION 201-2.5*

**back-up system**  
201-2.5a

Determine the back-up system fuel type and perform an inspection in accordance with the standards in 201-1.

*AIR HANDLER 201-2.6*

**condensate drainage**  
201-2.6a

Visually inspect the inside unit to determine if there is proper condensate drainage. Make sure that there are no puddles or residue present.

**A-coil**  
201-2.6b

Visually inspect the A-coil for existence of cracks or holes. If any are present, contact an EPA-certified technician to repair them.

**fins/filters/ducts**  
201-2.6c

Visually inspect for dirty or obstructed fins, filters, or ducts.

**temperature rise/  
drop airflow test**  
201-2.6d

With the unit operating, measure the temperature at the supply and return ducts close to, but not in, the plenums. Subtract the measured temperatures to determine temperature rise/drop. Determine whether the temperature rise/drop is PMI.

*CONTROLS 201-2.7*

**blower**  
201-2.7a

Determine whether the blower motor, belt, and fan are clean and operating properly. Determine if the blower motor needs lubrication.

**thermostat**  
201-2.7b

Determine whether the thermostat is operating correctly. Adjust the temperature to determine whether the thermostat properly activates the heating and cooling units.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Other Combustion Appliances</b>

*201-3.1 FUEL SUPPLY*

Use a combustible gas leak detector to check for propane or natural gas leaks on accessible rigid and flexible lines leading to cook stoves and gas combustion appliances other than the primary heat source or domestic hot water tank. If a dwelling unit has more than one secondary gas combustion appliance, inspect all appliances that are connected to the gas supply. Verify suspected leaks with soap solution. Determine the source and severity of the problem. Replace defective flexible range connectors.

**gas leaks**  
201-3.1a

If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the customer and leave the building. Contact the fuel vendor and have the problem corrected. Document all the actions taken in the customer file.

**major gas leaks**  
201-3.1b



**No weatherization work may be done until major gas leaks are corrected.**



If the gas leak is minor (see 1504, Definitions), inform the customer and have the problem corrected.

**minor gas leaks**  
201-3.1c

If there are gas shut-off valves present, determine whether they work properly.

**gas shut-off valve**  
201-3.1d

*201-3.2 OVEN VENT*

Determine whether the oven is vented to the outside. If so, determine whether the vent is securely fastened.

**vent to outside**  
201-3.2a

*201-3.3 GAS COOK STOVE EXHAUST FAN*

Determine whether there is an operational kitchen exhaust hood or fan that is vented to the outside. If an exhaust fan is present, but is not operational, have the unit repaired or replaced.

**exhaust fan, vented to outside**  
201-3.3a

Inform the customer about the reasons for, and the importance of, using the kitchen exhaust fan while cooking.

**proper use**  
201-3.3b



*RANGE INSPECTION AND OPERATION 201-3.4***cook stove condition**

201-3.4a

CEE
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Note the general condition and cleanliness of the cook stove. If the unit is visibly dirty, perform the inspection and test it as it is. Ask the customer to clean the oven so that it can be retested at the final inspection. Explain to the customer why this is necessary.

**type of ignition**

201-3.4b

Determine the type of ignition for the burners, oven, and broiler. If the unit has standing pilot lights, ensure that the pilot lights are lit.

**operable burners**

201-3.4c

Determine whether the burners are operable. If they are not operable, it is allowable to have them repaired.

*CARBON MONOXIDE (CO) TESTING 201-3.5***stove top burners**

201-3.5a

Using a digital combustion analyzer, individually test each burner for the presence of CO (see section 1506-2). Record the reading for each burner.

**oven vented outside**

201-3.5b

The oven test is not necessary if the oven is vented to the outside.

**oven/broiler testing**

201-3.5c

Turn on the oven/broiler unit. Ensure that the oven burner fires. Note the time that the oven fires, and allow it to run 10 minutes before beginning the oven test (see 1506-2).

*CLOTHES DRYERS (ALL ENERGY SOURCES) 201-3.6***vent to outside**

201-3.6a

Determine whether the clothes dryer is vented outside to daylight.

**dryer vent duct material (rigid-metal)**

201-3.6b

Determine whether the dryer vent is a rigid-metal duct that has a smooth interior surface, is a minimum 30 gauge galvanized steel or aluminum and is equipped with a backdraft damper.

**dryer vent duct material (flexible-metal)**

201-3.6c

Determine whether the dryer vent duct is a flexible-metal duct that is approved for use with the applicable energy source, is installed in a manner that minimizes overall length, and is sufficiently supported to eliminate sagging.

**dryer vent duct sizing (rigid-metal & flexible-metal)**

201-3.6d

Determine whether the diameter of the dryer vent duct is at least the diameter of the appliance outlet. Determine the length of a 4-inch diameter dryer vent duct. The maximum length shall not exceed 25 feet from the clothes dryer outlet to the termination point.

If the length exceeds 25 feet, increase the duct diameter to 5". (A reduction in maximum length of 2.5 feet for every 45-degree bend and 5 feet for every 90-degree bend shall apply).

**dryer vent duct  
sizing (rigid-metal &  
flexible-metal)  
(con't)  
201-3.6d**



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Domestic Hot Water</b>

*FUEL SUPPLY 201-4.1*

Fuel must be available to begin the inspection process of the DHW heater.

**fuel availability**  
201-4.1a

Use a combustible gas leak detector to determine if propane or natural gas is leaking from all accessible gas supply lines and gas-fired appliances. Verify every suspected leak with soap bubble solution. Determine the source and severity of the problem.

**fuel leakage, gas**  
201-4.1b

If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the customer and leave the dwelling. Contact the fuel vendor and have the problem corrected. Document all actions taken in the customer file.

**major gas leaks**  
201-4.1c



**No weatherization work may be done until major gas leaks are corrected.**



If the gas leak is minor (see 1504, Definitions), inform the customer and have the problem corrected.

**minor gas leaks**  
201-4.1d

Visually check for fuel leakage in kerosene and fuel oil DHW units.

**fuel leakage, oil**  
201-4.1e

When appropriate, test to determine if the gas DHW unit is over- or under-fired by clocking the meter on natural gas units and calculating the actual Btu input. On propane units, take a gas pressure test, measure the orifice, and calculate the actual Btu input. Determine corrective actions.

**Btu input**  
201-4.1f

*ELECTRICAL POWER SUPPLY 201-4.2*

Inspect the main electrical power supply to an electric tank to determine that it is safe.

**main power safety**  
201-4.2a



Inspect the wiring to the DHW unit and determine whether the electrical line to the heating unit is a dedicated circuit that is properly sized and fused. If no dedicated circuit exists, it is not necessary to install one unless the wiring is in poor condition, there is a history of circuit failure, or the unit is to be replaced.

**dedicated circuit**  
201-4.2b



**hazardous wiring**  
201-4.2c



Visually inspect all wiring at or in, the DHW unit to detect charred, frayed or missing wire insulation and improper or loose connections. If the wiring is hazardous, inform the customer of the problem and have the problem corrected.

*DHW UNIT CLEARANCES 201-4.3*

**unit clearances**  
201-4.3a

Note whether combustion-type DHW tanks are located with the required clearances from combustible materials PMI or the appropriate NFPA code. If they are not, have the DHW tank moved to achieve required distance from combustible surfaces.

*VENT SYSTEM VISUAL INSPECTION 201-4.4*

**clearance**  
201-4.4a



Determine whether the vent system is in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). Visually inspect the vent system to determine that it extends from the heating unit to the outside of the dwelling. Look for excessive corrosion or rust, cracks, holes and loose, unsealed, or disconnected sections. Repair of an existing problem is mandatory.

**vent connections**  
201-4.4b

Inspect the vent/chimney connections to make sure that they are securely fastened.

**vent slope**  
201-4.4c

Determine whether the vent connector is installed with no dips or sags, and rises at least 1/4" per foot of run.

**vent elbows**  
201-4.4d

Determine whether the number of elbows exceeds that allowed in the codes cited in Table 201-4.4a.

**chimney condition**  
201-4.4e

Determine whether any chimney in use is in sound condition. Determine whether existing liners, bricks or blocks and mortar are in good condition.

**chimney liner**  
201-4.4f

Determine whether chimney repair or a new chimney liner is needed.

**combustion air/  
backdrafting**  
201-4.4g

Determine whether the combustion air requirements are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). If the requirements are met, and carbon deposits and corrosion exist around the draft diverter, recheck for proper venting and backdrafting potential.

*DRAFT TESTING*    201-4.5

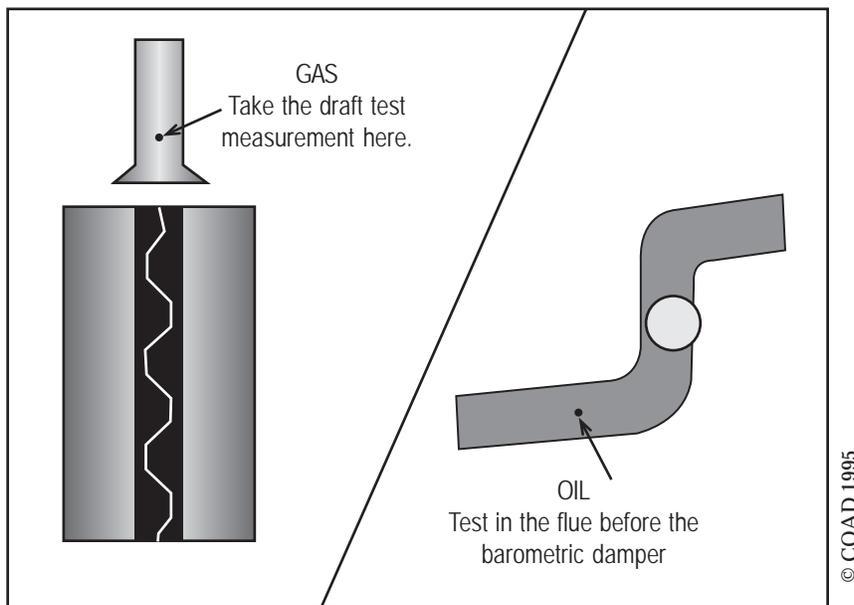
Set up the "worst case scenario" for draft testing (see 1506-4). All draft tests must be taken under "worst case scenario" conditions.

**draft, "worst case"**  
201-4.5a

Start the DHW unit. Insert the draft probe into a hole in the vent pipe above the draft diverter (see figure 201-4.5.) Measure the draft at two minutes and determine whether the draft reading is within the acceptable ranges identified in Table 201-4.5.

**draft**  
201-4.5b

Figure 201-4.5 Draft Test Probe Placement



*COMBUSTION SAFETY & EFFICIENCY TESTING*  
201-4.6

With the DHW unit operating, insert the sampling probe into the appropriate location illustrated in Figure 201-4.6. Measure and record the amount of CO in the flue gasses. More than 100 ppm in the flue is not permitted.

**carbon monoxide (CO)**  
201-4.6a

Table 201-1.6 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

**combustion analysis**  
201-4.6b



With the DHW unit operating, insert the probe of a calibrated digital combustion analyzer into the appropriate location illustrated in Figure 201-4.6. After the unit has been operating at least ten minutes, measure and record the O<sub>2</sub> and the stack temperature readings. Determine whether the readings are within the acceptable limits listed in Table 201-4.6.

Figure 201-4.6 Proper Probe Placement for Testing DHW Tanks

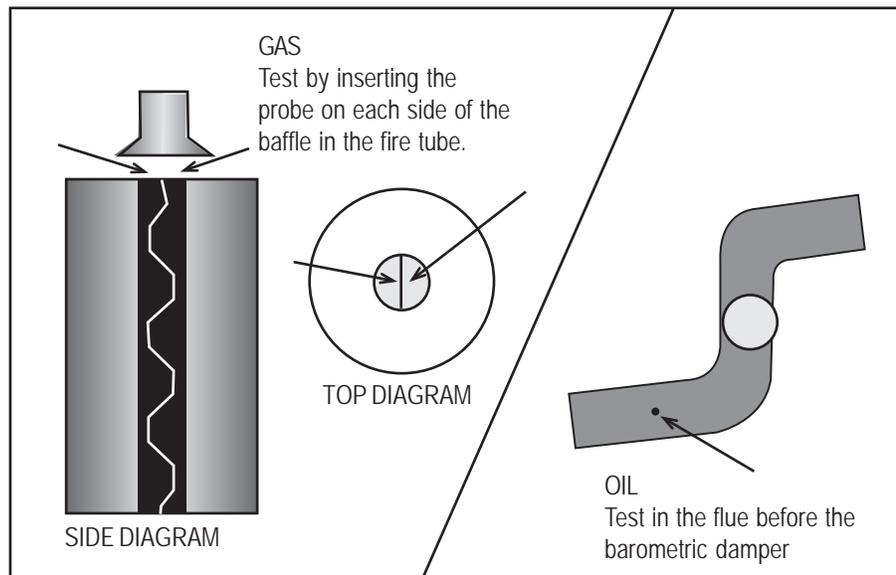


Table 201-4.6 Acceptable Combustion Test Analysis Measurements

DHW Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
	Fan-assisted	300-480° F	N/A	100
OIL Conventional Oil Burner	4-9%	325-600° F	1 or less	100
	Flame Retention	325-600° F	0 or trace	100

Determine whether the combustion air requirements are in accordance with those listed in the codes in Table 201-4.4g. If the requirements are met, and carbon deposits and corrosion exist around the draft diverter, recheck for proper venting and backdrafting potential.

**combustion air**  
201-4.6c

*WATER TANK CONDITION 201-4.7*

Determine if the tank is leaking water. If it is leaking, it may be replaced using HWAP Health and Safety funds.

**tank leakage**  
201-4.7a



Determine whether a pressure relief valve and a discharge pipe are present. If the relief valve and/or the discharge pipe is not present and there is an existing location for them, have them installed. If the relief valve and/or discharge pipe are not present and there is no existing location for them, have them installed in the hot water line.

**pressure relief valve/  
discharge pipe**  
201-4.7b



Do not call for insulation on tanks that have a manufacturer’s warning against adding additional insulation.

**tank insulation  
warning**  
201-4.7c



Determine whether the tank is insulated. Measure the tank to determine the amount of insulation needed to cover the tank.

**tank insulation**  
201-4.7d



Examine the temperature setting on the gas valve or thermostat. Consult with the customer to determine if lowering of the temperature can be accomplished without affecting the customer’s life-style.

**temperature  
setting**  
201-4.7e



## OWPS 201-4 MECHANICAL SYSTEMS INSPECTION—Domestic Hot Water

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**flame roll-out**  
201-4.7f

Turn up the thermostat to activate the water heating system. For a combustion-type system, determine whether flame roll-out is occurring.

**gas valve**  
201-4.7g

If the DHW tank is a gas-fired model, determine whether the gas valve is functioning properly (see 1506-8).

**thermostat**  
201-4.7h

Determine whether the thermostat is operating properly.

### *DHW DISTRIBUTION 201-4.8*

**water lines**  
201-4.8a

Inspect the water lines leading into, and out of, the water tank to determine whether they are leaking. If water lines are leaking, inform the customer and repair the leaks.

**water line insulation**  
201-4.8b



CEE

Determine whether there is insulation present on the first six feet of both the hot and cold water lines.

**fixture leaks**  
201-4.8c

CEE

Examine plumbing fixtures to determine if they are leaking. If plumbing fixtures are leaking, inform the customer. Repair of hot water leaks is mandatory. Determine whether cold water leaks are contributing to moisture problems.

**low-flow devices**  
201-4.8d

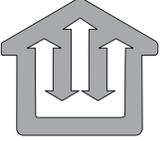
CEE

Examine plumbing fixtures to determine whether low-flow devices are present. Consult the customer to determine whether low-flow devices can be installed in the shower and at sink fixtures.

**consumer energy education**  
201-4.8e

CEE

Provide consumer energy education to the customer(s) regarding the management of hot water usage.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Heat Distribution System</b>

*FORCED-AIR DISTRIBUTION SYSTEM 201-5.1*

Note the locations of the registers in each room. Note any blocked or covered registers, and have them unblocked. Explain to the customer why this is important. Note the location of any registers outside the heated area or in other inappropriate locations. Consult with the customer about appropriate corrective measures.

**register locations  
and blockage**

CEE

201-5.1a

Note the presence and condition of any suspected asbestos on the ductwork. Follow safe work practices when in the presence of asbestos. Do not disturb friable asbestos (see 114-1.4a).

**asbestos**

!

201-5.1b

Test for duct leakage (see 1506-5).

**duct leakage test**

201-5.1c

Inspect for duct leakage locations (see 1506-5). Note sections of ductwork that are missing or disconnected, severely corroded, rusted through, or punctured.

**duct leak inspection**

201-5.1d

Note any sections of ductwork that are crushed or resisting air flow. Note any areas of return duct restriction.

**obstructions, flex duct**

201-5.1e

Inspect the return duct system and record any sections of ductwork that are missing, loose, unsealed, rusted through, or punctured. Identify gaps, holes or other problems in panned floor joist returns.

**return ducts**

201-5.1f

Inspect the supply duct system and record any sections of ductwork that are missing, loose, unsealed, rusted through, or punctured.

**supply ducts**

201-5.1g

Note the presence of ducts passing through non-conditioned spaces (see Table 201-5). Note the existence of any duct insulation. Determine if any insulation is needed and record measurements and the amount needed.

**duct insulation**

201-5.1h

Note the size of the furnace filter and whether it is dirty. Show the customer how to change the filter.

**furnace filter**

201-5.1i

CEE

Table 201-5

**Classification of Duct/Distribution System Zone**

What defines whether the area that a distribution system runs through is intentionally heated, conditioned, or non-conditioned? What retrofits should be done?

<b>Zone is:</b>	<b>Intentionally Heated</b> If the zone has heat being intentionally supplied to it	<b>Conditioned</b> if the temperature of the zone is closer to inside temperature than to outside temperature (in winter)	<b>Non-conditioned</b> if the temperature of the zone is near the outside temperature (in winter)
<b><u>1. DESCRIPTION:</u></b>			
Area has:	Supply registers, radiators, and/or heat source	Distribution system, furnace/boiler cabinet losses	No space heat
Intended communication with the house:	Inside the building envelope	Inside the building envelope	Outside the building envelope
<b><u>2. RETROFITS</u></b>			
Insulation: Perimeter?	YES	Dependent on occupant usage	NO
Basement? (optional based on NEAT)	<p>NOTE: Do not insulate basement walls that are below the ground surface level with any product where you can not ensure an air barrier, as the flow of moisture behind the insulation may tend to encourage mold growth.</p> <p>We learn that all wall components require a surface exposure to drying potential, either to inside or outside. Basement wall surfaces below grade level need to have the opportunity to “dry to the inside”.</p>		
Floor? Ducts/Boiler Pipes? Water Pipes?	NO NO NO	NO NO NO	YES YES YES: if danger of freezing
Air Leakage Seal envelope leaks?	To outside	To outside	To both in and outside
Duct leaks: Seal returns? Seal supplies?	YES NO	YES based on tests	YES YES
Ventilation?	NO	NO	NO: if dry, well drained & vapor barrier present YES: if moisture is present

Note closeable rooms containing supply registers and no returns. Note whether the central return is located in a room with a closeable door. Note the customer's door closing habits. Discuss with the customer the importance of having an uninterrupted air flow from the supply registers to the return registers.

**door closing**  
201-5.1j

CEE

### *GRAVITY DISTRIBUTION SYSTEM 201-5.2*

Note the locations of the registers in each room. Note any blocked or covered registers, and have them unblocked. Explain to the customer why this is important. Note the location of any registers outside the heated area or in other inappropriate locations. Consult with the customer about appropriate corrective measures.

**register locations  
and blockage**  
201-5.2a

CEE

Note the presence and condition of any suspected asbestos on the ductwork. Follow safe work practices when in the presence of asbestos. Do not disturb friable asbestos (see 114-1.4a).

**asbestos**  
201-5.2b

!

Inspect for duct leakage locations. Note any sections of ductwork that are missing or disconnected, severely corroded, rusted through, or punctured.

**duct leak inspection**  
201-5.2c

Note any sections of ductwork that are crushed or resisting air flow. Note any areas of return duct restriction.

**obstructions**  
201-5.2d

Inspect the return duct system and record any sections of ductwork that are missing, loose, unsealed, rusted through, or punctured. Identify gaps, holes or other problems in panned floor joist returns.

**return ducts**  
201-5.2e

Inspect the supply duct system and record any sections of ductwork that are missing, loose, unsealed, rusted through, or punctured.

**supply ducts**  
201-5.2f

Note the presence of ducts passing through non-conditioned spaces (see Table 201-5). Note the existence of any duct insulation. Determine if any insulation is needed and record measurements and the amount needed.

**duct insulation**  
201-5.2g

### *BOILER DISTRIBUTION SYSTEM 201-5.3*

Locate all water lines. Inspect for water leakage.

**distribution water  
lines**  
201-5.3a

**pipe insulation**  
201-5.3b

CEE

Check for the presence of insulation on the heat distribution pipes. Consult with the customer about the usage patterns of the area to determine if water lines should be insulated.

**heat transfer fins,  
radiators**  
201-5.3c

Inspect heat transfer fins and radiators, noting their condition and the presence of leaks and/or dirt.

**bleeder valves**  
201-5.3d

Inspect all bleeder valves for signs of leakage.

**zone valves**  
201-5.3e

Check for the presence of zone valves. Inspect all zone valves for leaks and corrosion. If it is the heating season, test the zone valves to see if they work.

#### *ELECTRIC BASEBOARD DISTRIBUTION SYSTEM* 201-5.4

**heat transfer fins**  
201-5.4a

CEE

Note and record the location of electric baseboard heaters. Inspect the heat transfer fins, noting their condition and the presence of dirt, bends or kinks. Discuss with the customer the importance of keeping the fins clean and that the heaters should not be blocked with furniture or other objects.

#### *“CLEVELAND DROPS”* 201-5.5

**building code authority**  
201-5.5a

Return air duct work must always be connected to the furnace unless the building department having jurisdiction over the exact dwelling where the return air ducts are not connected to the furnace specifically allows for this to occur.

**burden of proof**  
201-5.5b

Copies of specific building codes or municipal regulations, ordinances, rules, codes or laws must be included in the HWAP client file of any dwelling where this exception is used.

**evidence of moisture**  
201-5.5c

If evidence of moisture or standing water or molds are present in the basement or crawlspace, then the return air ducts must be connected to the furnace. A ground cover must be installed on any exposed earth.

**pressure test of the  
CAZ**  
201-5.5d

In any dwelling where these exceptions may be used, a pressure test of the combustion appliance zone (CAZ) with reference to the outside (see 1506-4) must be performed during the initial and final inspections.

In any dwelling where there are atmospherically-drafted appliances in the combustion appliance zone and the pressure is -5 Pa or above with reference to the outside, the return air ducts must be connected to the furnace, regardless of local code.

**allowable pressure readings**  
201-5.5e

In any dwelling where there are fan-induced combustion appliances in the combustion appliance zone and the pressure is -10Pa or above with reference to the outside, the return air ducts must be connected to the furnace, regardless of local code.



 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Mechanical Ventilation</b>

*EXHAUST FANS 201-6.1*

Note and record the locations of all exhaust fans, including clothes dryers, and whether they are properly vented to the outside. **number and location**  
201-6.1a

Record the type and condition of existing venting duct material. **vent duct material**  
201-6.1b

Note whether the venting duct extends to the outside of the house, i.e., through the roof, soffit or side of the house. Specify the installation of rigid duct or flexible duct for any duct that needs to be replaced or extended to the outside. Dryer vent ducts for clothes dryers must be smooth-surfaced, rigid duct or non-combustible metal, flexible duct. Specify insulation to be installed on all ducts extending through unconditioned areas (excluding dryers). **venting and termination**  
201-6.1c

Check for the presence of a damper and whether the vent connection is tight. **damper and connection**  
201-6.1d

Note the type of switch or control that is present. **control**  
201-6.1e

Inspect fan and switch wiring and connections, and note any hazards. Note whether the wiring is connected properly and working correctly. **power to fans**  
201-6.1f

Test each exhaust fan to see if it is operable and effective. Note inoperative, ineffective, or improperly vented fans. **effectiveness**  
201-6.1g

Consult with the customer to determine the usage pattern and frequency of use for each fan. **fan operation**  
201-6.1h CEE

If no fans are present, determine whether there is a need for a venting system according to the OVERALLS Scale, Building Tightness Limits or IAQ concerns. Consult with the customer about excess moisture and other IAQ problems. **potential need**  
201-6.1i CEE

## MECHANICAL SYSTEMS INSPECTION—Mechanical Ventilation OWPS 201-6

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**proper fan size**  
201-6.1j

Determine the proper fan size PMI in CFM for the area to be ventilated.

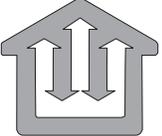
**on/off switch**  
201-6.1k

For new installations only, determine whether the fan should be wired into a separate timer control or the light switch.

**proper use**  
201-6.1l

CEE

Determine the proper use of the exhaust fans. If the residence is rated at or below the Building Tightness Limit (BTL), recommend that the resident open a window or other fresh air intake on the opposite end of the room or house whenever they use the exhaust fans. Otherwise, backdrafting of combustion appliances may occur. Consult the draft reading from the worst case scenario draft test.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Electrical Efficiency</b>

*FLUORESCENT LIGHTING 201-7.1*

Survey and note all interior lighting fixtures. Note the location, existing wattage and number of bulbs per fixture. Interview the customer to determine the hours per day the fixture is on.

**survey existing lighting**  
201-7.1a



Using the information gathered and the replacement chart (reference 1506-6), determine which bulbs may be replaced and note that on the inspection form.

**determine replacements**  
201-7.1b



The customer’s specific needs and habits must be considered in the replacement decision. Light quality (lumens) must not be compromised. Fluorescent bulbs must not be installed in fixtures equipped with dimmers unless the bulb manufacturer specifically allows for it.

**customer needs**  
201-7.1c



Lumen output at the lamp should be sufficient to assure these illuminance levels at the working surface.

<u>Activity</u>	<u>Foot-candle Level</u>
General or ambient lighting	5-20
Task lighting (non-critical)	20-50
Reading or close work	50-100

Lumen output is measured at 1 foot from the source and is the total output in all directions. Foot-candles measured at the surface considers light output, distance from the light source and reflectance of the surrounding surfaces.

Approximate lumen output of typical incandescent lamps:

<u>Watts</u>	<u>Lumens</u>
40	505
52	800
60	870
75	1190
90	1620
100	1750

Reference the manufacturer’s information (typically displayed on the box) for CFL lumen output.

**consumer education**  
201-7.1d

CEE



Consumer education must be provided concerning matters such as:

- a. Fluorescent bulbs are most cost-effective in applications where the light remains on for long periods of time.
- b. Fluorescent bulbs may take 60-90 seconds to reach full brightness.
- c. Fluorescent bulbs last approximately 10 times longer than incandescent bulbs and are therefore beneficial in hard to reach places.
- d. Fluorescent bulbs are applicable where safety is an issue, such as fixtures where incandescent bulbs exist that are overrated for the wattage of the fixture and therefore create a fire hazard.

*ELECTRICAL ENERGY EFFICIENCY MEASURES (EEMs) 201-7.2*

**improvements**  
201-7.2a

NEAT



All electrical efficiency measures (EEMs) paid for using HWAP dollars must have a material cost of \$150 or less. Only improvements determined to be cost-effective using NEAT may be installed. Savings potential must be documented and usage levels of the pre-existing condition should be metered. Those electric efficiency measures paid for using other funds must meet the applicable cost-effectiveness test described in 1506-6.

Typical electric efficiency measures would include repairs to water well pumps and lines, waterbed foam insulation covers, and repairs to timers on septic aerators (see 1506-6).

*CONSUMER ENERGY EDUCATION 201-7.3*

**consumer energy education**  
201-7.3a

CEE



Education should be provided concerning such matters as the impact of dirty filters on electric clothes dryers, the impact of dirty coils on refrigerators and freezers, behavioral impacts on refrigerator energy use, and the impacts of water leaks on well pumps.

*ELECTRIC ENERGY EFFICIENCY MEASURES (EEMs) 201-7.4*

**electric energy efficiency measures**  
201-7.4a



- a. For any heated waterbed, add (or have the customer add) a foam insulation blanket directly above the water filled mattress (cannot pay for with HWAP funds).

- b. Replace or convert any halide torchier lamp with a fluorescent torchier.

*REFRIGERATOR REPLACEMENT 201-7.5*

Survey and note each existing refrigerator. Note the location of each existing appliance and meter the existing appliance(s) wattage for at least 2 hours.

**survey existing appliances**  
201-7.5a



Using the information gathered during the inspection and the replacement chart (see 1506-6), determine which appliance(s) can be replaced and note that on the inspection form.

The client’s specific needs and habits must be considered in the replacement decision. From observation of the existing unit and discussion with the customer, determine if down-sizing of the replacement unit is appropriate.

**determine replacements**  
201-7.5b



Refrigerators taken out of service must be discarded in an environmentally-sensitive manner. Old units contain refrigerant gasses that must be reclaimed only at licensed stations. No units taken out of service may be returned to service by sale, barter, or for free. Disposal/recycling costs are to be added to the replacement cost and considered in the cost-effectiveness testing.

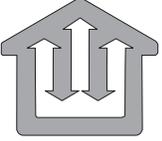
**client needs**  
201-7.5c



**recycle old units**  
201-7.5d





 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Electrical Safety</b>

*SERVICE ENTRY BOX 201-8.1*

Note the location and condition of the main service entry box. Note if it is properly mounted in an appropriate location. **location of box**  
201-8.1a

Determine if the main service entry box is properly grounded according to the NEC. **grounding**  
201-8.1b

Determine the type and amp rating of the main service box. **type of box**  
201-8.1c

Determine existing wire types and the location and condition of each type present. **type of wiring**  
201-8.1d

Note the sizes of the existing fuses/breakers and determine if they are properly sized for their circuits. **fuse/circuit size**  
201-8.1e

If the inspector determines that a hazardous situation exists, inform the customer of the problem. Have the problem corrected if it is possible within the scope of the HWAP. **hazards**  
201-8.1f







State of Ohio  
Weatherization Program  
Standards

Section	<b>BUILDING SHELL INSPECTION</b>
Subject	<b>Overall Building Shell</b>

*EXTERIOR HOUSE INSPECTION 202-1.1*

Note the wall direction, wall exposure, wall type, wall area, and the presence, type, and R value of the existing insulation. Record all of the required information when performing the NEAT audit.

**walls**  
202-1.1a

NEAT

List and measure all the windows. Record all of the required information when performing the NEAT audit.

**windows**  
202-1.1b

NEAT

List and measure all exterior doors. Indicate the type and condition. Record all of the required information when performing the NEAT audit.

**doors**  
202-1.1c

NEAT

Note the type and general condition of the roofing material(s).

**roofing surface**  
202-1.1d

Note the presence, condition and effectiveness of the gutter and downspout system. Note the general drainage condition around the dwelling. Determine whether the slope of the ground would cause water to run into or under the dwelling.

**drainage**  
202-1.1e

*INTERIOR INSPECTION 202-1.2*

Note whether there is a basement, crawl space, basement-crawl space combination, or slab. Determine whether the area is intentionally heated, conditioned or non-conditioned. Note whether a slab is insulated or uninsulated, or if the edges of the slab are exposed. Record all the required information when performing the NEAT audit.

**foundation**  
202-1.2a

NEAT

Note any hazards or problems at the foundation area. Determine if corrective action is within the scope of the program.

**foundation area  
hazards**  
202-1.2b

!

Perform an initial blower door test (see 1506-1).

**blower door test**  
202-1.2c

**CFM50 calculation/  
target reduction**  
202-1.2d

Calculate the CFM50 level to determine the target reduction goal from the OVERALLS scale (Figure 202-1.2d). Unless a valid technical reason exists, this will be the minimum air leakage reduction to be achieved on each job.

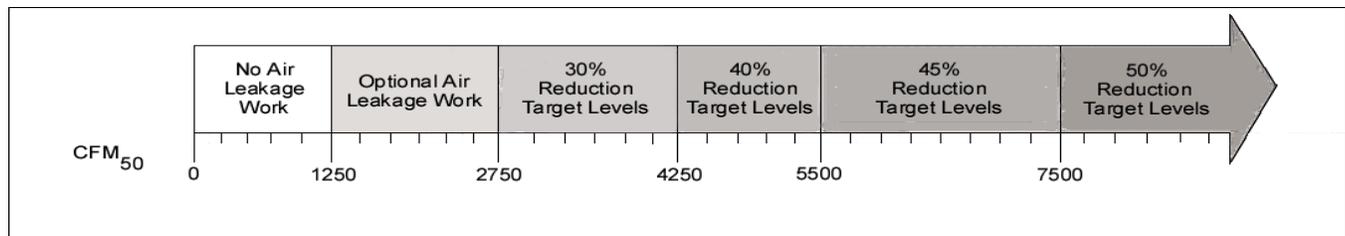


Figure 202-1.2d OVERALLS Scale

**pressure pan test**  
202-1.2e

If the house has a ducted, forced-air distribution system, perform a pressure pan test on each appropriate supply and return register (see 1506-5).

**BTL calculation**  
202-1.2f

Calculate the Building Tightness Limits (BTL) to ensure the minimum level of air leakage necessary for the home.



State of Ohio  
Weatherization Program  
Standards

Section	<b>BUILDING SHELL INSPECTION</b>
Subject	<b>Roof</b>

*EXTERIOR SURFACE CONDITION 202-2.1*

Identify the exterior roofing material type(s) (asphalt shingles, roll roofing, metal, slate, etc.). Examine for missing, damaged, or worn surfaces. Note any obvious damage.

**roofing**  
202-2.1a

Note the presence of existing attic ventilation (roof vents, soffit vents, gable vents, ridge vents). Determine the Net Free Ventilation Area (NFVA). Determine whether vents can be installed, if needed. Do not call for additional ventilation on slate roofs unless there is solid sheathing present.

**roof vents**  
202-2.1b

Examine the building for moisture problems due to missing or damaged flashing. Note any obvious damage.

**flashing**  
202-2.1c

Examine the chimney for soundness, noting any missing bricks, blocks or mortar. Check to see if any bricks or blocks are loose, or if any mortar is deteriorated. Note all chimney structural problems. Determine whether the chimney vents to the outside.

**chimney**  
202-2.1d

Examine all metal flues for soundness. Note any loose or disconnected sections, or excessive rust. Check stabilizing devices, such as guy wires or straps, and note their effectiveness.

**metal flue pipes**  
202-2.1e

Inspect the gutter and downspout system, if present. Note the condition of all existing sections (rusting, sagging, or other problems). Note the presence of debris or excessive standing water in the gutter. Determine whether the lack of an effective gutter system is causing moisture damage to the home.

**gutter system**  
202-2.1f

Access all flat or low-pitched attic sections that will be dense-packed with insulation to make sure that no problems or hazards exist. Determine if corrective measures are needed prior to installing insulation.

**attic access, exterior**  
202-2.1g

*INTERIOR SURFACE CONDITION 202-2.2***attic access**  
202-2.2a

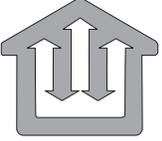
Note the location and size of any existing attic access, interior or exterior. If there is no access present, the inspector must create an opening large enough for a thorough inspection. Determine where a permanent access needs to be built.

**sheathing/rafters**  
202-2.2b

Inspect sheathing and rafters for discoloration, mold or rot. Note the location of any damage. Note any interior plaster or drywall damage due to moisture from roof leakage.

**metal roof/insulation**  
202-2.2c

Do not specify cellulose insulation where it may come in contact with exposed metal roofing. Determine whether fiberglass insulation is appropriate.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL INSPECTION</b>
	Subject	<b>Attic Floor</b>

*ELECTRICAL SYSTEM SAFETY 202-3.1*

Note the types of wiring present in the attic. Note all electrical junctions, and whether they are enclosed in covered junction boxes. Determine the overall integrity of wiring and wiring insulation. Note the presence of any bare wire, frayed or deteriorated wiring insulation, or any other electrical condition which must be corrected before installation of insulation.

**wiring**  
202-3.1a



Note all electrical devices which require safety clearance shielding, such as recessed lights without an IC (insulation contact) rating, vent fans, etc.

**electrical clearances**  
202-3.1b



Determine if circuits are properly fused. Explain to the customer the importance of properly fused circuits.

**fuse size**  
202-3.1c



*HAZARDS 202-3.2*

Document the presence of any animal or insect pests in the attic. Note the presence of any animal or bird feces that may pose a health threat. Determine measures or personal protective equipment necessary to ensure the safety of weatherization workers in the attic.

**health hazards**  
202-3.2a



Note any stored boxes or objects that may obstruct the weatherization work. Consult with the customer about removing obstructions. If the customer is unable or unwilling to remove the obstructions, determine if it is feasible for weatherization workers to remove obstructions, and obtain permission from the customer.

**stored objects**  
202-3.2b



*ATTIC FLOOR AIR LEAKAGE 202-3.3*

Note the existence of any penetrations through the attic floor, including open-topped interior or exterior walls, utility penetrations or chaseways, or chimney chaseways. Note the existence and location of kneewall floor cavities, ceiling height changes, stairwell cavities, etc.

**thermal bypasses**  
202-3.3a

**intentional penetrations**  
202-3.3b

Note the presence and location of all intentional penetrations such as light fixtures and fan housings.

*VENTS 202-3.4*

**vent function**  
202-3.4a

Determine the condition of vents and if they are functioning as designed.

**vent requirements**  
202-3.4b

Determine the venting requirements (1 ft<sup>2</sup> per 300 ft<sup>2</sup> of attic floor area; 1 ft<sup>2</sup> per 600 ft<sup>2</sup> when high-low ventilation is achievable) and whether high-low venting is possible. Diagram where vents may be installed and list suggested types. Do not call for additional ventilation on slate roofs unless there is solid sheathing present.

*ATTIC FLOOR INSULATION 202-3.5*

**attic floor condition**  
202-3.5a

Determine the condition of the attic floor. Note any rotted, molded, or otherwise damaged joists or ceiling components. Check the integrity of the ceiling surface. Determine if the ceiling can hold the weight of insulation.

**existing insulation**  
202-3.5b

NEAT

Note the type, condition, and amount of any existing insulation. Determine the effective R-value of the existing insulation. Note all voids and areas with incomplete coverage. Determine if a NEAT audit will be performed.

**insulation requirements**  
202-3.5c

Determine the type and amount of insulation needed. List all areas that insulation should not contact for safety reasons, including active chimneys and electrical devices such as recessed lights without an IC rating and ventilation fans. Determine appropriate protective measures for those areas.

**insulation type and amounts**  
202-3.5d

Calculate the amount of insulation needed to insulate uninsulated open joist attics to R-38, including upper attics, and flats behind kneewalls. Calculate the amount of insulation needed to insulate floored attics, kneewalls covered with stretched house wrap, and other restricted spaces to high density pack (3.25 - 3.75 lbs/ft<sup>3</sup> for cellulose, and 1.6 lbs/ft.<sup>3</sup> for fiberglass).

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL INSPECTION</b>
	Subject	<b>Sidewalls</b>

*HAZARDS 202-4.1*

Note the presence and condition of any electrical connection to the house. Note any bare, frayed, or uninsulated wires. Determine whether problems can be corrected within program guidelines.

**electrical hazards**   
202-4.1a

Note exterior flues and chimneys, gas or oil lines, fuel tanks, or plumbing lines if their location presents a hazard.

**pipng hazards**   
202-4.1b

Document the presence of any plant, animal, or insect hazards. Note the presence of any animal or bird feces that may pose a health threat. Determine appropriate measures needed to assure worker health and safety.

**health hazards**   
202-4.1c

Note any inclines in the yard layout or any obstructions which would require special ladder preparations or use of other safety equipment.

**special preparation**   
202-4.1d

*SIDEWALL CONDITION 202-4.2*

Note all types of siding material. Note siding material which may contain asbestos. Wherever possible, determine the presence and condition of previous layers of siding or sub-siding. In consultation with the homeowner/authorized agent, determine the best sidewall insulation installation strategy (the "tubing" method or the "two-hole per story" method ). As the primary acceptable method, the siding must be lifted or temporarily removed to gain access for drilling. Only after it has been determined by the inspector and insulation crew, in consultation with the homeowner/authorized agent, that the siding cannot or should not be removed, written permission is needed from the homeowner/authorized agent to drill through any type of exterior siding.

**siding type**  
202-4.2a

Determine the depth of the stud cavities and note the presence of any existing wall insulation. Look for evidence, such as insulation plugs, of previously installed insulation. Check several test locations. Note the presence of moisture in any existing insulation.

**existing insulation**  
202-4.2b

**exterior doors &  
windows**  
202-4.2c

Note any severe deterioration of frames and any missing glass. Note any excessively deteriorated parts, such as the exterior sill, jamb, or casing. Note missing glazing compound which leaves the glass pane in an unsafe state.

**moisture damage**  
202-4.2d

Note any areas with exterior moisture damage, including missing or rotted siding or siding with excessive deteriorated paint, or other problems.

**structural integrity**  
202-4.2e

Note the existence and condition of any exposed structural components, such as wall studs, sill plates, sole plates, etc. Note the presence and condition of structural additions, such as porches and porch roofs. Note any room additions to the main structure.

*INTERIOR SURVEY 202-4.3***interior surface**  
202-4.3a

Determine the type and condition of the interior surfaces of the sidewalls. Note all deteriorated or structurally unsound areas. Note any holes, penetrations or other conditions which may cause problems during the insulation process, such as panelling used as the only interior wall surface, or missing, loose, or damaged baseboard, casing, jambs or trim.

**obstacles**  
202-4.3b

Note the presence of obstacles to interior drilling and installation of insulation.

**interior mechanicals**  
202-4.3c

Note the existence and condition of all electrical outlets and switches in the sidewalls. Note the location and condition of vent fan penetrations, clothes dryer vent termination, wall heaters, air conditioners, etc. Note the location of chaseways containing utility runs or duct work in the sidewalls.

*OVERALL STRUCTURE 202-4.4***structural details**  
202-4.4a

Determine the approximate age of the structure. Note the type of wall construction. If it is frame, note whether it is balloon or platform construction. Note the presence and location of interior soffits, wall height changes, pocket doors, drop ceilings, open closets or cabinets, or other construction details that would require alternative installation methods.

Note the existence of open-topped or -bottomed walls or other bypass features which would require alternative installation methods.

Note the existence and the location of all critical framing junctures and determine an appropriate insulation strategy.  
*INSULATION 202-4.5*

Calculate the amount of cellulose insulation needed to insulate sidewalls to 3.25 - 3.75 lbs/ft<sup>3</sup>. If cellulose is not the appropriate material, document the reason, and calculate the amount of blown fiberglass insulation needed to insulate the walls to 1.6 lbs/ft<sup>3</sup>.

**insulation amount**  
202-4.5a

In open cavities, decide if fiberglass batts or another method would be appropriate. Consider the wall depth when deciding the size of the fiberglass batts. Calculate the amount of drywall needed to cover the insulation.

**insulation amount,  
open cavities**  
202-4.5b



 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL INSPECTION</b>
	Subject	<b>Foundation</b>

*FOUNDATION DESCRIPTION 202-5.1*

Note the presence of hazards. Determine if corrective actions are possible within the scope of the program.

**hazards**  
202-5.1a



Determine the types of materials that make up the foundation. Note any changes in the foundation materials and their location.

**construction materials**  
202-5.1b

Note evidence of any existing moisture inside or outside the foundation area. Note evidence of previous moisture problems, such as mold, mildew, rot, etc. Note sewage leakage problems. Determine if corrective action is possible within program guidelines.

**moisture/sewage problems**  
202-5.1c

Note the condition of the foundation walls. Note the location of building penetrations and damaged areas. If the foundation wall is damaged, determine if corrective action is allowable or possible within program guidelines.

**condition**  
202-5.1d

*CRAWL SPACE 202-5.2*

Determine whether the crawl space is intentionally heated, conditioned or non-conditioned (see Table 202-5). Treat a post foundation as a non-conditioned area.

**determining zone classification**  
202-5.2a



If the crawl space is connected to a basement, decide if isolating it from the basement is appropriate. Consider the possibility of water lines freezing (see Table 202-5).

**connection to basement**  
202-5.2b

Measure the crawl space area.

**measure area**  
202-5.2c

Note whether a vapor barrier is present and inspect for complete coverage and effectiveness. If a vapor barrier is needed, calculate the amount of material necessary to achieve total coverage.

**vapor barrier**  
202-5.2d

Note the presence of water lines and the potential for freezing if floor insulation is to be added.

**water lines**  
202-5.2e

<b>ventilation</b> 202-5.2f	Observe the amount and condition of any existing ventilation. Calculate the amount of closeable ventilation needed for the crawlspace area (1ft <sup>2</sup> NFVA for every 1500ft <sup>2</sup> crawlspace floor area). If proper drainage exists, and there is no danger of standing water or moisture production, foundation ventilation is not necessary. If there are vents present, proper drainage and an effective, complete vapor barrier exists, the vents may be closed permanently.
<b>direct air leakage</b> 202-5.2g	Note the presence and location of any direct penetrations, and any other direct air leakage sites. Record locations and make recommendations for correction.
<b>bypasses</b> 202-5.2h	Note any plumbing pipes, chaseways, or other bypass air leakage sites.
<b>exhaust vent termination</b> 202-5.2i	Note any exhaust vent terminations in the crawl space area.
<b>floor insulation</b> 202-5.2j	If the crawl space is non-conditioned, note the condition of any existing floor insulation. If there is no insulation, calculate the amount of R-19 insulation needed.
<b>perimeter insulation</b> 202-5.2k	Determine if the crawl space functions as an intentionally heated, conditioned or non-conditioned space (see Table 202-5). If the crawl space is conditioned, determine the amount of insulation necessary (R-11 vinyl faced). Moisture related problems and potential air quality problems must be corrected prior to the installation of perimeter insulation.
<i>BASEMENT 202-5.3</i>	
<b>determining zone classification</b> 202-5.3a	Determine whether the basement functions as an intentionally heated, conditioned or non-conditioned area (see Table 202-5).
<b>basement area</b> 202-5.3b	Measure the basement floor and wall area.
<b>floor moisture</b> 202-5.3c	Inspect for signs of a basement floor moisture problems and determine if corrective actions are necessary.
<b>water lines</b> 202-5.3d	Note the presence of water lines and the potential for freezing because of the addition of floor insulation.

**Table 201-5**

**Classification of Duct/Distribution System Zone**

What defines whether the area that a distribution system runs through is intentionally heated, conditioned, or non-conditioned? What retrofits should be done?

<b>Zone is:</b>	<b>Intentionally Heated</b> If the zone has heat being intentionally supplied to it	<b>Conditioned</b> if the temperature of the zone is closer to inside temperature than to outside temperature (in winter)	<b>Non-conditioned</b> if the temperature of the zone is near the outside temperature (in winter)
<b><u>1. DESCRIPTION:</u></b>  Area has:	Supply registers, radiators, and/or heat source	Distribution system, furnace/boiler cabinet losses	No space heat
Intended communication with the house:	Inside the building envelope	Inside the building envelope	Outside the building envelope
<b><u>2. RETROFITS</u></b>  Insulation: Perimeter?	YES	Dependent on occupant usage	NO
Basement? (optional based on NEAT)	<p>NOTE: Do not insulate basement walls that are below the ground surface level with any product where you can not ensure an air barrier, as the flow of moisture behind the insulation may tend to encourage mold growth.</p> <p>We learn that all wall components require a surface exposure to drying potential, either to inside or outside. Basement wall surfaces below grade level need to have the opportunity to “dry to the inside”.</p>		
Floor? Ducts/Boiler Pipes? Water Pipes?	NO NO NO	NO NO NO	YES YES YES: if danger of freezing
Air Leakage Seal envelope leaks?	To outside	To outside	To both in and outside
Duct leaks: Seal returns? Seal supplies?  Ventilation?	YES NO  NO	YES based on tests  NO	YES YES  NO: if dry, well drained & vapor barrier present YES: if moisture is present

**direct air leakage**  
202-5.3e

Note the presence and location of any direct penetrations, and any other direct air leakage sites.

**thermal bypass sites**  
202-5.3f

Note any plumbing pipes, chaseways, or other bypass air leakage sites.

**exhaust vent termination**  
202-5.3g

Note the presence of any exhaust vent terminations in the basement area.

**exterior windows and doors**  
202-5.3h

Note the number, size and condition of windows and exterior doors. Note any broken or missing parts or missing glass that would allow air infiltration.

**floor insulation**  
202-5.3i

If the basement area is non-conditioned, note the condition of any existing floor insulation. If there is no insulation, calculate the amount of R-19 insulation needed.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
	Subject	<b>Heating Units</b>

*TUNE-UPS AND REPAIRS 301-1.1*

A tune-up involves a visual inspection, some testing procedures, cleaning and adjustments to improve the combustion and seasonal efficiency of the heating system.

**tune-up**  
301-1.1a

Repairs involve the replacement or reconstruction of defective or unsafe parts for the purpose of ensuring the safe operation of the heating system.

**repairs**  
301-1.1b

*NON-OPERATIONAL UNITS 301-1.2*

Repair or replace non-operational heating units.

**repair/replace**  
301-1.2a

Replacements of heating units using weatherization funds must be cost justified using NEAT.

**cost-effectiveness**  
301-1.2b

NEAT
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Switching from the existing fuel source to a different fuel source for use by the heating unit is prohibited without the prior written approval of OEE. Requests for fuel switching must describe the technical reasons for the decision and include cost justification and written authorization from the party responsible for fuel payments.

**fuel switching**  
301-1.2c

The output rating of all replacement heating units shall be sized according to Manual J or NEAT calculations. Documentation of sizing calculations shall be maintained in the client file.

**sizing**  
301-1.2d

NEAT
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All new units shall carry a minimum one (1) year warranty on workmanship. Each customer shall receive all manufacturer’s product warranty information, clear maintenance instructions, educational information as necessary and a local phone number of who to contact for warranty problems.

**warranty**  
301-1.2e

All units shall be installed in conformance with manufacturer’s instructions, local codes, and/or NFPA manuals as required.

**local codes**  
301-1.2f

*FUEL SUPPLY 301-1.3***repair/replace supply lines**

301-1.3a

Repair or replacement of fuel supply lines shall be restricted to the length between the fuel storage tank and the heating unit, or in the case of metered fuels, the length between the meter and the heating unit. Repair leaks in the fuel supply lines. Replacement of fuel supply lines must meet the applicable NFPA material code for the fuel type. Installation of sediment trap and replacement of displacement rotor member valves (water valves) is only required if the fuel supply line has to be broken, i.e., repair fuel leak or a new appliance.

**fuel filters, oil**

301-1.3b

Change, clean or add fuel filters in oil-fired units.

**oil nozzle & electrodes**

301-1.3c

Replace the oil nozzle in oil-fired heating units according to the size on the unit data plate or by performing a post-weatherization condition heat loss calculation to determine the new nozzle size. Re-adjust or replace and adjust the electrodes.

**gas/oil pressure**

301-1.3d

Use a manometer to check the manifold gas pressure and adjust according to manufacturer's instructions. If unable to locate manufacturer's recommended pressures, it is possible to use 11" water column for LP/propane and 3.25-3.75" water column inches for natural gas. Set oil pump pressure to PMI. With oil burners it is too important to give a range.

**Btu input**

301-1.3e

Verify the Btu input of a metered fuel unit by clocking the meter. If the unit is over- or under-fired, adjust the gas pressure. Replace orifices in propane and natural gas units with the proper sized orifice, if necessary.

*ELECTRICAL POWER SUPPLY 301-1.4***main power safety**

301-1.4a

Repair or replace an unsafe power supply to the unit.

**dedicated circuit**

301-1.4b



Install a properly sized and fused dedicated circuit for the heating unit if one is necessary based on wire condition, a history of circuit failure, or a new unit is to be installed.

**hazardous wiring**

301-1.4c

Replace any wiring in, or connected to, the heating unit that is charred, frayed, or has damaged insulation. Correct loose or improper wiring connections. Repair or replace defective wiring in, or leading to, the heating unit in accordance with NFPA 70, the National Electric Code.

*HEATING UNIT CLEARANCES 301-1.5*

Ensure that the unit is located so that clearances from combustible materials are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel) or PMI. Move units that do not meet approved clearances or install approved heat shielding materials to reduce the clearances needed in accordance with approved NFPA methods.

**heating unit  
clearances**  
301-1.5a

*VENT SYSTEM INTEGRITY 301-1.6*

Repair or replace sections of the venting system that are corroded, rusted, clogged or blocked, contain cracks or holes, or are unsealed, loose or disconnected, in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). Clean solid fuel chimneys that contain creosote.

**damaged/corroded**  
301-1.6a

Ensure that all venting materials meet clearances from combustible materials in accordance with the applicable NFPA code. Correct any instances where vent clearances are not met.

**clearances**  
301-1.6b

Securely fasten vent-to-chimney connections.

**vent connections**  
301-1.6c

Repair or replace any vent connector pipe that dips or sags, or does not have a rise of at least 1/4" per foot of run.

**vent slope**  
301-1.6d

Repair or replace any vent system parts necessary so that it does not exceed the allowable number of elbows in the vent system. Refer to the venting codes listed in Table 301-1.6.

**vent elbows**  
301-1.6e

If the chimney is the primary vent stack for the dwelling, and it is not in sound condition, it must be repaired or replaced with an approved chimney liner or approved, double-walled, metal vent material as specified by codes listed in Table 301-1.6.

**chimney condition**  
301-1.6f

Clean solid fuel chimneys that contain creosote, soot, scale or other debris.

**solid fuel chimneys**  
301-1.6g

*DRAFT 301-1.7***draft test**  
301-1.7a

Perform a draft test on all vented combustion-type appliances in accordance with the Table 301-1.7 (see Figure 301-1.7 for probe placement) and correct any draft and venting problems in accordance with the applicable NFPA code listed in Table 301-1.6 and under "worst case" conditions.

**draft, "worst case"**  
301-1.7b

Perform the "worst case scenario" draft test (see 1506-4).

**draft, furnace**  
301-1.7c

Start the heating unit. Insert the draft probe into the appropriate location listed in Table 301-1.7. Measure and record the draft at two minutes. Determine whether the draft reading is within the acceptable ranges identified in Table 301-1.7. If draft is not within acceptable limits, determine the reason and correct.

Table 301-1.7 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

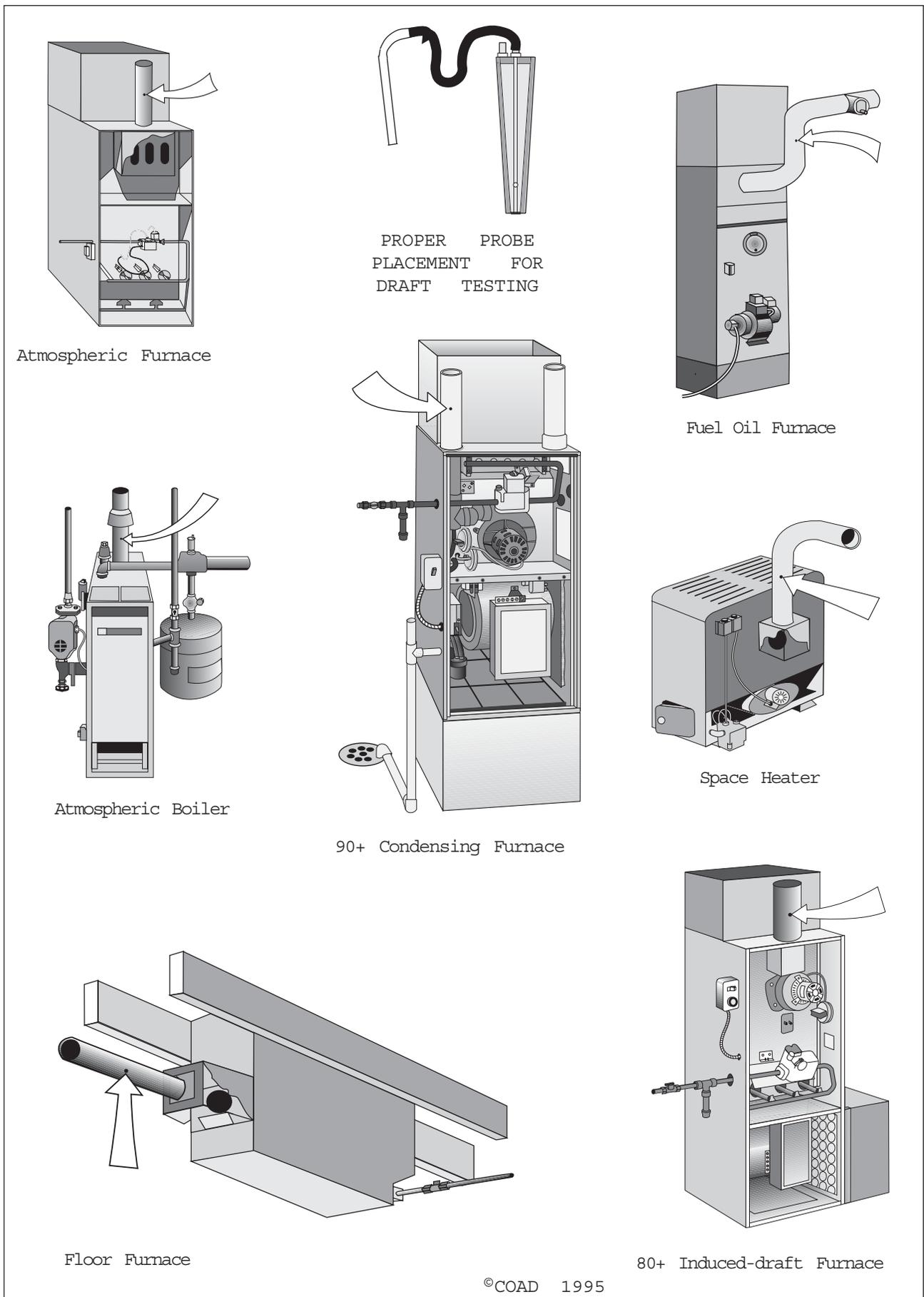


Figure 301-1.7

*COMBUSTION SAFETY AND EFFICIENCY 301-1.8*

**clean burners**  
301-1.8a

Clean gas burners of dirt and rust. Repair or replace them if necessary.

**clean combustion chamber**  
301-1.8b

Clean the combustion chamber on oil-fired units, replace or repair any defects in the combustion chamber, and seal the area around the air (blast) tube, inspection port and other areas to reduce uncontrolled, excess air.

**power gas burners**  
301-1.8c

Seal openings around power gas burners.

**carbon monoxide (CO)**  
301-1.8d

With the heating unit operating, insert the sampling probe into the appropriate location listed in Table 301-1.8d and illustrated in Figure 301-1.8. Measure and record the amount of CO in the flue gasses. More than 100 ppm in the flue is not permitted. If the cleaning and tuning work does not reduce the CO level below 100 ppm in the unit, repeat the procedures outlined above and retest. If the CO levels are still not below 100 ppm, consult with an OEE representative.

Table 301-1.8d CO and Combustion Analyzer Probe Placement Locations

Heating Unit Types	Probe Location
Gas-fired, Central Furnaces and Direct Heating Equipment	Each heat exchanger port
Oil-fired, Central Furnaces and Direct Heating Equipment	Vent pipe before barometric damper
Gas-fired Boilers	Vent pipe before draft diverter
Sealed Combustion Units	Exhaust vent pipe

**combustion analysis**  
301-1.8e

Insert the sampling probe of a calibrated digital combustion analyzer into the location listed in Table 301-1.8d and illustrated in Figure 301-1.8. Adjust the heating unit so that the unit is within the acceptable combustion gas levels in Table 301-1.8e.

Table 301-1.8e Acceptable Combustion Test Analysis Measurements

Heating Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
	Fan-assisted	300-480° F	N/A	100
	Condensing	PMI	N/A	100
	Space Heaters	300-650° F	N/A	100
	Standard Power Burner	275-550° F	N/A	100
OIL				
	Standard Oil Burner	325-600° F	1 or less	100
	Flame Retention	325-600° F	1 or less	100
Condensing	PMI	1 or less	100	

Perform a worst case draft test. If unit passes test, no additional measures are needed. If unit does not pass, address the problem using one of the methods described in the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel), or use a system that is designed to ensure combustion air.

**combustion air**  
301-1.8f

### *HEAT EXCHANGER 301-1.9*

Clean the heat exchanger. Remove soot and debris. Reseal with appropriate materials.

**clean heat exchanger**  
301-1.9a

If cracks or holes exist in the heat exchanger, replace the heat exchanger if a new one can be located, or have the unit replaced. No weatherization work can be performed until the repair or replacement is complete.

**heat exchanger,  
cracks or holes**  
301-1.9b

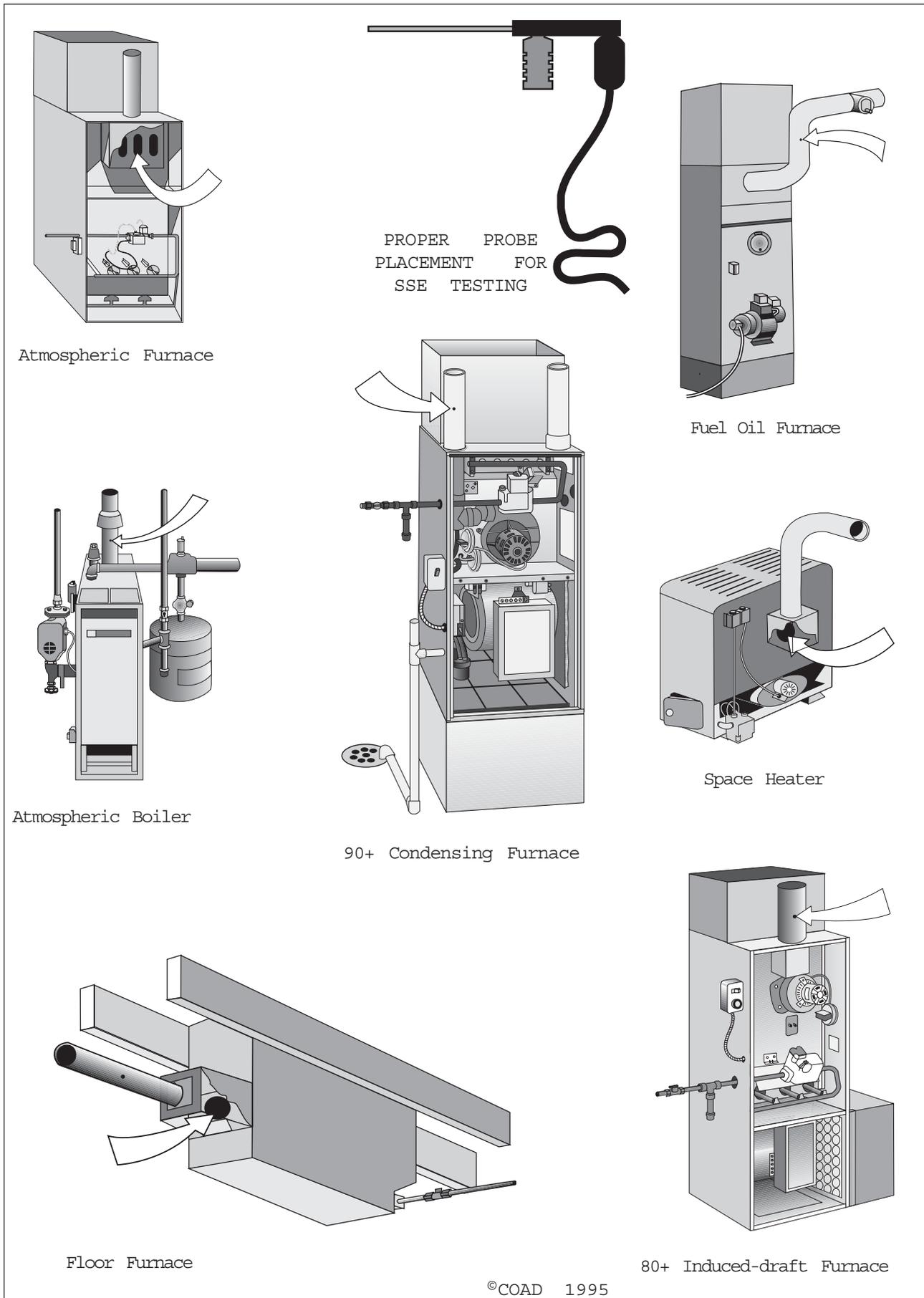


Figure 301-1.8

TEMPERATURE RISE 301-1.10

Perform a temperature rise test, and take corrective action if the temperature rise is not within the acceptable range listed in the manufacturer's specifications. Refer to Tables 301-1.10a.i and 301-1.10a.ii for remedies.

**corrective action**  
301-1.10a

Table 301-1.10a.i Typical Solutions for High Temperature Rise

PROBLEM:	CHECK FOR:	REMEDY:
High Temperature Rise [>90°/PMI]	<ul style="list-style-type: none"> <li>• Fan speed too slow</li> <li>• Obstruction in duct work</li> <li>• Inadequate return/distribution ductwork</li> <li>• Blower belt/filter/AC coil defective or dirty</li> <li>• Unit overfired</li> <li>• Dirty or defective blower</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed higher or replace motor</li> <li>• Remove obstruction</li> <li>• Install proper ductwork</li> <li>• Clean or replace belt/filter/AC coil</li> <li>• Adjust fuel pressure, change orifices</li> <li>• Clean or replace blower</li> </ul>

Table 301-1.10a.ii Typical Solutions for Low Temperature Rise

PROBLEM:	CHECK FOR:	REMEDY:
Low Temperature Rise [<60°/PMI]	<ul style="list-style-type: none"> <li>• Fan speed too fast</li> <li>• Excessive air flow from blower</li> <li>• Unit underfired</li> <li>• Low stack temperature (PMI)</li> <li>• Cycling on high limit</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed slower or replace motor</li> <li>• Adjust air flow or replace blower</li> <li>• Adjust fuel pressure or change orifices</li> <li>• Resize the vent pipe</li> <li>• Clean or replace blower, install more or larger duct work</li> </ul>

CONTROLS 301-1.11

Replace defective fan/limit controls and test the new control after putting the unit into operation.

**fan/limit control**  
301-1.11a

Move improperly located thermostats to an area free from drafts or heat from the heating system, lights, or appliances. Replace defective thermostats.

**thermostat location**  
301-1.11b  
**thermostat replacement**  
301-1.11c



Adjust the heat anticipator in the thermostat to match the amp draw of the system controls.

**heat anticipator**  
301-1.11d

*AUTOMATIC FUEL SAFETY SHUT-OFF 301-1.12***test gas valve**  
301-1.12a

Test gas valves to ensure that, in the event of a pilot outage, the flow of gas to the burners is interrupted. For gas valves with 100% safety shutoff, ensure that the flow of gas to the pilot is also interrupted in the event of a pilot outage. Ensure that the tip of the thermocouple is enveloped by the pilot flame. Replace defective gas valves and thermocouples.

**safety check**  
301-1.12b

Perform a safety check of the primary control and cad cell in oil fired units. Replace defective primary controls or cad cells.

*BOILER CONTROLS 301-1.13***boiler controls**  
301-1.13a

Verify that boiler safety controls such as the low water cutoff, automatic water feed, relief valve and circulating pumps are functioning properly. Replace or repair any defective components.

*ELECTRIC FURNACES 301-1.14***sequencing**  
301-1.14a

Check for proper sequencing and operation of elements. Replace defective elements and other defective components.

**line voltage**  
301-1.14b

Check for adequate line voltage and correct as necessary.

*DISTRIBUTIONS SYSTEM 301-1.15***forced-air and  
gravity systems**  
301-1.15a

Clean dirty blower motors, fans and belts. Inspect the blower for excessive free play and correct as necessary. Inspect the pulleys and drive assembly for wear, alignment and proper tension and correct as necessary. Inspect the motor bracket for tightness and alignment and correct as necessary. Lubricate the motor and motor bearing cups if necessary.

**fan control**  
301-1.15b

Test the fan control to ensure that it is functioning properly. Set the fan "on" control to 110° F and the fan "off" control to 90° F after determining that the customer's life-style or this particular installation will permit these settings. Replace defective fan controls.

**supply ducts**  
301-1.15c

Repair or replace any missing, loose fitting, blocked, leaky, or unsealed plenum or supply air ducts and seal with compatible duct sealing materials.

Repair or replace any missing, loose fitting, blocked, leaky, or unsealed blower compartment or return air ducts and seal with compatible duct sealing materials.

**return ducts**  
301-1.15d

Install or replace missing or dirty return air filters. Instruct the customer on filter replacement.

**air filters**  
301-1.15e

Insulate uninsulated duct work passing through non-conditioned areas so that the duct is completely covered and the insulation is not compressed. Terminate duct insulation at the floor register boots in such a manner that the register boot is completely covered and the duct insulation fits snugly against the floor. Secure sections of duct insulation with staples, straps, or wires and tape any exposed fiberglass.

**insulate ducts**  
301-1.15f

Vacuum the heat transfer fins on electric baseboard units.

**electric baseboard**  
301-1.15g

CEE
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### *BOILER SYSTEMS 301-1.16*

Repair any water leaks in the system.

**water leaks**  
301-1.16a

Verify that the water circulation pump is properly activated by the aquastat. Set the pump “on” and “off” temperature according to manufacturer's recommendations.

**aquastat**  
301-1.16b

Insulate supply and return water lines passing through non-conditioned areas with pipe insulation, ensuring that the pipes are completely covered. Secure pipe insulation with mechanical fasteners or tape

**insulate water lines**  
301-1.16c

Bleed any air from the distribution system. Assure that air vents and steam traps are properly functioning. Repair or replace defective vents or traps.

**vents or traps**  
301-1.16d

Ensure that thermostatically-controlled zone valves are functioning properly. Repair or replace defective valves.

**zone valves**  
301-1.16e

Adjust the aquastat high limit and pump control in accordance with manufacturer's recommendations. The maximum high limit setting is 250° F for steam and 200° F for hot water units.

**aquastat high limit**  
301-1.16f

Lubricate the water circulating pump motor if necessary.

**pump motor**  
301-1.16g

Verify the presence and proper functioning of a pressure relief valve and repair, replace, or add one if necessary.

**pressure relief valve**  
301-1.16h

Vacuum and clean heat transfer fins or radiators.

**heat transfer fins**  
301-1.16i

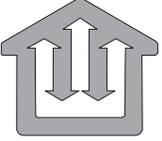
Check the compression tank for sufficient air pressure. Replace defective tanks.

**compression tank**  
301-1.16j

*CERTIFICATION 301-1.17*

**identification sticker**  
301-1.17

Once the unit has been serviced, the installer must place a sticker on the heating unit, in plain view, certifying that the system has been properly serviced. The sticker shall indicate the date of service, name of the service contractor and the phone number of the service contractor.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
	Subject	<b>Electric Heat Pump/ Central Air Conditioning</b>

*TUNE-UPS/REPAIRS 301-2.1*

A tune-up involves a visual inspection, some testing procedures, cleaning and adjustments to improve the combustion and seasonal efficiency of the heating system.

**tune-up**  
301-2.1a

Repairs involve the replacement or reconstruction of defective or unsafe parts for the purpose of ensuring the safe operation of the heating system.

**repairs**  
301-2.1b

*NON-OPERATIONAL UNITS 301-2.2*

Repair or replace non-operational heating units.

**repair/replace**  
301-2.2a

Replacements of heating units using weatherization funds must be cost justified using NEAT.

**cost-effectiveness**  
301-2.2b

NEAT

Switching from the existing fuel source to a different fuel source for use by the heating unit is prohibited without the prior written approval of OEE. Requests for fuel switching must describe the technical reasons for the decision and include cost justification and written authorization from the party responsible for fuel payments.

**fuel switching**  
301-2.2c

The output rating of all replacement heating units shall be sized according to Manual J or NEAT calculations. Documentation of sizing calculations shall be maintained in the client file.

**sizing**  
301-2.2d

NEAT

All new units shall carry a minimum one (1) year warranty on workmanship. Each customer shall receive all manufacturer’s product warranty information, clear maintenance instructions, educational information as necessary and a local phone number of who to contact for warranty problems.

**warranty**  
301-2.2e

All units shall be installed in conformance with manufacturer’s instructions, local codes, and/or NFPA manuals as required.

**local codes**  
301-2.2f

*THERMAL FLUID LEAKAGE 301-2.3*

**thermal fluid  
leakage test**  
301-2.3a

If there is a refrigerant leak in the central air conditioning system, promptly contact an EPA-certified technician to repair the leak(s).

*ELECTRICAL POWER SUPPLY 301-2.4*

**main power safety**  
301-2.4a

Repair or replace the main electrical supply wiring to the unit if it is unsafe.

**dedicated circuits**  
301-2.4b

Add a dedicated circuit that is properly sized and fused to a heat pump/AC unit that does not have one.

**disconnect switch**  
301-2.4c

Add a disconnect switch or repair a defective switch on outdoor units.

**hazardous wiring**  
301-2.4d

Replace any unsafe wiring to the heat pump/AC unit.

*UNIT CLEARANCES 301-2.5*

**unit clearance,  
indoors**  
301-2.5a

Move any unit or combustible material where clearances are not PMI.

**unit clearances,  
outdoors**  
301-2.5b

Move any unit or obstruction that is not PMI. Clean the cooling fins if they are dirty.

*BACK-UP SYSTEM 301-2.6*

**back-up system**  
301-2.6a

Address the back-up system based on fuel and unit type in accordance with the standards in 301-1.

*AIR HANDLER 301-2.7*

**condensate drainage**  
301-2.7a

If the condensate drains improperly, make any changes necessary to ensure proper drainage.

**A-coil**  
301-2.7b

If any holes or cracks are visible in the A-coil, have an EPA-certified technician make repairs.

**fins/filters/ducts**  
301-2.7c

Clean the fins, filters and ducts as needed. Remove any obstructions.

# MECHANICAL SYSTEMS INSTALLATION—Heat Pump/Central Air OWPS 301-2

If the temperature rise/drop is out of the range specified by the manufacturer, determine what the problem is and remedy it. Consult Tables 301-2.7.i and 301-2.7.ii for some possibilities.

**temperature rise/drop problem**  
301-2.7d

Table 301-2.7.i Typical Solutions for High Temperature Rise

PROBLEM:	CHECK FOR:	REMEDY:
High Temperature Rise [ $>70^{\circ}$ /PMI]	<ul style="list-style-type: none"> <li>• Fan speed too slow</li> <li>• Obstruction in duct work</li> <li>• Inadequate return/distribution ductwork</li> <li>• Blower belt/filter/AC coil defective or dirty</li> <li>• Unit overfired</li> <li>• Dirty or defective blower</li> </ul>	<ul style="list-style-type: none"> <li>• Set Fan speed higher or replace motor</li> <li>• Remove obstruction</li> <li>• Install proper ductwork</li> <li>• Clean or replace belt/filter/AC coil</li> <li>• Adjust fuel pressure, change orifices</li> <li>• Clean or replace blower</li> </ul>

Table 301-2.7.ii Typical Solutions for Low Temperature Rise

PROBLEM:	CHECK FOR:	REMEDY:
Low Temperature Rise [ $<40^{\circ}$ /PMI]	<ul style="list-style-type: none"> <li>• Fan speed too fast</li> <li>• Excessive air flow from blower</li> <li>• Unit underfired</li> <li>• Low stack temperature (PMI)</li> <li>• Cycling on high limit</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed slower or replace motor</li> <li>• Adjust air flow or replace blower</li> <li>• Adjust fuel pressure or change orifices</li> <li>• Resize the vent pipe</li> <li>• Clean or replace blower, install more or larger duct work</li> </ul>

## CONTROLS 301-2.8

Clean the blower motor, belt, and fan, and/or replace parts, if needed. Lubricate the motor if it is needed.

**blower**  
301-2.8a

Replace or relocate the thermostat, if needed.

**thermostat**  
301-2.8b





State of Ohio  
Weatherization Program  
Standards

Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
Subject	<b>Other Combustion Appliances</b>

*FUEL SUPPLY 301-3.1*

Repair all gas leaks in combustion appliances and in the pipes leading to them. Replace all defective or illegal flexible range connectors.

**gas leaks**  
301-3.1a

Replace shut-off valves to cookstoves and other combustion appliances if they are faulty. It is allowable, but not required, to install a shut-off valve to an appliance that does not have one.

**gas shut-off valve**  
301-3.1b

*OVEN VENT 301-3.2*

If the oven is vented to the outside, repair or replace the vent pipe and fixtures if needed.

**vent to outside**  
301-3.2a

*GAS COOK STOVE EXHAUST FAN 301-3.3*

If there is an existing exhaust fan that is vented to the outside, and it is incorrectly installed, repair or replace it. If the exhaust fan is not operational or effective, repair or replace it if it is needed according to the OVERALLS Scale, Building Tightness Limits, or IAQ needs.

**exhaust fan, vented to  
outside**  
301-3.3a

*CARBON MONOXIDE ACTION LEVELS 301-3.4*

Clean and adjust or replace each burner that has a CO level higher than 25 ppm (see section 1506-2).

**stove top burners**  
301-3.4a

The oven test is not necessary if the oven is vented to the outside.

**oven vented to outside**  
301-.34b

If the oven/broiler is producing 25 ppm or more CO in the ambient air, or 100 ppm or above in the vent (that is not vented to the outside), clean and adjust the oven burners to reduce the CO below these levels (see section 1506-2).

**oven/broiler testing**  
301-3.4c



If the CO output from the oven cannot be reduced to acceptable levels, testing of all other combustion appliances may continue.

**continue testing**  
301-3.4d



No weatherization work may be started until the problem is corrected.

**cook stove ventilation**  
301-3.4e



If repeated attempts prove unsuccessful in reducing the CO levels to those specified above, install a properly sized and rated ventilation system to exhaust the CO. Educate the customer on the proper use of the ventilation system.

*CLOTHES DRYERS (ALL ENERGY SOURCES) 301-3.5*

**vent to outside**  
301-3.5a

All clothes dryers shall be vented outside to daylight.

**dryer vent duct material (rigid-metal)**  
301-3.5b

Vent clothes dryers with a rigid, metal duct that has a smooth interior surface, is a minimum 30 gauge galvanized steel or aluminum and is equipped with a backdraft damper. Run duct with joints in the direction of the air flow. Do not fasten duct with screws or other fasteners that extend into the duct.

**dryer vent duct material (flexible metal)**  
301-3.5c

Vent clothes dryers with a flexible, metal transition duct that is approved for use with the applicable energy source type. The preferred material for transition and exhaust duct is rigid metal. Install it in a manner that minimizes overall length, and is sufficiently supported to eliminate sagging.

**dryer vent duct sizing (rigid metal & flexible-metal)**  
301-3.5d

If the diameter of the dryer vent duct is not at least the diameter of the appliance outlet, install one that is at least the diameter of the appliance outlet. Determine the length of a 4-inch diameter dryer vent duct. The maximum length shall not exceed 25 feet from the clothes dryer outlet to the termination point. If the length exceeds 25 feet, increase the duct diameter to 5". (A reduction in maximum length of 2.5 feet for every 45-degree bend and 5 feet for every 90-degree bend shall apply).



State of Ohio  
Weatherization Program  
Standards

Section **MECHANICAL SYSTEMS  
INSTALLATION**

Subject **Domestic Hot Water**

### *FUEL SUPPLY 301-4.1*

Repair leaks in the fuel supply lines. Replacement fuel lines shall be in accordance with the applicable NFPA material code for the fuel type being serviced.

**fuel leaks**  
301-4.1a

Change, clean or add fuel filters in oil-fired systems.

**fuel filters, oil**  
301-4.1b

Replace the oil nozzle in oil fired DHW systems according to the size on the data plate. Readjust or replace and adjust the electrodes.

**oil nozzle &  
electrodes**  
301-4.1c

Use a manometer to check the manifold gas pressure and adjust according to manufacturer's instructions. If unable to locate manufacturer's recommended pressures, it is possible to use 11" water column for LP/propane and 3.25-3.75" water column inches for natural gas. Set oil pump pressure to PMI. With oil burners it is too important to give a range.

**gas/oil pressure**  
301-4.1d

Adjust the gas pressure if the DHW tank is under- or over-fired. Replace the orifice in a propane or natural gas system with the proper sized orifice, if necessary.

**gas orifices**  
301-4.1e

### *ELECTRICAL POWER SUPPLY 301-4.2*

Repair or replace the main electrical power supply to an electric tank if it is unsafe.

**main power supply**  
301-4.2a



Install a properly sized and fused, dedicated circuit for the DHW if one is necessary based on wire condition, a history of circuit failure, or if a new unit is to be installed.

**dedicated circuit**  
301-4.2b



Replace any wiring in or connected to the heating unit that is charred, frayed, or has damaged insulation. Correct loose or improper wiring connections. Repair or replace defective wiring in, or leading to, the unit in accordance with NFPA 70, the National Electric Code.

**hazardous wiring**  
301-4.2c



*DHW UNIT CLEARANCES 301-4.3***unit clearances**  
301-4.3a

If the combustion-type DHW tank is not located with the required clearance from combustible materials according to the appropriate NFPA code or PMI, move it to achieve the required distance.

*VENT SYSTEM INTEGRITY 301-4.4***damaged/corroded**  
301-4.4a

Repair or replace sections of the venting system that are corroded, rusted, clogged or blocked, contain cracks or holes, or are unsealed, loose or disconnected, in accordance with the applicable NFPA code for the fuel type (#54 gas, #31 for fuel oil, #211 for solid fuel).

**vent connections**  
301-4.4b

Securely fasten all vent to chimney connections.

**vent slope**  
301-4.4c

Repair or replace any vent connector pipe that dips or sags, or does not have a rise of at least 1/4" per foot of run.

**vent elbows**  
301-4.4d

Repair or replace any vent system parts necessary so that it does not exceed the allowable number of elbows in the vent system. Refer to the venting codes listed in Table 301-4.4.

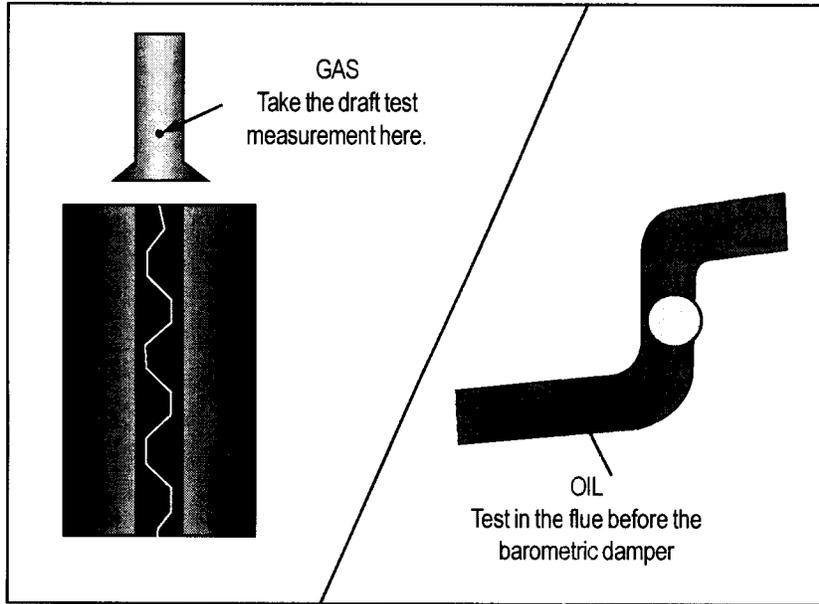
**chimney condition**  
301-4.4e

If the chimney is the vent stack for the DHW tank, and it is not in sound condition, it must be repaired, lined with a new liner, or replaced with an approved double walled-metal, vent pipe, as specified by codes listed in Table 301-4.4.

*DRAFT 301-4.5***draft problems**  
301-4.5a

Correct any vent or combustion appliance zone pressure problem that prevents the proper draft from a combustion DHW tank. Refer to Figure 301-4.5 for proper location for draft testing sites and Table 301-4.5 for acceptable draft measurements.

Figure 301-4.5 Draft Test Probe Placement



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Table 301-4.5a Draft Test Locations and Acceptable Reading

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

*COMBUSTION SAFETY & EFFICIENCY 301-4.6***CO abatement**  
301-4.6a

Clean, repair, or adjust the DHW burner and fire tube to reduce CO amounts if the levels are higher than 100 ppm, as measured according to Figure 301-4.6.

**O<sub>2</sub> and stack temperature**  
301-4.6b

Clean, repair, or adjust the DHW burner and fire tube if the O<sub>2</sub> and the net stack temperature readings are not within the acceptable limits listed in Table 301-4.6b.

**Table 301-4.6b Acceptable Combustion Test Analysis Measurements**

DHW Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
	Fan-assisted	300-480° F	N/A	100
OIL	4-9%	325-600° F	1 or less	100
Flame Retention	4-7%	325-600° F	1 or less	100

**combustion air**  
301-4.6c

Add combustion air if the combustion air requirements are not in accordance with the applicable NFPA codes for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel). If the requirements are met, and carbon deposits and corrosion exist around the draft diverter, recheck for proper venting and backdrafting potential.

*WATER TANK CONDITION 301-4.7***tank leakage**  
301-4.7a

Replace the tank if it is leaking. It may be replaced using HWAP Health and Safety funds.

**pressure relief valve/  
discharge pipe**  
301-4.7b

If the pressure relief valve and/or the discharge pipe is not present and there is an existing location for them, install them. If the relief valve and/or discharge pipe are not present and there is no existing location for them, install them in the hot water line.

Wrap the tank with DHW tank wrap, unless there is a written warning on the tank stating not to insulate. Do not wrap the tank if there is no pressure relief valve and no way to install one.

**tank insulation**  
301-4.7c

If called for in the job order, lower the temperature setting on the DHW.

**temperature setting**  
301-4.7d

If flame roll-out is occurring, clean and tune the DHW, and retest.

**flame roll-out**  
301-4.7e

Replace the gas valve if it is not functioning properly.

**gas valve**  
301-4.7f

Replace the thermostat if it is not operating properly.

**thermostat**  
301-4.7g

*DHW DISTRIBUTION 301-4.8*

If water lines are leaking, inform the customer and repair the leaks.

**water line leaks**  
301-4.8a



Insulate the first six feet of the hot and cold water lines with foam pipe wrap.

**water line insulation**  
301-4.8b



NOTE: Keep the insulation at a safe clearance from gas or oil vent pipes, if the pipes are near the water lines. Refer to Table 301-4.4 for NFPA Venting Codes.

Repair hot water fixture leaks. If cold water fixtures are leaking, inform the customer, and repair cold water fixture leaks that may contribute to moisture problems.

**water fixture leaks**  
301-4.8c



Install appropriate low-flow devices if the customer has agreed.

**low flow devices**  
301-4.8d







State of Ohio  
Weatherization Program  
Standards

Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
Subject	<b>Heat Distribution System</b>

*FORCED-AIR DISTRIBUTION SYSTEM 301-5.1*

Clean the blower motor and fan if they are dirty. Replace or tighten the belt if it needs it. Check that the unit is operating properly.

**fan operation/  
condition**  
301-5.1a

Adjust, repair or replace the fan control, as necessary, so that it properly activates the fan.

**fan control**  
301.5.1b

Uncover any blocked registers. Explain the importance of maintaining an unrestricted air flow to the customer. When appropriate, remove heat runs and registers located outside the heated area.

**register locations  
and blockage**  
301-5.1c

CEE

Use proper safety practices when working around suspected asbestos-containing materials. Do not remove or disturb friable asbestos on or around ducts (see 114-1.4a).

**asbestos**  
301-5.1d

!

Test for duct leakage, and locate duct leak sites (see 1506-5).

**duct leakage test**  
301-5.1e

Connect disconnected duct sections and replace missing as well as severely corroded, punctured or crushed duct sections.

**missing or  
disconnected sections**  
301-5.1f

Use hangar strap to eliminate sags in flex duct runs. Rehang flex duct sections in which strapping is constricting the duct and reducing air flow.

**flex duct**  
301-5.1g

Repair or replace missing, loose or otherwise damaged return duct sections. All return leaks must be sealed. Repair all gaps, holes and problem connections in panned floor joists. Return duct runs must be connected by ductwork, panning, or a combination thereof, from a return register to the furnace.

**return ducts**  
301-5.1h

NOTE: If a central air conditioner is present, be sure that there is enough return air so that the A-coils are not damaged by insufficient return air. If necessary, correctly install additional return air.

**supply ducts**  
301-5.1i      Repair or replace disconnected, missing or loose supply ducts. Seal supply duct leaks in nonconditioned areas and other areas where pressure pan testing indicates that sealing is necessary (see 1506-5). Seal applicable duct runs to achieve 1Pa or less pressure pan test.

**room-to-room test**  
301-5.1j      After all applicable sealing is complete, perform a room-to-room balance test and install relief as necessary to achieve a less than +/- 4pa difference in each room (see 1506-4).

**duct insulation**  
301-5.1k      Insulate uninsulated supply and return ducts in non-conditioned areas using vinyl-backed R-6 fiberglass duct insulation. Observe proper clearances from combustion appliance vent pipes.



**WARNING: Do not insulate any duct work on a solid fuel furnace system because of possible high temperatures.**

**furnace filter**  
301-5.1l       Change the furnace filter, if it is needed. Demonstrate the filter changing procedures to the customer whenever possible.

*GRAVITY DISTRIBUTION 301-5.2*

**register locations and blockage**  
301-5.2a       Clear any blocked registers if possible. Explain the importance of maintaining an unrestricted air flow to the customer. When necessary, remove heat runs and registers which terminate outside the heated area.

**asbestos**  
301-5.2b       Follow proper safety precautions and use proper personal protective equipment when working near suspected asbestos. Do not disturb friable asbestos (see 114-1.4a).

**missing or disconnected sections**  
301-5.2c      Connect disconnected duct sections and replace missing, as well as severely corroded, punctured or crushed duct sections.

**obstructions, flex duct**  
301-5.2d      Repair or replace crushed ductwork and remove any obstructions that are restricting air flow. Install a metal connector midway in any flex duct section longer than 14 feet. Rehang any sagging sections of flex duct and adjust any strapping which is crimping flex duct.

**return ducts**  
301-5.2e      Repair or replace any missing or unsecured sections of return ductwork or panning.

Repair or replace any missing, unsecured or damaged sections of supply ductwork.

**supply ducts**  
301-5.2f

Insulate uninsulated supply and return ducts in non-conditioned areas using vinyl-backed R-6 fiberglass duct insulation. Observe proper clearances from combustion appliance vent pipes.

**duct insulation**  
301-5.2g

**WARNING: Do not insulate any duct work on a solid fuel furnace system because of possible high temperatures.**



*BOILER DISTRIBUTION 301-5.3*

Repair or replace any distribution water lines that leak.

**distribution water lines**  
301-5.3a

Insulate heat distribution pipes running through non-conditioned areas with foam pipe wrap. Observe proper clearances from combustion appliance vent pipes.

**pipe insulation**  
301-5.3b

Repair leaks in radiators and heat transfer fin connections. Clean dirty heat transfer fins. Straighten bent fins.

**heat transfer fins, radiators**  
301-5.3c

Replace leaking or defective bleeder valves.

**bleeder valves**  
301-5.3d

Repair or replace leaking or corroded zone valves. Test zone valves and repair or replace inoperative zone valves.

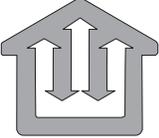
**zone valves**  
301-5.3e

*ELECTRIC BASEBOARD DISTRIBUTION SYSTEM*  
*301-5.4*

Clean dirty heat transfer fins. Straighten bent fins.

**heat transfer fins**  
301-5.4a



 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
	Subject	<b>Mechanical Ventilation</b>

*EXISTING EXHAUST FANS 301-6.1*

Install rigid or flexible vent duct to the outside of the house on each exhaust vent fan that is not properly vented to the outside. Ensure that the vent duct is properly-sized, insulated with at least an R-6 material or covered with the insulation blown into the attic, and is pitched towards the outside, if possible. Flexible ducts must be installed tightly, with a minimum of sagging. Vent ducts for clothes dryers must be smooth-surfaced, rigid duct or non-combustible metal, flexible duct and are not to be insulated.

**vent to outside**  
301-6.1a

Install a working damper and tighten or replace any loose connections on the exhaust vent pipe. Install a weather-protective termination fixture if one is not present.

**damper and connection**  
301-6.1b

If the exhaust fan is not operational or effective, repair or replace it if it is needed according to the OVERALLS Scale, Building Tightness Limits, or IAQ needs. If the exhaust fan is not operational or effective, and it is not needed according to the determinations mentioned above, do not work on it.

**determination of need**  
301-6.1c

**The following standards assume that the exhaust fan is needed.**

Use a rigid or flexible duct for any duct replacement and new exhaust fan installation. Use smooth-surfaced, rigid ducts or non-combustible metal, flexible ducts for clothes dryer vent duct replacements.

**vent duct material**  
301-6.1d

Replace any switch or control that is not operational.

**control**  
301-6.1e

Repair or replace any fan and switch wiring and connections that are improper.

**power to fans**  
301-6.1f

Instruct the customer on the proper use of exhaust fans. Perform a worst-case draft test (see 1506-4). Install passive venting if necessary.

**proper use**  
301-6.1g



## *NEW EXHAUST FANS 301-6.2*

**proper fan size**  
301-6.2a

Determine the proper fan size PMI in CFM for the area to be ventilated.

**potential need**  
301-6.2b

Install a properly-sized exhaust fan where needed according to the OVERALLS Scale, Building Tightness Limits, or IAQ needs.

**vent duct material**  
301-6.2c

Install rigid or flexible vent duct to the outside of the house on each exhaust vent fan. Ensure that the vent duct is properly-sized, insulated with at least an R-6 material or covered with the insulation blown into the attic, and is pitched downward toward the outside to allow condensation to escape, if possible. Flexible ducts must be installed taut.

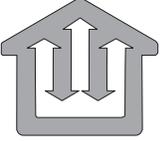
**termination**  
301-6.2d

Install a weather-protective termination fixture to the outside end of the vent pipe.

**proper use**  
301-6.2e

CEE

Instruct the customer on the proper use of exhaust fans. Perform a worst-case draft test (see 1506-4). Install passive venting if necessary.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
	Subject	<b>Electrical Efficiency</b>

*FLUORESCENT LIGHTING 301-7.1*

Install screw-in compact fluorescent lighting per manufacturer’s instructions in the fixtures determined during the initial inspection. Never install fluorescent lighting in fixtures with dimmers unless specifically allowed by the bulb manufacturer.

**fluorescent lighting**  
301-7.1a



*OTHER ELECTRIC ENERGY EFFICIENCY MEASURES 301-7.2*

The customer's specific needs and habits must be considered in the repair or replacement of efficiency measures. All material installed must be installed PMI and in compliance with local codes.

**improvements**  
301-7.2a



*CONSUMER ENERGY EDUCATION 301-7.3*

Education should be provided concerning such matters as the impact of dirty filters on electric clothes dryers, the impact of dirty coils on refrigerators and freezers, behavior impacts on refrigerator energy use, and the impacts of water leaks on well pumps.

**consumer energy  
education**  
301-7.3a



*REQUIRED ELECTRIC ENERGY EFFICIENCY MEASURES 301-7.4*

Foam waterbed covers must be purchased with non-HWAP funds. The waterbed cover shall be installed to cover the entire exposed surface of the mattress. The foam must be placed directly on the mattress surface under any and all covers. The thermostat temperature for the appliance must be reduced at the time of installation. Normal operating temperature with the foam insulation in place should be between 70° and 80° F.

**waterbeds**  
301-7.4a



*REFRIGERATOR/FREEZER REPLACEMENT*

*301-7.5*

**install refrigerators/  
freezers**

301-7.5a



Install refrigerators/freezers per manufacturer's instructions in a location acceptable to the customer.

**recycle old units**

301-7.5b



Refrigerator and freezers taken out of service must be discarded in an environmentally-sensitive manner. Old appliances contain refrigerant gasses that must be reclaimed only at licensed stations. No appliances taken out of service may be returned to service by sale, barter, or for free. Disposal/recycling fees are to be added to the replacement cost and considered in the cost-effectiveness testing.



State of Ohio  
Weatherization Program  
Standards

Section	<b>MECHANICAL SYSTEMS INSTALLATION</b>
Subject	<b>Electrical Safety</b>

*SERVICE ENTRY BOX/CIRCUITS 301-8.1*

Have the electric utility company replace the main electrical supply if it is unsafe. **main power supply**  
301-8.1a

When needed, replace the main service panel according to the NEC considering amp size, number of circuits, and wire size of circuits. **main supply panel**  
301-8.1b

Circuit wiring must be installed in conformance to the NEC. **circuits**  
301-8.1c



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL INSTALLATION</b>
	Subject	<b>Overall Building Shell</b>

*OVERALL BUILDING SHELL TESTING 302-1.1*

Perform a blower door test. Categorize areas that need to be addressed based on performance testing. Ensure that the Building Tightness Limits (BTL) minimum level of air leakage is available within the home. Ensure that the home will not be brought below the BTL, or that mechanical ventilation or pressure relief is added. Use the blower door and smoke bottle as a tool to assist in finding and sealing air leakage sites (see 1506-1). Continue to locate and seal air leakage sites until the target reduction goal is met or surpassed. Document the valid technical reason(s) which prevented the target reduction goal from being achieved.

**crew assessment**  
302-1.1a

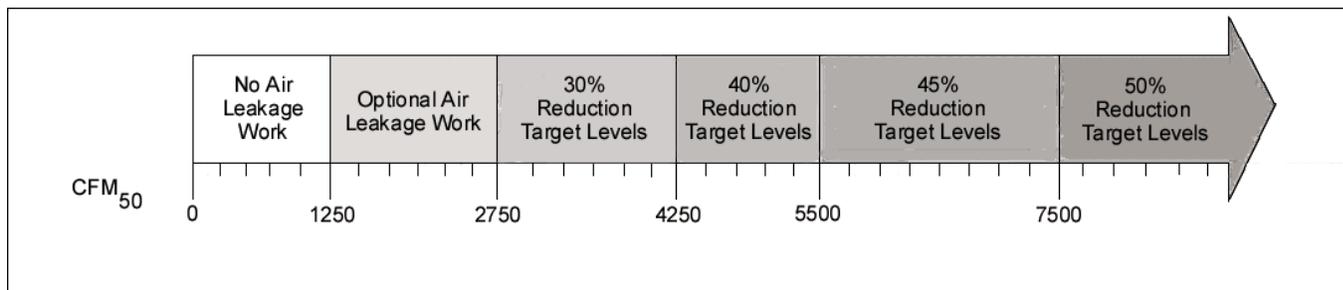
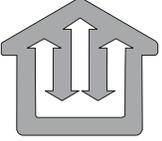


Figure 302-1.1a OVERALLS Scale



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL INSTALLATION</b>
	Subject	<b>Roof</b>

*EXTERIOR SURFACE 302-2.1*

Make any necessary repairs to damaged roofing material and structural roofing members.

**roofing**  
302-2.1a

Repair or replace missing or damaged flashing.

**flashing**  
302-2.1b

Repair masonry chimneys as required by the work order.

**chimney**  
302-2.1c

Repair or replace metal flues and stabilizing devices as required by work order.

**metal flue pipes**  
302-2.1d

Repair or replace gutter system components as required to stop moisture damage. Clean the gutter system if it is clogged or causing moisture damage. Explain the importance of keeping the gutter system unclogged to the customer.

**gutter system**  
302-2.1e

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State of Ohio  
Weatherization Program  
Standards

Section **BUILDING SHELL  
INSTALLATION**

Subject **Attic Floor**

### *ELECTRICAL SYSTEM SAFETY 302-3.1*

Correct electrical problems such as unsafe wiring, uncovered junction boxes, or electrical situations which must be corrected prior to performing any other work in the attic(s). If insulation exists, ensure that wiring is in a safe and legal state.

**wiring**  
302-3.1a



All electrical junctions must be flagged and be installed in covered junction boxes.

**junction boxes**  
302-3.1b

Install safety clearance shielding around all heat producing electrical devices such as recessed lights without an IC (insulation contact) rating, vent fans, etc.

**electrical clearances**  
302-3.1c



If knob and tube wiring is in use, install proper sized S-type fuses in boxes that contain fuses before installing any insulation.

**S-type fuses**  
302-3.1d

### *HAZARDS 302-3.2*

Use appropriate personal protective equipment (PPE) and work practices in the presence of animal or insect hazards. Ensure personal safety during work.

**health hazards**  
302-3.2a



Remove any stored items that need to be moved in order to install attic insulation effectively.

**stored objects**  
302-3.2b

Repair any rotted, broken, or damaged attic structural components. Ensure that the ceiling will safely hold the weight of the insulation. Repair or replace any weakened, damaged, or missing interior ceiling surface.

**ceiling repair**  
302-3.2c

### *ATTIC ACCESS 302-3.3*

When it is necessary to install an interior access in the ceiling, it must be at least 14 1/2" x 24", and shall be weatherstripped and insulated to the same level as the attic floor. If there is an existing fold-down stairs, a coffin type hatch shall be made. The lid and the sides of this hatch shall have the same R-value as the rest of the ceiling and be weatherstripped.

**attic access hatch-  
ceiling**  
302-3.3a

**attic access hatch--  
kneewall**  
302-3.3b

When it is necessary to install an interior attic access in a kneewall, it must be at least the kneewall stud cavity width x 24", and shall be weatherstripped and insulated to R-19. A latch shall also be installed to ensure airtightness.

**access--insulation  
dam**  
302-3.3c

A ceiling access shall have an insulation dam, made of rigid materials, that exceeds the height of the insulation to be installed. The dam must be strong enough to hold the weight of a person entering or exiting the attic.

**exterior access**  
302-3.3d

If there are no interior accesses, at least one exterior access to each attic space shall be left unsealed for inspection purposes.

#### *ATTIC PREPARATION FOR INSULATION 302-3.4*

**thermal bypasses**  
302-3.4a

Locate and seal attic thermal bypasses, chaseways, and open-topped partition walls. Deal with ceiling height changes and stairwells as necessary to stop bypass leakage. Seal kneewall floor cavities. Check for completion of bypass sealing before installing any insulation (see 1506-3).

**blocking for  
insulation**  
302-3.4b

Block around recessed lights which do not have an IC (insulation contact) rating and other electrical devices such as fan units. Seal around flue pipes and chimneys with noncombustible materials and install blockage to ensure proper clearances for the type of flue or chimney. When insulating stairs to an attic, a chimney liner may need to be installed if the chimney is against the stairs or the walls of the walk-up attic. Blown fiberglass may be used.

**existing attic vents**  
302-3.4c

Ensure that existing vents are not blocked, crushed or otherwise obstructed. Correct problems as necessary, or replace.

**attic vent  
installation**  
302-3.4d

Install venting as directed by the work order. Install high roof vents as close to the ridge as possible. Install high gable vents at least 3' above the soffit or gable vent used for low venting.

If directed by the work order, prepare to add necessary insulation to eliminate voids and areas of incomplete coverage. Cut existing fiberglass batts back 2' from the soffit and prepare to dense pack the perimeter. Prepare floored areas or other restricted zones with existing insulation for high density application.

**existing insulation**  
302-3.4e

Prior to insulating, ensure that any areas insulation should not contact are thoroughly blocked and that blocked electrical devices will be temporarily covered while blowing insulation.

**temporary cover**  
302-3.4f

Repair or replace weak or damaged sections of plaster or drywall to ensure stability of insulation.

**damaged plaster repair**  
302-3.4g

Install house wrap air barrier material tightly to the kneewall framing using staples or other appropriate fasteners spaced no more than 3 inches apart. No material may be used which would create a vapor barrier. Install additional horizontal strapping so that there is no more than 3 feet between straps or between straps and the top or bottom of the wall. Install house wrap material along floor and rafter framing so that insulation may be installed in a continuous fashion. After insulation is installed, secure the house-wrap to the slope and floor with staples.

**prep kneewalls for dense pack**  
302-3.4h

*ATTIC INSULATION 302-3.5*

Do not install cellulose insulation when it will be in contact with an exposed metal roof. Use another insulation type.

**metal roof/ insulation**  
302-3.5a

Insulate uninsulated open joist attics to R-38. Add insulation to other areas as necessary or as directed.

**insulation--open joist**  
302-3.5b

Insulate enclosed areas (under floors, slopes, under kneewall cavities, etc.) to high density level as follows:

**insulation--enclosed**  
302-3.5c

- blown cellulose 3.25 to 3.75 lb/ft<sup>3</sup>
- blown fiberglass 1.6 lb/ft<sup>3</sup>

Insulate kneewall areas as follows:

**kneewalls**  
302-3.5d

- blown cellulose 3.25 to 3.75 lb/ft<sup>3</sup>
- blown fiberglass 1.6 lb/ft<sup>3</sup>
- fiberglass batts R-19

**insulation - kneewall**  
302-3.5e

Insulate kneewalls with an appropriate insulation that completely fills the cavities. If installing fiberglass batts or if batts are existing, housewrap must encapsulate the insulation.

Install netting, housewrap, or rigid insulation, which is appropriately attached, and must be installed for blown insulation.

**air barrier**  
302-3.5f

Install an air barrier at the bottom of each slope area, including cathedral ceilings, whether the areas are insulated or not.

**perimeter pull**  
302-3.5g

Where there are existing fiberglass batts, use the perimeter pull method (see 1504 Abbreviations and Definitions).

*CERTIFICATE OF INSULATION 302-6***certificate of  
insulation**  
302-3.6a

Post a consumer information card or certificate of insulation which complies with OAC 109:4-3-14 on, or adjacent to, the electric service panel.



State of Ohio  
Weatherization Program  
Standards

Section	<b>BUILDING SHELL INSTALLATION</b>
Subject	<b>Sidewalls</b>

### *HAZARDS 302-4.1*

Correct any electrical hazard such as bare, frayed, or uninsulated wiring on house connections prior to any other sidewall work.

**electric hazards**  
302-4.1a



Correct any problems at exterior flues, gas or oil lines, or fuel tanks prior to beginning sidewall insulation.

**pipng hazards**  
302-4.1b



Employ appropriate safety measures before setting up near insect, plant, or animal hazards.

**health hazards**  
302-4.1c



Set up ladders in a safe manner, using ladder levelers or other safety devices, to compensate for yard inclines or other physical obstructions to safe ladder use.

**ladder safety**  
302-4.1d



### *SIDEWALL CONDITION 302-4.2*

Note all types of siding material. Note siding material which may contain asbestos. Wherever possible, determine the presence and condition of previous layers of siding or sub-siding. In consultation with the homeowner/authorized agent, determine the best sidewall insulation installation strategy (the "tubing" method or the "two-hole per story" method). As the primary acceptable method, the siding must be lifted or temporarily removed to gain access for drilling. Only after it has been determined by the inspector and insulation crew, in consultation with the homeowner/authorized agent, that the siding cannot or should not be removed, written permission is needed from the homeowner/authorized agent to drill through any type of exterior siding.

**siding type**  
302-4.2a

Ensure that the exterior drill installations have been properly finished and that the final appearance is as close to the original as possible.

**exterior finish**  
302-4.2b

Repair or replace severely deteriorated window or door components as directed by the work order. Replace all missing glass.

**exterior doors &  
windows**  
302-4.2c

**moisture damage**

302-4.2d

Determine the source and correct any problem which has led to moisture in wall cavities prior to installing insulation. Repair or replace damaged, rotted, or deteriorated siding to ensure the integrity of the insulation. If any missing siding, flashing, etc. would allow disintegration of installed insulation, replace it with a compatible material.

**structural integrity**

302-4.2e

Access structural additions and critical junctures to determine the ability of these areas to contain high-density insulation. Correct any openings or gaps prior to installing insulation.

*INTERIOR SURVEY 302-4.3***interior surface**

302-4.3a

Repair or replace weak or damaged drywall or lath and plaster sections. Patch holes in exterior walls. Locate any interior areas of paneling with no sub-wall surface, or that are not securely fastened. Determine an insulation strategy which will not damage the paneling. Repair or replace damaged or missing baseboard, casing, jambs, etc. that may allow insulation to escape from the wall cavity. Holes drilled for insulation must be finished and returned to a condition as close to the original as possible.

**interior mechanicals**

302-4.3b

Locate the positions of all wall-mounted switches and outlets before beginning insulation work. Locate all chaseways, utility runs, duct runs, wall heaters, vent fan penetrations, etc. prior to insulating. Block around these areas, if possible. If it is not possible to block around an area, avoid that area when insulating.

**structural details**

302-4.3c

Find any interior soffit areas, pocket doors, or other structural details which may need preparation prior to insulating, and prepare as necessary. Correct all openings at the bottoms of walls and other areas which may allow insulation to escape. Locate critical framing junctures and ensure adequate insulation density.

*INSULATION 302-4.4***install blown insulation**

302-4.4a

Determine the appropriate sidewall insulation technique(s) to be used. Insulate all sidewalls to 3.25-3.75 lbs/ft<sup>3</sup> with cellulose insulation, unless a technical barrier prevents this technique. All technical problems must be documented in the client file. When using blown fiberglass, install at a density of 1.6 lb/ft<sup>3</sup>.

If wall insulation exists, only call for more wall insulation if an evaluation has determined that it will significantly reduce the air leakage or is necessary to address the critical framing junctures.

**install blown  
insulation (con't)**  
302-4.4a

Insulate open wall cavities as directed. Enclose the cavity so that insulation is not exposed to the living area

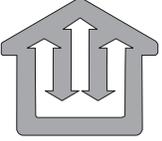
**install insulation in  
open cavities**  
302-4.4b

*CERTIFICATE OF INSULATION 302-4.5*

Post a consumer information card or certificate of insulation which complies with OAC 109:4-3-14 on, or adjacent to, the electric service panel.

**certificate of  
insulation**  
302-4.5a



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	BUILDING SHELL INSTALLATION
	Subject	Foundation

### *FOUNDATION AREA 302-5.1*

If a hazardous situation exists, correct, if possible, under program guidelines before beginning weatherization. Hazardous situations include, but are not limited to, unsafe electrical situations, excessive moisture, sewage leaks, excessive animal droppings, or dangerous physical situations, such as broken glass in the crawl space.

**hazards**  
305-5.1a



Correct moisture or sewage problems, if possible under program guidelines.

**moisture/sewage  
problems**  
302-5.1b

Repair damaged or missing areas of foundations, when allowable under program guidelines. Penetrations to the outside should be sealed.

**repair**  
302-5.1c

### *CRAWL SPACE 302-5.2*

If the inspector has called for the separation of the crawl space and basement, separate the vented, non-conditioned crawl space from the unintentionally conditioned or conditioned basement with suitable materials.

**crawl space/  
basement separation**  
302-5.2a

Install a vapor barrier in the crawl space if none is present. Overlap edges a minimum of 6 inches and up at least 6 inches on the perimeter wall. Seal all joints.

**vapor barrier**  
302-5.2b

If floor insulation is to be installed, and there is a danger of freezing, insulate the water lines.

**water lines**  
302-5.2c

Crawl space ventilation is not necessary if the crawl space is well drained and dry, there is a complete, effective vapor barrier, and there is no danger of standing water. Otherwise, install the required amount of closeable foundation ventilation (1ft<sup>2</sup> of closeable NFVA for each 1500ft<sup>2</sup> of floor area) when insulating the crawl space.

**ventilation**  
302-5.2d

Seal all direct air leakage sites into the crawl space.

**direct air leakage**  
302-5.2e

<b>bypasses</b> 302-5.2f	Seal all bypasses and chaseways into and through the conditioned areas of the house to achieve a house to zone leakage of 20 square inches or less (see 1506-3 Zone Pressure Testing).
<b>exhaust fan termination</b> 302-5.2g	Route any exhaust fans to the outside, using dampered vents and smooth bore rigid pipe and an appropriate termination fixture.
<b>insulation</b> 302-5.2h	Install insulation, when required, with the vapor barrier toward the living area. Cut floor insulation to fit snugly into the cavities and secure with mechanical fasteners. Install perimeter insulation from the sillbox (including the band joist) to the crawl space floor. The crawl space wall insulation shall extend vertically and horizontally a minimum total distance of 24" linearly from the outside finished ground level. Mechanically fasten the insulation and seal all joints with tape.
<i>BASEMENT 302-5.3</i>	
<b>floor moisture</b> 302-5.3a	Correct basement floor moisture problems as directed by the work order.
<b>water lines</b> 302-5.3b	If floor insulation is to be installed, and there is a danger of freezing, insulate the water lines.
<b>direct air leakage</b> 302-5.3c	Seal all penetrations and other direct air leakage sites into the basement.
<b>bypasses</b> 302-5.3d	Seal all bypasses and chaseways into and through the conditioned areas of the house to achieve a 50Pa pressure difference into the non-conditioned area (see 1506-3).
<b>exhaust fan termination</b> 302-5.3e	Route any exhaust fans to the outside using dampered vents, smooth-bore rigid pipe, and an appropriate termination fixture.
<b>exterior doors and windows</b> 302-5.3f	Repair or replace exterior doors or door components to reduce air leakage. Replace all missing glass and repair or replace window components to reduce air leakage.
<b>insulation</b> 302-5.3g	Install insulation, when required, with the vapor barrier toward the living area. Cut floor insulation to fit snugly into the cavities, and secure with mechanical fasteners.

Install perimeter insulation from the sillbox to the basement floor. Mechanically fasten the insulation and seal all joints with tape. Insulate the band joist of conditioned or unintentionally conditioned basements.

**insulation (con't)**

302-5.3g

NOTE: do not insulate basement walls that are below the ground surface level with any product where you cannot ensure an air barrier, as the flow of moisture behind the insulation may tend to encourage mold growth.

**basement**

302-5.3h

We learn that all wall components require a surface exposure to drying potential, either to inside or outside. Basement wall surfaces below grade level need to have the opportunity to “dry to the inside”.

*CERTIFICATE OF INSULATION 302-5.4*

Post a consumer information card or certificate of insulation which complies with OAC 109:4-3-14 on, or adjacent to, the electric service panel.

**certificate of  
insulation**

302-5.4a





State of Ohio  
Weatherization Program  
Standards

Section **MECHANICAL SYSTEMS  
FINAL INSPECTION**

Subject **Heating Units**

*OPERATIONAL UNITS 401-1.1*

Ensure that primary heating unit is operational.

**operational heating  
unit**  
401-1.1a

*FUEL SUPPLY 401-1.2*

Ensure that fuel is available (except for solid fuel units) to begin final inspection.

**fuel availability**  
401-1.2a

Ensure that all solid fuel units are free from heat exchanger leakage, excessive corrosion, and unsafe or improper wiring (when applicable). Ensure that venting for all fuel types meet safety and clearance requirements in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

**solid fuels**  
401-1.2b

Use a combustible gas leak detector to ensure that there are no propane or natural gas leaks.

**fuel leakage, gas**  
401-1.2c

Visually ensure that there are no kerosene or fuel oil leaks.

**fuel leakage, oil**  
401-1.2d

Ensure that the heating units are not under- or over-fired. Clock the meter on natural gas units. On propane units, take a gas pressure test, measure the orifice, and calculate the actual Btu input.

**Btu input**  
401-1.2e

*ELECTRICAL POWER SUPPLY 401-1.3*

Ensure that the main electrical power supply to the heating unit is safe.

**main electrical power  
safety**  
401-1.3a

If called for, ensure that the electrical line to the unit is a dedicated circuit that is properly sized and fused. Note: Each new unit shall have a dedicated electrical circuit.

**dedicated circuit**  
401-1.3b

**safe wiring**  
401-1.3c

Ensure that all the wiring in or at the heating unit is properly insulated and in good condition, and that there are no improper or loose connections.

*HEATING UNIT CLEARANCES 401-1.4*

**heating unit clearances**  
401-1.4a

Ensure that clearances from combustibles are in accordance with NFPA codes listed in Table 401-1.2b.i or PMI.

*VENT SYSTEM VISUAL INSPECTION 401-1.5*

**vent system visual inspection**  
401-1.5a

Ensure that the vent system extends from the heating unit to the outside of the dwelling, extends to the proper height, and has no cracks, holes, or loose, unsealed, or disconnected sections. Ensure that there is no excessive corrosion or rust.

**vent connections**  
401-1.5b

Ensure that the vent/chimney connection is securely fastened and properly sized and installed.

**vent slope**  
401-1.5c

Ensure that the vent connector is installed with no dips or sags, and rises at least 1/4" per foot of run.

**vent elbows**  
401-1.5d

Ensure that the number of elbows does not exceed that allowed by codes cited in Table 401-1.2b.ii.

**chimney condition**  
401-1.5e

Ensure that any chimney in use is in sound condition, including liner, bricks, blocks and mortar.

**chimney liner**  
401-1.5f

If a new chimney liner was to be installed, ensure that it has been properly sized and installed PMI.

*DRAFT TESTING 401-1.6*

**draft, "worst case"**  
401-1.6a

Set up and perform the "worst case scenario" for draft testing (see 1506-4). Refer to Table 401-1.6 for proper probe placement. Ensure that draft is within the acceptable range.

Table 401-1.6 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

**COMBUSTION SAFETY AND EFFICIENCY TESTING**  
401-1.7

With the heating unit operating, collect a flue gas sample, according to the location in Table 401-1.7a. Ensure that the CO reading is less than 100 ppm.

**carbon monoxide (CO)**  
401-1.7a

With the heating unit operating, use a combustion analyzer to measure and record O<sub>2</sub>, and net stack temperature. Refer to Table 401-1.7a for probe placement. Ensure that readings are within the limits in Table 401-1.7b.

**combustion analysis**  
401-1.7b

Table 401-1.7a CO and Combustion Analyzer Probe Placement Locations

Heating Unit Types	Probe Location
Gas-fired Central Furnaces and Direct Heating Equipment	Heat exchanger ports
Oil-fired Central Furnaces and Direct Heating Equipment	Vent pipe before barometric damper
Gas-fired Boilers	Vent pipe before draft diverter
Sealed combustion units/Fan-assisted appliances	Exhaust vent pipe

Table 401-1.7b Acceptable Combustion Test Analysis Measurements

Heating Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
<b>GAS</b> (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
Fan-assisted	4-9%	300-480° F	N/A	100
Condensing	PMI	PMI	N/A	100
Space Heaters	5-15%	300-650° F	N/A	100
Standard Power Burner	4-9%	275-550° F	N/A	100
<b>OIL</b>				
Standard Oil Burner	4-9%	325-600° F	1 or less	100
Flame Retention	4-7%	325-600° F	1 or less	100
Condensing	PMI	PMI	1 or less	100

**combustion air**  
401-1.7c

Ensure that the combustion air requirements are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

*HEAT EXCHANGER INTEGRITY 401-1.8*

**visual inspection**  
401-1.8a

Ensure that the heat exchanger is free of deterioration, cracks, or holes. Ensure that boilers are free of water leakage

**carbon monoxide (CO)**  
401-1.8b

Test the distribution system and ambient air for CO, and ensure that combustion appliances are not producing CO.

**oxygen fluctuation,  
forced air systems**  
401-1.8c

During the combustion efficiency test on forced air systems, ensure that there is no fluctuation in the O<sub>2</sub> reading during blower operation. If fluctuation is observed, use an approved method to confirm the existence of a cracked heat exchanger.

Ensure that a cracked heat exchanger has been replaced with a new heat exchanger or a new furnace or heating unit.

**cracked heat exchanger**  
401-1.8d

*TEMPERATURE RISE 401-1.9*

Measure the temperature rise of the unit to ensure that it is between 60°-90° F, or PMI.

**measurement**  
401-1.9a

*CONTROLS 401-1.10*

Ensure that the fan control properly activates the fan.

**fan control, forced-air units**  
401-1.10a

Ensure that the high limit setting is within code limits and proper for the unit, or PMI.

**high limit control, forced air units**  
401-1.10b

Ensure that the blower motor, belt, and fan are clean and operating properly.

**blower, forced-air system**  
401-1.10c

Ensure that the boiler aquastat works properly.

**aquastat, boiler**  
401-1.10d

Ensure that the boiler water pump works properly.

**water pump, boiler**  
401-1.10e

Ensure that the thermostat is operating properly and is located in a position so as to work effectively.

**thermostat**  
401-1.10f





State of Ohio  
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Standards

Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Electric Heat Pump/ Central Air Conditioning</b>

*OPERATIONAL UNITS 401-2.1*

Ensure that heat pumps which are primary heating units are operational.

**operational units**  
401-2.1a

Do not test a heat pump when the exterior air temperature is 70°F or above.

**heat pump test**  
401-2.1b

Do not test a central air conditioning unit when the exterior air temperature is below 70°F.

**central air conditioner  
test**  
401-2.1c

*THERMAL FLUID 401-2.2*

Ensure that any thermal fluid or refrigerant leaks have been corrected by an EPA-certified repair technician.

**thermal fluid  
leakage**  
401-2.2a

*ELECTRICAL POWER SUPPLY 401-2.3*

Ensure that the main electrical power supply to the unit is safe according to the NEC.

**main power supply**  
401-2.3a

Ensure that the heat pump/AC unit has a dedicated circuit that is properly sized and fused.

**dedicated circuit**  
401-2.3b

Ensure that there is an operating disconnect switch present on an outdoor unit.

**disconnect switch**  
401-2.3c

Ensure that no wiring at or in the heat pump/AC unit is charred, frayed, missing insulation, or has loose or improper connections.

**safe wiring**  
401-2.3d

*UNIT CLEARANCES 401-2.4*

Ensure that the unit has clearance from combustible materials that are PMI.

**unit clearances,  
indoors**  
401-2.4a

Ensure that the outdoor unit clearances are PMI. Ensure that cooling fins are clean and not obstructed.

**unit clearances,  
outdoors**  
401-2.4b

*BACK-UP SYSTEM INSPECTION 401-2.5*

**back-up system**  
401-2.5a

Ensure that the back-up systems meet the appropriate heating unit standards in 401-1.

*AIR HANDLER 401-2.6*

**condensate drainage**  
401-2.6a

Ensure that the condensate is draining properly and that there is no puddling or residue present.

**A-coil**  
401-2.6b

Ensure that the A-coil is clean and functional. Ensure that any cracks or holes in the coil have been corrected by an EPA-certified technician.

**unobstructed air flow**  
401-2.6c

Ensure that air flow is not obstructed.

**temperature rise/drop**  
401-2.6d

Ensure that the temperature rise or temperature drop of the heat pump/AC unit is within the manufacturer's specifications.

*CONTROLS 401-2.7*

**blower controls**  
401-2.7a

Ensure that the fan-on and the fan-off switches are working correctly.

**thermostat**  
401-2.7b

Ensure that the thermostat works correctly.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
	Subject	<b>Other Combustion Appliances</b>

*FUEL SUPPLY 401-3.1*

Ensure that there are no gas leaks at the combustion appliances, or in the pipes leading to them. Ensure that all flexible range connectors are in good condition and functioning properly.

**gas leaks**  
401-3.1a

Ensure that all shut-off valves to the cookstove and other combustion appliances are in good condition and functioning properly.

**gas shut-off**  
401-3.1b

*OVEN VENT 401-3.2*

Ensure that an oven vented to the outside is safe and effective.

**vent to outside**  
401-3.2a

*GAS COOK STOVE EXHAUST FAN 401-3.3*

If there is an existing exhaust fan that is vented to the outside, ensure that it is installed properly and functioning effectively and safely.

**exhaust fan, vented to outside**  
401-3.3a

Ensure that the customer understands proper fan usage.

**proper use**  
401-3.3b

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*CARBON MONOXIDE ACTION LEVELS 401-3.4*

Ensure that the amount of CO is less than 25 ppm at each burner, or that there is a properly sized and rated ventilation system to exhaust the CO (see 1506-2).

**stove top burners**  
401-3.4a

Ensure that the oven is producing less than 25 ppm CO in the ambient air, and less than 100 ppm in the vent (that is not vented to the outside), or that there is a properly sized and rated ventilation system to exhaust the CO (see 1506-2).

**oven/broiler**  
401-3.4b

*CLOTHES DRYERS (ALL ENERGY SOURCES) 401-3.5*

Ensure all clothes dryers are vented outside to daylight.

**vent to outside**  
401-3.5a

**dryer vent duct  
material (rigid-metal)**  
401-3.5b

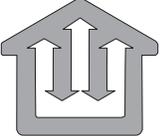
Ensure the clothes dryer is vented with a rigid-metal duct that has a smooth interior surface, is a minimum of 30 gauge galvanized steel or aluminum, and is equipped with a backdraft damper. Ensure the duct is run with the joints in the direction of the air flow and is not fastened with screws or other fasteners that extend into the duct.

**dryer vent duct  
material (flexible-  
metal)**  
401-3.5c

Ensure the diameter of the dryer vent duct is at least the diameter of the appliance outlet. Ensure the 4 inch diameter dryer vent duct does not exceed the maximum length of 25 feet from the clothes dryer outlet to the termination point. If the length exceeds 25 feet, increase the duct diameter to 5". A reduction in maximum length of 2.5 feet for every 45 degree bend and 5 feet for every 90 degree bend shall apply).

**vent duct sizing (rigid-  
metal)**  
401-3.5d

Ensure the diameter of the dryer vent duct is at least the diameter of the appliance outlet. Ensure the 4 inch diameter dryer vent duct does not exceed the maximum length of 25 feet from the clothes dryer outlet to the termination point. If the length exceeds 25 feet, increase the duct diameter to 5". (A reduction in maximum length of 2.5 feet for every 45 degree bend and 5 feet for every 90 degree bend shall apply).

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
	Subject	<b>Domestic Hot Water</b>

*FUEL SUPPLY 401-4.1*

Ensure that there is fuel available to begin the final inspection. **fuel availability**  
401-4.1a

Ensure that there are no propane or natural gas leaks. **fuel leakage, gas**  
401-4.1b

Visually determine that there is no fuel leakage in kerosene or fuel oil DHW units. **fuel leakage, oil**  
401-4.1c

Ensure that natural gas units are not over- or under-fired by clocking the meter to determine the actual Btu input. **Btu input**  
401-4.1d

*ELECTRICAL POWER SUPPLY 401-4.2*

Determine that the main electrical power supply to the unit is safe. **main power safety**  
401-4.2a 

Ensure that the electrical line to the unit is a dedicated circuit that is properly sized and fused if one was called for by the initial inspection. **dedicated circuit**  
401-4.2b 

Ensure that the wiring at or in the DHW unit is not charred, frayed, missing insulation and has no loose or improper connections. **safe wiring**  
401-4.2c 

*DHW UNIT CLEARANCES 401-4.3*

Ensure that a combustion-type DHW tank is at the required distance from combustibles according to the appropriate NFPA code or PMI. **unit clearances**  
401-4.3a

*VENT SYSTEM INTEGRITY 401-4.4*

Ensure that the vent system extends from the DHW unit to the outside of the dwelling and has no cracks, holes, or disconnected sections, and has no serious corrosion or rust. **vent system, visual inspection**  
401-4.4a  
Ensure that the venting is in compliance with the applicable NFPA codes listed in Table 401-4.

## OWPS 401-4 MECHANICAL SYSTEMS FINAL INSPECTION—Domestic Hot Water

**vent connections**  
401-4.4b Ensure that the vent-to-chimney connections are securely fastened.

**vent slope**  
401-4.4c Ensure that the vent connector has no dips or sags and rises at least 1/4" per foot of run.

**vent elbows**  
401-4.4d Ensure that the number of elbows does not exceed that allowed by the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

**chimney condition**  
401-4.4e Ensure that any chimney in use is in sound condition including liner, bricks, blocks and mortar. If a new chimney liner was required, ensure that it has been properly installed.

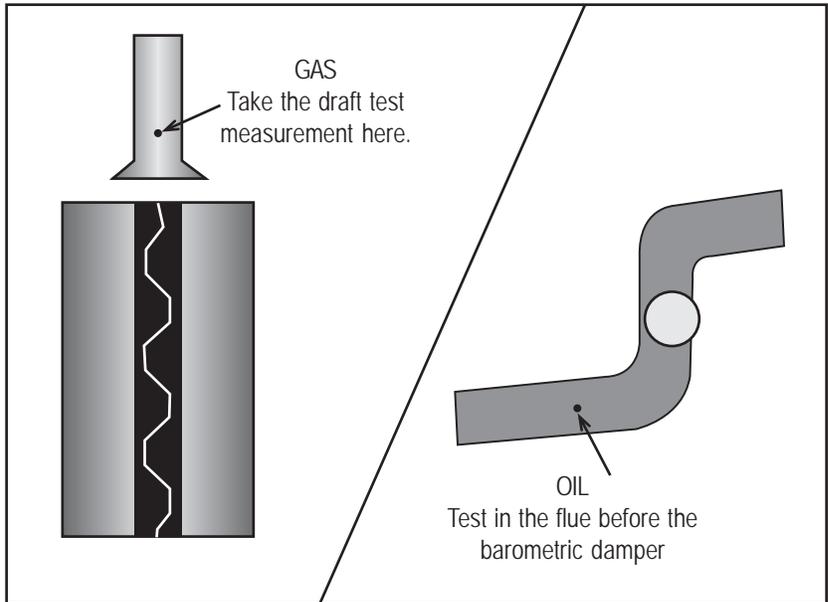
### *DRAFT TESTING 401-4.5*

**draft “worst case”**  
401-4.5a Perform the worst case draft test (see 1506-4), and ensure that draft is within the acceptable range as specified in Table 401-4.5. Refer to Figure 401-4.5 for probe placement.

Table 401-4.5 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

Figure 401-4.5 Draft Test Probe Placement

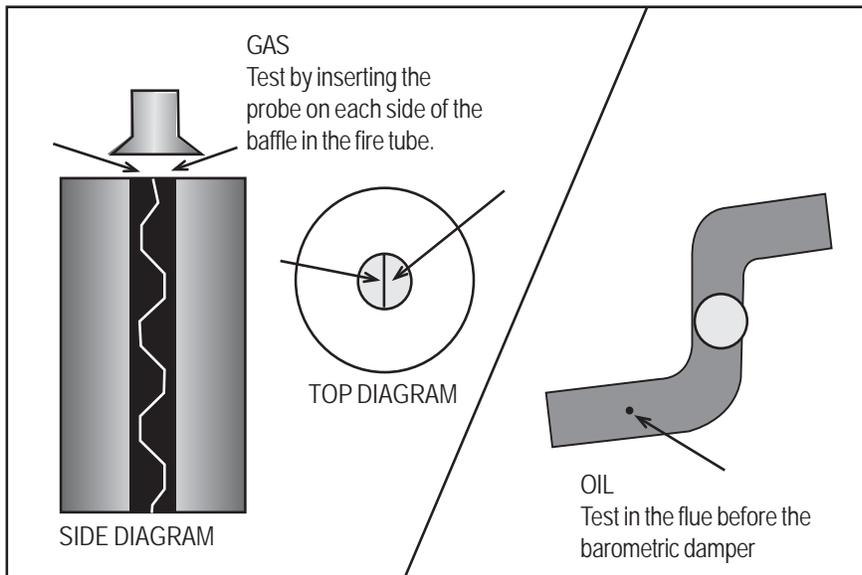


**COMBUSTION SAFETY & EFFICIENCY TESTING**  
401-4.6

Perform the CO test by placing the probe as indicated in Figure 401-4.6. Ensure that the CO in the flue gas is at or below 100 ppm.

**carbon monoxide (CO)**  
401-4.6a

Figure 401-4.6 Proper Probe Placement for Testing DHW Tanks



Perform the combustion analysis test placing the probe as indicated in Figure 401-4.6b. Ensure that the O<sub>2</sub> and the net stack temperature levels are within the limits in Table 401-4.6b.

**combustion analysis**  
401-4.6b

Table 401-4.6c Acceptable Combustion Test Analysis Measurements

DHW Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
	Fan-assisted	300-480° F	N/A	100
OIL				
	Standard Oil Burner	325-600° F	1 or less	100
Flame Retention	4-7%	325-600° F	1 or less	100

**combustion air**  
401-4.6c

Ensure that the combustion air requirements are in accordance with the applicable NFPA code for the fuel type (#54 for gas, #31 for fuel oil, #211 for solid fuel).

*TANK CONDITION 401-4.7*

**tank leakage**  
401-4.7a

Ensure that the DHW tank is not leaking water.

**pressure relief valve/  
discharge pipe**  
401-4.7b

Ensure that an operable pressure relief valve and discharge pipe are present and installed correctly on each DHW tank.

**tank insulation  
warning**  
401-4.7c



Document tanks which have a manufacturer's warning against insulating.

**tank insulation**  
401-4.7d

Ensure that the DHW tank has been insulated, if required.

**temperature setting**  
401-4.7e



Ensure that the DHW tank temperature has been lowered, when possible, without affecting the customer's lifestyle.

**flame roll-out**  
401-4.7f

Ensure that no flame roll-out occurs when the DHW unit is activated.

If the DHW tank is gas-fired, ensure that the gas valve is working properly.

**gas valve**  
401-4.7g

Ensure that the thermostat is operating correctly

**thermostat**  
401-4.7h



*DOMESTIC HOT WATER DISTRIBUTION 401-4.8*

Ensure that the water lines leading to and from the DHW tank are not leaking.

**water lines**  
401-4.8a

Ensure that the first 6 feet of hot and cold water lines are insulated, and that safe clearances from combustion sources are maintained.

**water line insulation**  
401-4.8b

Ensure that there are no leaks in the hot water fixtures. Ensure that leaks in cold water fixtures have been corrected, if the leaks contribute to moisture problems.

**fixture leaks**  
401-4.8c

Ensure that low-flow devices are installed in the shower and sink fixtures if called for by the initial inspection.

**low-flow devices**  
401-4.8d



Ensure that the customer is provided with consumer energy education regarding DHW management.

**consumer energy education**  
401-4.8e







State of Ohio  
Weatherization Program  
Standards

Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Heat Distribution Systems</b>

*FORCED-AIR DISTRIBUTION SYSTEM 401-5.1*

Ensure that the blower motor and fan are clean and operating properly.

**fan operation/  
condition**  
401-5.1a

Ensure that the fan control properly activates the fan.

**fan control**  
401.5.1b

Ensure that none of the registers are blocked. Ensure that there are no open ducts or registers either exhausting heat or drawing in return air from outside the heated area. Ensure that the resident knows why it is important that registers are not to be blocked.

**register locations  
and blockage**  
401-5.1c

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Ensure that any existing asbestos has not been disturbed (see 114-1.4a).

**asbestos**  
401-5.1d

!

Ensure that all the ductwork is connected and in good condition.

**condition/  
disconnected sections**  
401-5.1e

Ensure that all the existing flex duct is in good condition and without any restrictions. Ensure that all the suspended ductwork has proper hangers, which do not restrict air flow.

**flex duct**  
401-5.1f

Ensure that all return ducts are in good condition, that they are sealed and complete, running from the return grill in the living space to the furnace.

**return ducts**  
401-5.1g

Ensure that all the supply ducts are in good condition and that there are no leaks in non-conditioned or unintentionally conditioned areas.

**supply ducts**  
401-5.1h

Ensure that return and supply ducts in nonconditioned areas are insulated with vinyl-backed R-6 fiberglass duct insulation. Ensure that proper clearances from vent pipes have been observed.

**duct insulation**  
401-5.1i

**WARNING: Make sure that no duct work on a solid fuel furnace system is insulated because of possible high temperatures.**

**furnace filter**  
401-5.1j



Ensure that the furnace filter has been changed or is in new condition, and the customer has been instructed on how to change the filter.

*GRAVITY DISTRIBUTION SYSTEM 401-5.2*

**register locations and blockage**  
401-5.2a



Ensure that none of the registers are blocked. Ensure that there are no open ducts or registers either exhausting heat or drawing in return air from outside the heated area.

**asbestos**  
401-5.2b



Ensure that any existing asbestos has not been disturbed (see 114-1.4a).

**condition/disconnected sections**  
401-5.2c

Ensure that all the ductwork is connected and in good condition.

**flex duct**  
401-5.2d

Ensure that all the existing flex duct is in good condition, and that there are no runs longer than 14 feet without rigid-metal connectors present. Ensure that all the suspended ductwork has proper hangers which do not restrict air flow.

**return ducts**  
401-5.2e

Ensure that all the return ducts are in good condition, that they are sealed and complete, running from the grill in the living space to the furnace.

**supply ducts**  
401-5.2f

Ensure that all the supply ducts are in good condition, and that there are no supply air leaks in non-conditioned or unintentionally conditioned areas.

**duct insulation**  
401-5.2g



Ensure that supply and return ducts which pass through non-conditioned areas are insulated with vinyl-backed R-6 fiberglass duct insulation. Maintain proper clearances from the vent pipe.

**WARNING: Make sure that no duct work on a solid fuel furnace system is insulated because of possible high temperatures.**

*BOILER DISTRIBUTION SYSTEM 401-5.3*

Ensure that all the distribution water lines including valves, joints, etc. are in good condition and free of leaks.

**distribution water lines**  
401-5.3a

Ensure that all the heat distribution water pipes running through non-conditioned areas are insulated with foam pipe wrap. Where the distribution pipes run near any combustion appliance vent pipes, ensure that the required distances to combustible surfaces is observed.

**water lines insulation**  
401-5.3b

Ensure that all the radiators and heat transfer fin connections are free of leaks. Ensure that the heat transfer fins are clean and not bent.

**heat transfer fins, radiators**  
401-5.3c

Ensure that the bleeder valves are not leaking or defective.

**bleeder valves**  
401-5.3d

Ensure that there are no leaking or corroded zone valves.

**zone valves**  
401-5.3e

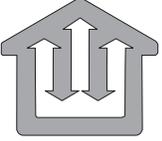
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*ELECTRIC BASEBOARD DISTRIBUTION SYSTEM 401-5.4*

Ensure that the baseboard distribution system is in good working condition. Ensure that the heat transfer fins are clean and not bent. Ensure that the customer has been informed about the importance of keeping the fins clean and that the heaters should not be blocked with furniture or other objects.

**heat transfer fins**  
401-5.4a



 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
	Subject	<b>Mechanical Ventilation</b>

*EXHAUST FANS 401-6.1*

Ensure that there is an operable exhaust fan system if it is needed according to the OVERALLS Scale, Building Tightness Limits, or indoor air quality (IAQ) needs.

**effectiveness**  
401-6.1a

Ensure that all exhaust fans are properly vented to a weather-protective termination fixture located on the outside of the house, either through an attic or sidewall, by means of rigid- or flexible-metal (no vinyl) ductwork. This ductwork must be insulated with at least an R-6 material or buried under the attic insulation, and if possible, pitched toward the outside. Flexible duct must be installed tightly, so that minimal sagging occurs. Ensure that clothes dryers are vented with smooth-surfaced, rigid duct or non-combustible flexible-metal duct and that they are not insulated.

**venting and termination**  
401-6.1b

Ensure that the exhaust vent system has a working damper and tight connections on the exhaust vent pipe.

**damper and connections**  
401-6.1c

Ensure that the fan and switch wiring and connections are effective and in good condition.

**wiring**  
401-6.1d

Ensure that the switch or control for the exhaust fan is operable.

**control**  
401-6.1e

Ensure that the exhaust fan is properly sized PMI in CFM for the area to be ventilated.

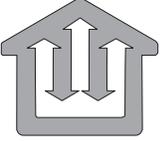
**proper fan size**  
401-6.1f

Ensure that the customer knows how to properly use an exhaust vent fan. Ensure that passive venting has been installed, if needed.

**proper use**  
401-6.1g

CEE
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 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
	Subject	<b>Electrical Efficiency</b>

*FLUORESCENT LIGHTING 401-7.1*

Ensure that screw-in, compact fluorescent lighting was installed per manufacturer’s instructions in the fixtures determined by the initial inspection. Ensure no fluorescent lighting was installed in fixtures with dimmers unless specifically allowed by the bulb manufacturer.

**fluorescent lighting**  
401-7.1a

*REFRIGERATOR/FREEZER REPLACEMENT 401-7.2*

Ensure that refrigerators/freezers were install per manufacturer’s instructions in a location acceptable to the customer.

**refrigerators/freezers**  
401-7.2a



Ensure that refrigerators and freezers taken out of service were discarded in an environmentally-sensitive manner. If applicable, ensure that old units were reclaimed only at licensed stations. Ensure that no units taken out of service were returned to service.

**old units**  
401-7.2b



*OTHER ELECTRICAL ENERGY EFFICIENCY MEASURES 401-7.3*

Ensure that all materials have been installed PMI and in compliance with local codes. Ensure that the benefit expected in the estimation (repairing water leaks to reduce well water pump operation) has been achieved.

**improvements**  
401-7.3a



*REQUIRED MEASURES 401-7.4*

Ensure that the foam insulation blanket is installed to cover the entire exposed surface of the mattress and that it is placed directly on the mattress surface under any and all covers. Ensure that the thermostat temperature for the appliance is reduced to between 70° and 80° F with the customer’s permission. Ensure that they have been purchased with non-HWAP funds and installed.

**waterbeds**  
401-7.4a



*CONSUMER ENERGY EDUCATION 401-7.5*

**consumer energy  
education**  
401-7.5a



Ensure that education has been provided concerning such matters as the impact of dirty filters on electric clothes dryers, the impact of dirty coils on refrigerators and freezers, behavior impacts on refrigerator energy use, and the impacts of water leaks on well pumps.



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Section	<b>MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Electrical Safety</b>

*SERVICE ENTRY BOX 401-8.1*

Ensure that the main service entry box is properly mounted in an appropriate location (away from dampness and other hazards).

**location of box**  
401-8.1a

Ensure that the main service entry box is properly grounded according to the NEC.

**grounding**  
401-8.1b

Ensure that existing wire types and that the location and condition of each type is hazard free.

**type of wiring**  
401-8.1c

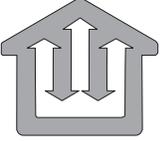
Ensure that the existing fuses/breakers are properly sized for their circuits.

**fuse/circuit size**  
401-8.1d

Ensure that a copy of the Certificate of Insulation is present at the service box, if applicable.

**certificate of  
insulation**  
401-8.1e



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL FINAL INSPECTION</b>
	Subject	<b>Overall Building Shell</b>

*EXTERIOR HOUSE INSPECTION 402-1.1*

Ensure that the gutter and downspout system, if present, is working effectively. Ensure that water is not running into or under the house. **drainage**  
402-1.1a

*INTERIOR INSPECTION 402-1.2*

Ensure that the foundation information is correct. **foundation**  
402-1.2a

Ensure that noted hazards or problems have been corrected or documented. **foundation area hazards**  
402-1.2b

Perform a final blower door test (see 1506-1). Ensure that the target reduction goal has been met or surpassed. Verify the valid technical reason(s) that prevented the goal from being achieved, and ensure that they are documented and placed in the client file. **blower door test and target**  
402-1.2c

Ensure that the Building Tightness Limit (BTL) minimum level of air leakage is available within the home. **Building Tightness Limit (BTL)**  
402-1.2d

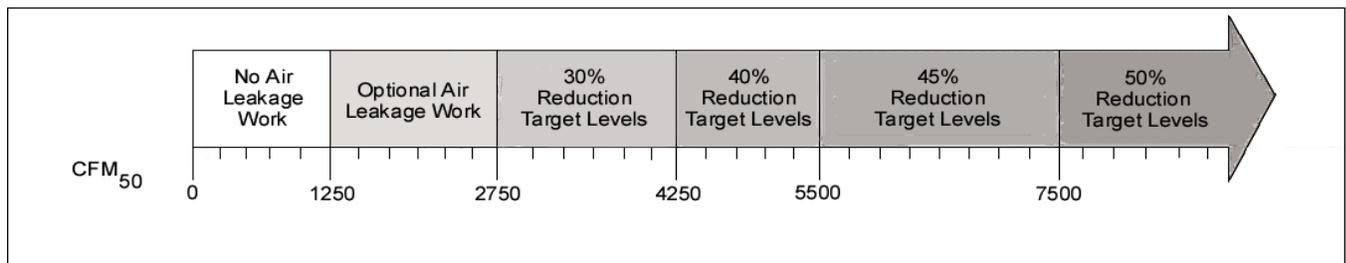
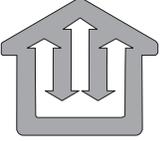


Figure 402-12.d OVERALLS Scale

Ensure that the forced-air system register locations are documented. **register locations**  
402-1.2e

Ensure that the pressure pan readings are acceptable (see 1506-5). **pressure pan test**  
402-1.2f



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL FINAL INSPECTION</b>
	Subject	<b>Roof</b>

*EXTERIOR SURFACE CONDITION 402-2.1*

Ensure that missing or damaged roofing materials have been repaired or replaced.	<b>roofing</b> 402-2.1a
Ensure that the required amount of NFVA has been installed. Ensure that slate roofs have not received additional venting unless there is solid sheathing present.	<b>roof vents</b> 402-2.1b
Ensure that missing or damaged flashing has been properly repaired or replaced.	<b>flashing</b> 402-2.1c
Ensure that active masonry chimneys are in sound condition and vent to the outside.	<b>chimney</b> 402-2.1d
Ensure that metal flues are in sound condition and vent to the outside.	<b>metal flue pipes</b> 402-2.1e
Ensure that the gutter system is not causing moisture damage to any exterior surface.	<b>gutter system</b> 402-2.1f
Ensure that any problems or hazards in flat or low-pitched roofs have been corrected, if possible.	<b>flat &amp; low-pitched roofs</b> 402-2.1g
If there is no interior attic access, ensure that each attic space is accessible through an unsealed exterior access.	<b>attic access, exterior</b> 402-2.1h

*INTERIOR SURFACE CONDITION 402-2.2*

Ensure that any newly installed attic access is properly constructed, insulated, and weatherstripped.	<b>attic access</b> 402-2.2a
Ensure that damaged sheathing, rafters, plaster, or drywall has been repaired or replaced, as necessary.	<b>sheathing/rafters</b> 402-2.2b
Ensure that cellulose insulation is not in contact with exposed metal roofing.	<b>metal roof/insulation</b> 402-2.2c
Ensure that cellulose insulation is not in contact with a masonry chimney or a metal flue.	<b>chimney/insulation</b> 402-2.2d





State of Ohio  
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Section	<b>BUILDING SHELL FINAL INSPECTION</b>
Subject	<b>Attic Floor</b>

*ELECTRICAL SYSTEM SAFETY 402-3.1*

Ensure that all attic electrical junctions have been enclosed and flagged. Ensure that attic electrical problems have been corrected.

**wiring**  
402-3.1a

Ensure that safety clearance shielding has been installed around all necessary electric and other heat-producing devices.

**electrical clearances**  
402-3.1b

Ensure that circuits are properly fused. Explain to the customer the importance of properly-fused circuits.

**fuse size**  
402-3.1c

CEE

*HAZARDS 402-3.2*

Ensure that any existing animal or insect problems are documented.

**health hazards**  
402-3.2a

Ensure that stored objects do not reduce the effectiveness of the insulation.

**stored objects**  
402-3.2b

*ATTIC FLOOR AIR LEAKAGE 402-3.3*

Ensure that any interior attic access has been properly insulated and weatherstripped and that latches have been installed on kneewall accesses.

**access**  
402-3.3a

Ensure that the thermal bypasses have been sealed by verifying the results of the zone pressure test (see 1506-3).

**thermal bypasses**  
402-3.3b

Ensure that intentional penetrations are free of insulation overblow and that they are not restricted.

**intentional penetrations**  
402-3.3c

*VENTS 402-3.4*

Ensure that all vents are functioning as designed.

**vent function**  
402-3.4a

Ensure that vents have been installed to meet NFVA requirements.

**vent requirements**  
402-3.4b

**combustion air vents**  
402-3.4c

If combustion air vents are present, ensure that they are sized correctly and are permanently open.

*ATTIC FLOOR INSULATION 402-3.5*

**attic floor condition**  
402-3.5a

Ensure that damaged or rotted ceiling components have been repaired or replaced. Ensure that the ceiling is safely holding the weight of the insulation.

**previous insulation**  
402-3.5b

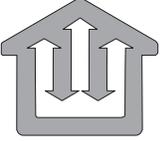
Ensure that all the voids and areas of incomplete coverage in the existing insulation have been addressed. For partially insulated attics or attics with existing insulation of R-19 or greater, additional insulation should have been added if it has been determined cost-effective by a NEAT audit. Ensure that the insulation retrofit complies with the NEAT audit.

**protective measures**  
402-3.5c

Ensure that appropriate protective measures have been taken for all the areas that insulation should not contact for safety reasons, i.e., active chimneys and electrical devices, except properly covered and flagged junction boxes).

**proper type and amount**  
402-3.5d

Ensure that the proper type and amount of attic insulation has been installed. Uninsulated attics must be insulated to R-38.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BUILDING SHELL FINAL INSPECTION</b>
	Subject	<b>Sidewalls</b>

*HAZARDS 402-4.1*

Observe all necessary measures to ensure personal health and safety during the final inspection.

**health and safety**  
402-4.1a

Ensure that allowable repairs have been made to bare, frayed, or uninsulated wires leading to the house.

**electrical hazards**  
402-4.1b

Ensure that exterior flues, chimneys, gas or oil lines, fuel tanks, and plumbing lines have not been damaged and are in operable condition.

**pipng hazards**  
402-4.1c

*SIDEWALL CONDITION 402-4.2*

Ensure that asbestos siding has not been drilled.

**asbestos siding**  
402-4.2a

Ensure that severely deteriorated window or door components have been repaired or replaced. Ensure that missing glass has been replaced.

**exterior doors &  
windows**  
402-4.2b

Ensure that exterior moisture damaged areas, such as missing or rotted siding, have been repaired or replaced.

**moisture damage**  
402-4.2c

Ensure that exposed structural components have been addressed so that the insulation is contained in the wall cavities.

**structural integrity**  
402-4.2d

Ensure that insulation has been properly installed in all required wall cavities.

**insulation installation**  
402-4.2e

Ensure that the exterior drill installations have been proerply finished and that the final appearance is as close to the original as possible.

**exterior finish**  
402-4.2f

*INTERIOR SURVEY 402-4.3*

If insulation has not been installed because of weak interior wall surfaces, verify the noted surfaces.

**interior surface**  
402-4.3a

**interior finish**  
402-4.3b

Ensure that the interior drill installations have been properly finished and that the final appearance is as close to the original as possible.

**dust and debris**  
402-4.3c

Ensure that no insulation dust or debris has been left in the house.

**interior mechanicals**  
402-4.3d

Ensure that insulation has not escaped into wall heaters, vent fans, ducts, or other mechanical or intentional penetrations.

**structural details**  
402-4.3e

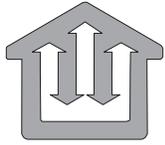
Ensure that structural details such as interior soffits, pocket doors and other bypass features have been properly addressed in the insulation process. Ensure that critical framing junctures have been properly addressed.

*INSULATION 402-4.4***insulation amount**  
402-4.4a

Ensure that sidewall insulation has been installed to the proper density.

**open cavity installation**  
402-4.4b

Ensure that insulation installed in open cavities is not exposed to the living area.



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Section	<b>BUILDING SHELL FINAL INSPECTION</b>
Subject	<b>Foundation</b>

*FOUNDATION DESCRIPTION 402-5*

Ensure that allowable corrective actions have been taken concerning hazards.

**hazards**  
402-5.1a

Ensure that allowable repairs have been made to moisture or sewage problems.

**moisture/sewage**  
402-5.1b

Ensure that allowable repairs have been made to damaged foundation areas and that holes in the foundation have been repaired, except for combustion air supply openings.

**allowable repairs**  
402-5.1c

*CRAWL SPACE 402-5.2*

Ensure that the zone classification for the area was properly determined.

**zone classification**  
402-5.2a

Ensure that the crawl space has been isolated from the basement, if called for by the initial inspection.

**connection to  
basement**  
402-5.b

Ensure that a complete ground cover vapor barrier has been installed correctly, if applicable (may already have one).

**vapor barrier**  
402-5.2c

Ensure that water lines have been protected from freezing, if necessary.

**water lines**  
402-5.2d

Ensure that the proper amount of venting has been installed, if necessary.

**ventilation**  
402-5.2e

Ensure that direct penetrations and air leakage have been addressed.

**direct air leakage**  
402-5.2f

Ensure that bypasses and chaseways have been properly addressed.

**bypasses**  
402-5.2g

Ensure that exhaust vents have been properly vented to the outside.

**exhaust vent  
terminations**  
402-5.2h

<b>insulation</b> 402-5.2i	Ensure that floor or perimeter insulation has been properly installed, when required.
	<i>BASEMENT 402-5.3</i>
<b>zone classification</b> 402-5.3a	Ensure that the zone classification for the area was properly determined.
<b>floor moisture</b> 402-5.3b	Ensure that allowable measures have been taken to correct excessive basement floor moisture.
<b>water lines</b> 402-5.3c	Ensure that water lines have been protected from freezing, if necessary.
<b>direct air leakage</b> 402-5.3d	Ensure that direct penetrations and other direct air leakage sites have been properly addressed.
<b>thermal bypass sites</b> 402-5.3e	Ensure that chaseways and other bypass sites have been properly addressed.
<b>exhaust vent termination</b> 402-5.3f	Ensure that exhaust vents have been properly vented to the outside.
<b>exterior doors and windows</b> 402-5.3g	Ensure that damaged or missing exterior doors have been repaired or installed as necessary to reduce air infiltration. Ensure that missing glass in windows has been replaced to reduce air infiltration.
<b>floor insulation</b> 402-5.3h	Ensure that floor insulation has been properly installed, when required.



State of Ohio  
Weatherization Program  
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Section **MOBILE HOME MECHANICAL  
SYSTEMS INSPECTION**

Subject **Heating Units**

*APPROVED MOBILE HOME HEATING UNITS 601-1.1*

Determine whether the existing heating unit is approved for use in mobile homes.

**approved unit**  
601-1.1a

**The inspection process may not proceed if the heating unit in use is not approved for mobile home use.**



*NON-OPERATIONAL UNITS 601-1.2*

A mobile home may not be weatherized until the primary non-operational heating unit is repaired or replaced.

**repair/replace**  
601-1.2a

*FUEL SUPPLY 601-1.3*

Fuel must be available (except for solid fuel units) to begin the inspection process.

**fuel availability**  
601-1.3a

When no fuel is available for solid fuel units, check for:

**solid fuel**  
601-1.3b

- i. heat exchanger leakage or corrosion
- ii. unsafe and/or improper wiring, if applicable
- iii. unsafe and/or improper venting and clearances

Use a combustible gas leak detector to check for propane or natural gas leaks from all accessible gas supply lines and gas-fired appliances. Verify every suspected leak with soap bubble solution. Determine the source and severity of the problem. Determine corrective actions.

**fuel leakage - gas**  
601-1.3c

If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the customer and leave the building. Contact the fuel vendor, and have the problem corrected. Document all actions taken in the customer file.

**major gas leaks**  
601-1.3d



**Weatherization work shall not begin until major gas leaks are corrected.**



If the gas leak is minor (see 1504 Abbreviations and Definitions), inform the customer and have the problem corrected.

**minor gas leaks**  
601-1.3e

**fuel leakage, oil**  
601-1.3f

Visually check for fuel leakage from kerosene and fuel oil heating units. Visually inspect fuel oil storage tank for leaks.



**Weatherization work shall not begin until oil or kerosene leaks are corrected.**

**Btu input**  
601-1.3g

When appropriate, test to determine if the heating unit is over- or under-fired by clocking the meter on natural gas units and calculating the actual Btu input. On propane units, take a gas pressure test, measure the orifice, and calculate the actual Btu input. Determine corrective actions.

#### *ELECTRICAL POWER SUPPLY 601-1.4*

**main power safety**  
601-1.4a

Inspect the main electric power supply to the heating unit and determine whether it is safe.

**dedicated circuit**  
601-1.4b

Inspect the wiring to the heating unit. Determine whether the electrical line to the heating unit is a dedicated circuit that is properly sized and fused in accordance with NFPA 54, Section 5.6.4.

If no dedicated circuit exists, it is not necessary to have one installed unless the wiring is in poor condition or there is a history of circuit failure or a new heating unit is to be installed.

**hazardous wiring**  
601-1.4c



If the mobile home has aluminum wiring, be aware that it can be a fire hazard if it is corroded, loose, or exposed. Take special care when working in a mobile home with this type of wiring. Visually inspect all wiring at or in the heating unit to locate charred, frayed or missing wire insulation, or any improper or loose connections.



**If the wiring is hazardous, inform the customer of the problem, and have it corrected prior to beginning weatherization work.**

#### *HEATING UNIT CLEARANCES 601-1.5*

**unit clearances**  
601-1.5a

Inspect the unit to determine whether clearances from combustibles are in accordance with applicable NFPA codes listed in Table 601-1.5 or PMI.

Table 601-1.5 NFPA Heating Unit Clearances

NFPA Fuel Type	NFPA Manual	NFPA Code Section #	Table #
Natural Gas	54	6	6.2.3(a)
Propane	"	"	6.2.3(b)
Oil	31	4, 5	4-4.1.1 4-4.1.2 5-5.1
Solid Fuel	211	6, 9	6-5.1.1 6-5.1.2 9-6.1 9-6.2.1

**VENT SYSTEM VISUAL INSPECTION 601-1.6**

Determine whether the vent system extends from the heating unit to the outside of the mobile home. Look for corrosion, rust, cracks, holes, or loose, unsealed or disconnected sections. Determine whether the venting is approved for mobile home use. Inspect the venting to ensure that it is in compliance with the manufacturer's instructions.

**vent system visual inspection**  
601-1.6a

Determine whether the sealed combustion unit has properly installed venting which functions as designed.

**proper installation**  
601-1.6b

Determine whether the mobile home venting system has any elbows.

**elbows**  
601-1.6c

**DRAFT TESTING 601-1.7**

If the mobile home does not have a sealed combustion unit, set up for the worst case draft test (see 1506-4).

**draft, "worst case"**  
601-1.7a

Start the unit and insert the probe in the appropriate location listed in Table 601-1.7. Measure the draft at two minutes and determine whether the draft reading is within the acceptable ranges identified in Table 601-1.7.

**draft**  
601-1.7b

Table 601-1.7 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

**COMBUSTION SAFETY & EFFICIENCY TESTING**  
601-1.8

**carbon monoxide (CO) 601-1.8a**

With the heating unit operating, insert the probe into the appropriate location identified in Table 601-1.8a. Measure and record the amount of CO in the flue gasses. The CO reading must be at 100 ppm or less.

Table 601-1.8a CO and Combustion Analyzer Probe Placement Locations

Heating Unit Types	Probe Location
Gas-fired Central Furnaces and Direct Heating Equipment	Each heat exchanger port
Oil-fired Central Furnaces and Direct Heating Equipment	Vent pipe before barometric damper
Sealed Combustion Units	Exhaust vent pipe

**combustion analysis 601-1.8b**

With the heating unit operating in winter operating condition, insert the sampling probe of a calibrated digital combustion analyzer into the appropriate location listed in Table 601-1.8a and 601-1.7b.

After the stack temperature stabilizes, measure and record the O<sub>2</sub> and the net stack temperature readings. Determine whether the readings are within the acceptable limits listed in Table 601-1.8b or PMI.

**Table 601-1.8b Acceptable Combustion Test Analysis Measurements**

Heating Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm					
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600 F	N/A	100					
	Fan-assisted	300-480 F	N/A	100					
	Condensing	PMI	N/A	100					
Space Heaters	5-15%	300-650 F	N/A	100					
Standard Power Burner	4-9%	275-550 F	N/A	100					
OIL	Standard Oil Burner	325-600 F	1 or less	100					
					Flame Retention	4-7%	325-600 F	1 or less	100
					Condensing	PMI	PMI	1 or less	100

When necessary, determine whether the combustion air requirements are in accordance with those listed in Table 601-1.8c. Determine whether combustion air openings are free of obstructions and operating as designed. In non-sealed combustion units, check for carbon deposits around the draft diverter, and inspect for proper venting and backdraft potential.

**combustion air**  
601-1.8c

**Table 601-1.8c Applicable NFPA Combustion Air Codes**

Fuel Type	NFPA Manual	Code #
Natural Gas/Propane	54	5.3
Oil	31	1-9
Solid Fuels	211	9-3

*HEAT EXCHANGER INTEGRITY 601-1.9*

**visual inspection**  
601-1.9a



Visually inspect the heat exchanger for evidence of deterioration, cracks or holes.

**carbon monoxide (CO)**  
601-1.9b

With the heating unit operating, use a CO tester sensitive to at least 10 parts per million to test for CO in the distribution system and in the ambient air. If the source of CO is not the heating unit, then look for other possible sources of CO.

**oxygen fluctuation, forced air systems**  
601-1.9c

During the combustion efficiency tests on forced-air systems, measure and record any change in the O<sub>2</sub> reading when the furnace blower motor comes on. If there is a change in the reading, reinspect the heat exchanger. Other industry accepted tests may be performed to confirm the problem.

**verified crack**  
601-1.9d

If a crack in the heat exchanger is verified, then the heat exchanger or the heating unit must be replaced.

*TEMPERATURE RISE 601-1.10*

**measurements**  
601-1.10a

Furnace filter must be clean or be removed. With the heating unit and blower operating, measure the temperature in a register that is the closest to the supply plenum. Return temperature may be taken in the return plenum or at the filter compartment. Determine whether the temperature rise is within the acceptable range of 60° F and 90° F, or PMI.

*CONTROLS 601-1.11*

**fan control, forced-air units**  
601-1.11a

Determine whether the fan is properly activated by the fan control.

**high limit control, forced-air units**  
601-1.11b

Check the high limit setting on forced-air units. Determine whether it is working correctly.

**blower operation/condition**  
601-1.11c

Determine whether the blower motor, belt, and fan are clean, properly lubricated, and operating properly. Determine if the blower motor needs lubrication.

Locate the thermostat and determine whether it is functioning correctly. If it is not, determine whether the problem is due to the location or type of thermostat. Determine if the thermostat will properly activate the heating system. Determine if the thermostat is a magnetically-controlled or the mercury bulb type.

**thermostat**  
601-1.11d



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Electric Heat Pump/ Central Air Systems</b>

*NON-OPERATIONAL UNITS 601-2.1*

A mobile home may not be weatherized until a non-operational, electric heat pump that is the primary heating unit is repaired or replaced.

**repair/replace**  
601-2.1a



Perform an authorized mobile home audit, or complete a Manual J before replacing unit.

**cost-effectiveness**  
601-2.1b

Do not test heat pumps when the exterior air temperature is above 70°F.

**heat pump test**  
601-2.1c

Do not test air conditioning units when the exterior air temperature is below 70°F.

**air conditioner test**  
601-2.1d

*THERMAL FLUID LEAKAGE 601-2.2*

Use a refrigerant leak detector to inspect for thermal fluid leakage. If a leak is detected, promptly contact an EPA-certified technician to correct the problem.

**thermal fluid leakage test**  
601-2.2a

*ELECTRICAL POWER SUPPLY 601-2.3*

Inspect the main electrical power supply to the heat pump/AC unit to ensure that it is safe.

**main power safety**  
601-2.3a

Inspect the wiring to the heat pump/AC unit. Determine whether the heat pump/AC unit has a properly sized and fused dedicated circuit.

**dedicated circuit**  
601-2.3b

Verify that there is a disconnect switch present on outdoor units.

**disconnect switch**  
601-2.3c

Visually inspect all wiring at, or in, the heat pump/AC unit for the presence of charred, frayed or missing wire insulation, and for loose or improper connections.

**hazardous wiring**  
601-2.3d



**If a hazard exists, inform the customer and have the problem corrected before performing weatherization work.**



*HEATING/COOLING UNIT CLEARANCES 601-2.4*

**unit clearances,  
indoors**  
601-2.4a

Visually inspect the unit to determine whether clearances from combustible surfaces are PMI.

**unit clearances,  
outdoors**  
601-2.4b

CEE

Visually inspect the outside unit and determine that clearances are PMI. Determine if cooling fins are obstructed or dirty. Determine whether access to the unit is blocked. Explain to the customer why this is important.

*BACK UP SYSTEM INSPECTION 601-2.5*

**back up system**  
601-2.5a

Determine the back-up system fuel type and perform an inspection in accordance with 601-1.

*AIR HANDLER 601-2.6*

**condensate drainage**  
601-2.6a

Visually inspect the inside of the unit to determine if there is proper condensate drainage. Make sure that there are no puddles or residue present.

**a-coil**  
601-2.6b

Visually inspect the A-coil for existence of cracks or holes. If any are present, contact an EPA-certified technician to repair them.

**fins/filters/ducts**  
601-2.6c

Visually inspect for dirty or obstructed fins, filters or ducts.

**temperature rise/  
drop test**  
601-2.6d

With the unit operating, measure the temperature at the supply and return side close to, but not in, the plenums. Subtract the measured temperatures to determine temperature rise/drop. Determine whether the temperature rise/drop is PMI

*CONTROLS 601-2.7*

**blower**  
601-2.7a

Determine whether the blower motor, belt, and fan are clean and operating properly. Determine if the blower motor needs lubrication.

**thermostat**  
601-2.7b

Determine whether the thermostat is operating correctly. Adjust the temperature to determine whether the thermostat properly activates the heating and cooling units.



State of Ohio  
Weatherization Program  
Standards

Section **MOBILE HOME MECHANICAL  
SYSTEMS INSPECTION**

Subject **Other Combustion Appliances**

*FUEL SUPPLY 601-3.1*

Use a combustible gas leak detector to check for propane or natural gas leaks on accessible rigid and flexible lines leading to cook stoves and gas combustion appliances other than the primary heat source or domestic hot water tank. If a dwelling unit has more than one secondary gas combustion appliance, inspect all appliances that are connected to the gas supply. Verify suspected leaks with soap solution. Determine the source and severity of the problem. Replace defective flexible range connectors.

**gas leaks**  
601-3.1a

If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the customer and leave the building. Contact the fuel vendor and have the problem corrected. Document all the actions taken in the customer file.

**major gas leaks**  
601-3.1b

**No weatherization work may be done until major gas leaks are corrected.**



If the gas leak is minor (see 1504 Abbreviations and Definitions), inform the client and have the problem corrected.

**minor gas leaks**  
601-3.1c

If there are gas shut-off valves present, determine whether they work properly.

**gas shut-off valve**  
601-3.1d

*OVEN VENT 601-3.2*

Determine whether the oven is vented to the outside. If so, determine whether the vent is securely fastened.

**vent to outside**  
601-3.2a

*GAS COOK STOVE EXHAUST FAN 601-3.3*

Determine whether there is an operable kitchen exhaust hood or fan that is vented to the outside. If an exhaust fan is present, but it is not operable, have the unit repaired or replaced.

**exhaust fan, vented to outside**  
601-3.3a

## OWPS 601-3 M H MECHANICAL SYSTEMS INSPECTION—Other Combustion Appliances

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**proper use**  
601-3.3b

CEE

Inform the customer of the reasons for, and the importance of, using the kitchen exhaust fan while cooking.

### *RANGE INSPECTION AND OPERATION 601-3.4*

**cook stove condition**  
601-3.4a

CEE

Note the general condition and cleanliness of the cook stove. If the unit is visibly dirty, perform the inspection and test it as it is. Ask the customer to clean the oven so that it can be retested at the final inspection. Explain to the customer why this is necessary.

**type of ignition**  
601-3.4b

Determine the type of ignition for the burners, oven, and broiler. If the unit has standing pilot lights, ensure that the pilot lights are lit.

**operable burners**  
601-3.4c

Determine whether the burners are operable. If they are not operable, it is allowable to have them repaired.

### *CARBON MONOXIDE (CO) TESTING 601-3.5*

**stove top burners**  
601-3.5a

Using a digital combustion analyzer, individually test each burner for the presence of CO (see 1506-2). Record the reading for each burner.

**oven vented outside**  
601-3.5b

The oven test is not necessary if the oven is vented to the outside.

**oven/broiler testing**  
601-3.5c

Turn on the oven/broiler unit. Ensure that the oven burner fires. Note the time that the oven fires, and allow it to run 10 minutes before beginning the oven test (see 1506-2).

### *CLOTHES DRYERS (ALL ENERGY SOURCES) 601-3.6*

**vent to outside**  
601-3.6a

Determine whether the dryer is vented to the outside to daylight.

**horizontal vent slope**  
601-3.6b

Determine whether a clothes dryer that is vented horizontally under a mobile home is sloping downward, 1/8" per foot toward the termination hood.

**dryer vent duct material (rigid-metal)**  
601-3.6c

Determine whether the dryer vent duct is a rigid-metal duct that has a smooth interior surface, is a minimum 30 gauge galvanized steel or aluminum and is equipped with a backdraft damper.

Vent clothes dryer with a flexible-metal transition duct that is approved for use with the applicable energy source type. The preferred material for transition and exhaust duct is rigid-metal. Install it in a manner that minimizes overall length, and is sufficiently supported to eliminate sagging.

**dryer vent duct sizing  
(flexible-metal)**

601-3.6d

If the diameter of the dryer vent duct is not at least the diameter of the appliance outlet, install one that is at least the diameter of the appliance outlet. Determine the length of a 4-inch diameter dryer vent duct. The maximum length shall not exceed 25 feet from the clothes dryer outlet to the termination point. If the length exceeds 25 feet, increase the duct diameter to 5". (A reduction in maximum length of 2.5 feet for every 45-degree bend and 5 feet for every 90-degree bend shall apply).

**dryer vent duct sizing  
(rigid-metal)**

601-3.6e





State of Ohio  
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Section **MOBILE HOME MECHANICAL  
SYSTEMS INSPECTION**

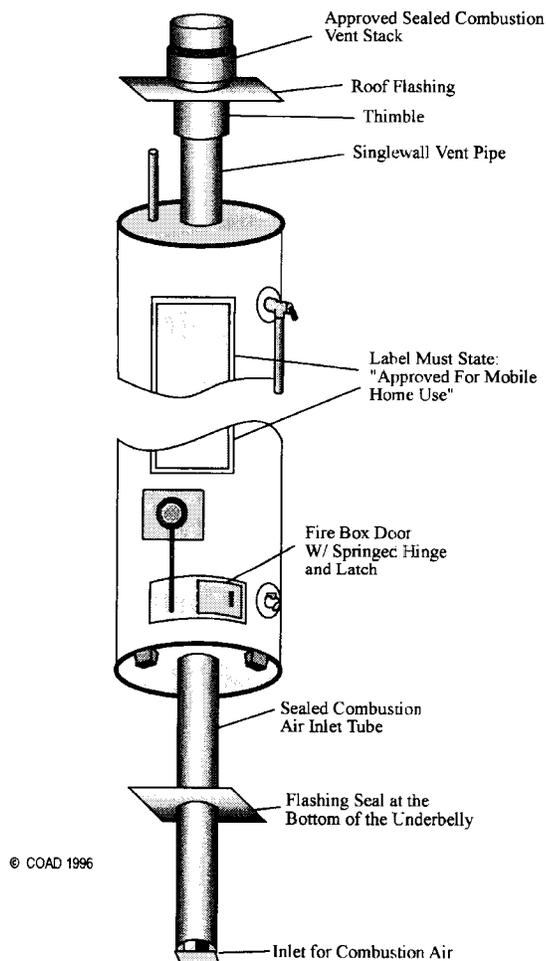
Subject **Domestic Hot Water**

*APPROVED MOBILE HOME GAS DHW UNITS 601-4.1*

Determine if the gas DHW unit is approved for use in mobile homes. An existing DHW unit is approved for mobile home use if the tank is accessible from the outside and the compartment is isolated from the living area, and there is sufficient combustion air according to NFPA 54 code requirements.

**approved gas DHW  
unit  
601-4.1a**

Mobile Home  
Sealed Combustion Domestic Hot Water (DHW) Tank



**If it is not, no weatherization work may be performed until it is replaced.**



*FUEL SUPPLY 601-4.2*

**fuel availability**  
601-4.2a

Fuel must be available to begin the inspection process of the DHW heater.

**fuel leakage, gas**  
601-4.2b

Use a combustible gas leak detector to determine if propane or natural gas is leaking from all accessible gas supply lines and gas-fired appliances. Verify every suspected leak with soap bubble solution. Determine the source and severity of the problem.

**major gas leaks**  
601-4.2c

If the gas leak is major (see 1504 Abbreviations and Definitions), immediately inform the customer and leave the dwelling. Contact the fuel vendor and have the problem corrected. Document all actions taken in the customer file.



**No weatherization work may be done until major gas leaks are corrected.**

**minor gas leaks**  
601-4.2d

If the gas leak is minor (see 1504 Abbreviations and Definitions), inform the customer and have the problem corrected.

**fuel leakage, oil**  
601-4.2e

Visually check for fuel leakage in kerosene and fuel oil DHW units. These must be approved for mobile homes.

**Btu input**  
601-4.2f

Test to determine if the gas DHW unit is over- or under-fired by clocking the meter on gas units and calculate the actual Btu input. On propane units, take a gas pressure test, measure the orifice, and calculate the actual Btu input. Determine corrective measures.

*ELECTRICAL POWER SUPPLY 601-4.3*

**main power safety**  
601-4.3a

Inspect the main electrical power supply to the electric tank to determine that it is safe.

**dedicated circuit**  
601-4.3b

Inspect the wiring to the DHW unit and determine whether the electrical line to the heating unit is a dedicated circuit that is properly sized and fused. If no dedicated circuit exists, it is not necessary to install one unless the wiring is in poor condition, there is a history of circuit failure, or the unit is to be replaced.

**hazardous wiring**  
601-4.3c



Visually inspect all wiring at, or in, the DHW unit to detect charred, frayed or missing wire insulation and improper or loose connections. If the wiring is hazardous, inform the customer of the problem and have the problem corrected.

*DHW UNIT CLEARANCES 601-4.4*

Note whether combustion-type DHW tanks are located with the required clearances from combustible materials PMI or the appropriate NFPA code. If they are not, have the DHW tank moved to achieve required distance from combustible surfaces.

**unit clearances**  
601-4.4a

*VENT SYSTEM VISUAL INSPECTION 601-4.5*

Visually inspect the vent system to determine that it extends from the DHW unit to outside the dwelling. Look for serious corrosion or rust, cracks, holes and loose, unsealed, or disconnected sections. Determine that venting is in compliance with the applicable code, Part 3280.707 (d) (1) or (2) of the HUD Mobile Home Construction and Safety Standards for Energy Efficiency.

**vent system, visual inspection**  
601-4.5a

Inspect the vent connections to make sure that they are securely fastened.

**vent connections**  
601-4.5b

Inspect the bottom of the DHW unit to determine if the combustion air inlet is connected and in good condition.

**combustion air**  
601-4.5c

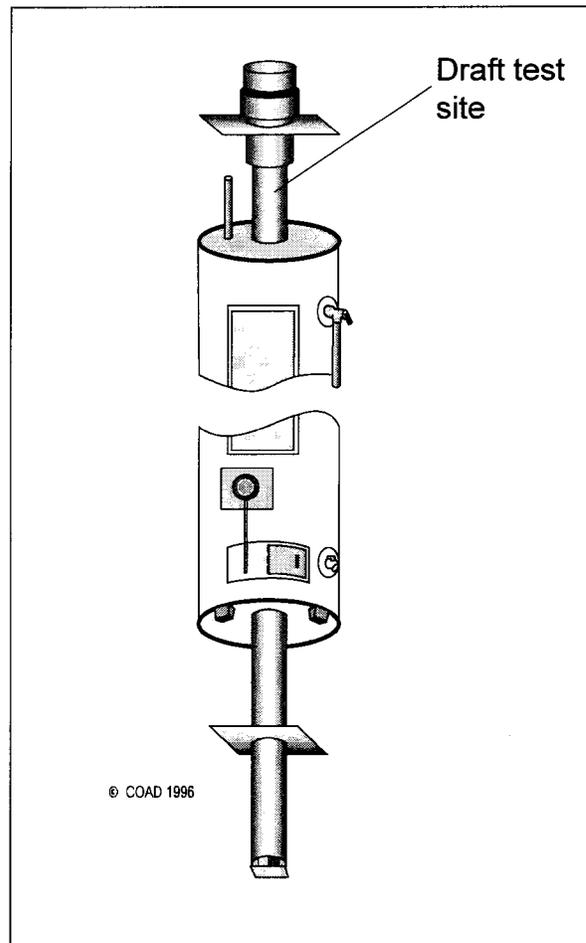
*DRAFT TESTING 601-4.6*

Start the DHW unit. Insert the draft probe into the hole in the vent pipe above the draft diverter and start the DHW unit (See Figure 601-4.6). After two minutes, measure the draft and determine whether the draft reading is within the acceptable ranges identified in Table 601-4.6.

**draft**  
601-4.6a

**Table 601-4.6 Draft Test Locations and Acceptable Readings**

DHW Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		< 20	21-40	41-60	61-80	> 80
Gas Atmospheric Appliances	Flue (after diverter)	-5 Pa	-4 Pa	-3 Pa	-2 Pa	-1 Pa
Gas Power Burners		-.02 w. c."	-.016 w. c."	-.012 w. c."	-.008 w. c."	-.004 w. c."
Oil Burners	Flue (before Barometric Damper) or draft diverter	-15 Pa -.06 w. c."	-13 Pa -.053 w. c."	-11 Pa -.045 w. c."	-9 Pa -.038 w. c."	-7 Pa -.03 w. c."



*COMBUSTION SAFETY & EFFICIENCY TESTING 601-4.7*

**CO testing**  
601-4.7a

With the DHW unit operating, insert the sampling probe in the appropriate location. Measure and record the amount of CO in the flue gasses. More than 100 ppm in the flue is not permitted.

**combustion analysis**  
601-4.7b

With the DHW unit operating, insert the sampling probe into the same hole drilled for the draft test. The combustion test analysis measurements must be PMI, or:

- i. Oxygen (O<sub>2</sub>), 4-9%
- ii. Net Stack Temperature, 300-600° F
- iii. Carbon Monoxide (CO), 100 ppm maximum
- iv. Smoke Test (oil) 1 or less

*WATER TANK CONDITION 601-4.8*

Determine if the tank is leaking water. If it is leaking, it may be replaced using HWAP Health and Safety funds.

**tank leakage**  
601-4.8a

Determine whether a pressure relief valve and a discharge pipe are present. If the relief valve and/or the discharge pipe is not present and there is an existing location for them, have them installed. If the relief valve and/or discharge pipe are not present and there is no existing location for them, have them installed in the hot water line.

**pressure relief valve/  
discharge pipe**  
601-4.8b

Do not call for insulation on tanks that have a manufacturer's warning against adding additional insulation.

**tank insulation  
warning**  
601-4.8c

Determine whether the tank is insulated. Measure the tank to determine the amount of insulation needed to cover the tank.

**tank insulation**  
601-4.8d

Examine the temperature setting on the gas valve or thermostat. Consult with the customer to determine if lowering of the temperature can be accomplished without affecting the customer's life-style.

**temperature  
setting**  
601-4.8e

CEE

Turn up the thermostat to activate the water heating system. For combustion-type equipment, determine whether flame roll-out is occurring (see 1506-8).

**flame roll-out**  
601-4.8f

If the DHW tank is a gas-fired model, determine whether the gas valve is functioning properly.

**gas valve**  
601-4.8g

Determine whether the thermostat is operating properly.

**thermostat**  
601-4.8h

*DHW DISTRIBUTION 601-4.9*

Inspect the water lines leading into and out of the water tank to determine whether they are leaking. If water lines are leaking, inform the customer and repair the leaks.

**water lines**  
601-4.9a

CEE

Determine whether there is insulation present on the first six feet of both the hot and cold water lines.

**water line insulation**  
601-4.9b

Examine plumbing fixtures to determine if they are leaking. If plumbing fixtures are leaking, inform the customer. Repair of hot water leaks is mandatory. Determine whether cold water leaks are contributing to moisture problems.

**fixture leaks**  
601-4.9c

CEE

## OWPS 601-4 M H MECHANICAL SYSTEMS INSPECTION—Domestic Hot Water

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**low-flow devices**  
601-4.9d

CEE

Examine plumbing fixtures to determine whether low-flow devices are present. Consult the customer to determine whether low-flow devices can be installed in the shower and at sink fixtures.

**consumer energy  
education**  
601-4.9e

CEE

Provide consumer energy education to the customer regarding management of hot water usage.

 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Heat Distribution System</b>

*FORCED AIR DISTRIBUTION SYSTEM 601-5.1*

Inspect the blower motor, belt, and fan. Determine if they are clean and operating properly.

**fan operation/  
condition** 601-5.1a

Determine whether the fan is activated properly by the fan control.

**fan control**  
601-5.1b

Record the locations of the registers in each room. Note any blocked or covered registers and have them unblocked. Explain to the customer why this is important.

**register locations  
and blockage**  
601-5.1c

CEE

Test for duct leakage (see section 1506-5.6) using only the taped duct test. Enter the results in the MHEA under *post duct sealing cfm* (if applicable).

**duct leakage test**  
601-5.1d

Inspect the furnace closet door to determine whether enough louvered opening is present to allow sufficient return air to the furnace. If the mobile home has floor returns, call for the sealing of these returns, and have all return air routed through the furnace closet door (see 1506-7.2). Specify sealing of the return air opening in the floor of the furnace compartment (it may be located behind the furnace, out of view). *Note: Make sure that it is an opening for return air, not for combustion air.* Combustion air openings, if present, must be kept open unless the combustion air is supplied through the roof jack.

**return air**  
601-5.1e

Inspect the supply duct system. Note and record any obstructions, openings, or missing end caps, and any loose, unsealed, rusted through, or punctured ducts. Note and record any registers that are crushed and need to be replaced.

**supply ducts**  
601-5.1f

Note the size of the furnace filter and whether it is dirty. If practical, show the customer how to change the filter.

**furnace filter**  
601-5.1g

CEE

Note the customer's door closing habits. Educate the customer about the importance of having an uninterrupted air flow from the supply registers to the return.

**door closing**  
601-5.1h

CEE

*ELECTRIC BASEBOARD DISTRIBUTION SYSTEM 601-5.2*

**heat transfer fins**  
601-5.2a

CEE

Note and record the location of electric baseboard heaters. Inspect the heat transfer fins, noting their condition and the presence of dirt, bends or kinks. Discuss with the customer the importance of keeping the fins clean and that the heaters should not be blocked with furniture or other objects.

 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Mechanical Ventilation</b>

*EXHAUST FANS 601-6.1*

Note and record the locations of all exhaust fans, including clothes dryers, and whether they are properly vented to the outside.

**number and location**  
601-6.1a

Record the type and condition of existing venting duct material. Specify the installation of rigid duct or flexible-metal duct for any duct that needs to be replaced or extended to the outside. Dryer vent ducts for clothes dryers must be smooth surfaced, rigid duct, are not to be insulated, is a minimum of 30 gauge galvanized steel or aluminum, and is equipped with a backdraft damper.

**vent duct material**  
601-6.1b

Check for the presence of a damper and whether the vent connection is tight.

**damper and connection**  
601-6.1c

Note whether there is a properly-sized termination fixture and if a working baffle is present.

**termination**  
601-6.1d

Note the type of switch or control that is present.

**control**  
601-6.1e

Inspect fan and switch wiring and connections, and note any hazards. Note whether the wiring is connected properly, and working correctly.

**power to fans**  
601-6.1f

Test each exhaust fan to see if it is operable and effective. Note inoperative, ineffective, or improperly vented fans.

**effectiveness**  
601-6.1g

Consult with the customer to determine the usage pattern and frequency of use for each fan.

**fan operation**  
601-6.1h

CEE
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If no fans are present, determine whether there is a need for a venting system according to the OVERALLS Scale, Building Tightness Limits or IAQ concerns. Consult with the customer about excess moisture and other IAQ problems.

**potential need**  
601-6.1i

CEE
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**proper fan size**  
601-6.1j

Determine the proper fan size PMI in CFM for the area to be ventilated.

**on/off switch**  
601-6.1k

For new installations only, determine whether the fan should be wired into a separate timer control, dehumidistat, or the light switch.

**Distribution system leakage test**  
601-6.1

Ensure that a distribution system leakage test is performed.

**proper use**  
601-6.1m

Determine the proper use of any exhaust fans. If the residence is rated at the Building Tightness Level (BTL) or below, recommend that the customer open a window or other fresh air intake on the opposite end of the room or house, whenever fans are used. Otherwise, backdrafting of combustion appliances may occur. Consult the draft reading of the worst case scenario draft test (see 1506-4).

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSPECTION</b>
	Subject	<b>Electrical Efficiency</b>

*FLUORESCENT LIGHTING 601-7.1*

Survey and note all interior lighting fixtures. Note the location, existing wattage and number of bulbs per fixture. Interview the client to determine the hours per day the fixture is on.

**survey existing lighting**  
601-7.1a

CEE
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Using the information gathered and the replacement chart (see 1506-6.), determine which bulbs may be replaced and note that on the inspection form.

**determine replacements**  
601-7.1b

The customer’s specific needs and habits must be considered in the replacement decision. Light quality (lumens) must not be compromised. Fluorescent bulbs must not be installed in fixtures equipped with dimmers unless the bulb manufacturer specifically allows for it.

**customer needs**  
601-7.1c

Lumen output at the lamp should be sufficient to assure these illuminance levels *at the working surface*.

<u>Activity</u>	<u>Foot-candle Level</u>
General or ambient lighting	5-20
Task lighting (non-critical)	20-50
Reading or close work	50-100

Lumen output is measured at 1 foot from the source and is the total output in all directions. Foot-candles at the surface considers light output, distance from the light source and reflectance of the surrounding surfaces.

Approximate lumen output of incandescent lamps.

<u>Watts</u>	<u>Lumens</u>
41	505
53	800
61	870
76	1190
91	1620
100	1750

Reference the manufacturer’s information (typically on the box) for CFL lumen output.

**consumer education**

601-7.1d

CEE

Consumer education must be provided concerning matters such as:

- a. Fluorescent bulbs are most cost-effective in applications where the light remains on for long periods of time.
- b. Fluorescent bulbs may take 60-90 seconds to reach full brightness.
- c. Fluorescent bulbs last approximately 10 times longer and are therefore beneficial in hard to reach places.
- d. Fluorescent bulbs are applicable where safety is an issue, such as fixtures where incandescent bulbs exist that are overrated for the wattage of the fixture and therefore create a fire hazard.

*OTHER ELECTRIC EFFICIENCY MEASURES (EEM)*

*601-7.2*

**measures**

601-7.2

Only improvements determined to be cost-effective using approved audit calculations may be installed. Savings potential must be documented and usage levels of the pre-existing condition should be metered.

**required electric energy efficiency measures**

601-7.2b

- a. For any heated water bed, add (or have the customer add) a foam insulation blanket directly above the water filled mattress.
- b. Replace or convert any halide torchier lamp with a fluoresent torchier.

Typical electrical efficiency improvements would include repairs to water well pumps and lines, waterbed foam insulation covers, and repairs to timers on septic aerators (see 1506-6).

*CONSUMER ENERGY EDUCATION 601-7.3*

**consumer energy education**

601-7.3a

CEE

Education should be provided concerning such matters as the impact of dirty filters on electric clothes dryers, the impact of dirty coils on refrigerators and freezers, behavior impacts on refrigerator energy use, and the impacts of water leaks on well pumps.

**REFRIGERATOR/FREEZER REPLACEMENT 601-7.4**

**survey existing appliances**

601-7.4a

Survey and note each existing refrigerator and freezer. Note the location of each existing appliance and meter the existing wattage for at least 2 hours.

Using the information gathered and the replacement chart (see 1506-6.), determine which units can be replaced and note that on the inspection form.

**determine  
replacements**  
601-7.4b

The customer's specific needs and habits must be considered in the replacement decision. Observe the existing appliance and discuss with the customer whether down-sizing of the replacement unit is appropriate.

**customer needs**  
601-7.4c

Refrigerator and freezers taken out of service must be discarded in an environmentally-sensitive manner. Old units contain refrigerant gasses that must be reclaimed only at licensed stations. No appliances taken out of service may be returned to service by sale, barter, or for free. Disposal/recycling costs are to be added to the replacement cost and considered in the cost-effectiveness testing.

**recycle old units**  
601-7.4d





State of Ohio  
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Section **MOBILE HOME MECHANICAL  
SYSTEMS INSPECTION**

Subject **Electrical Safety**

*SERVICE ENTRY BOX 601-8.1*

Note the location and condition of the main service entry box. Note if it is properly mounted, and in an appropriate location (away from dampness and other hazards).

**location of box**  
601-8.1a

Determine if the main service entry box is properly grounded according to the NEC.

**grounding**  
601-8.1b

Determine the type and amp rating of the main service box.

**type of box**  
601-8.1c

Determine existing wire types and the location and condition of each type present.

**type of wiring**  
601-8.1d

Note the sizes of the existing fuses/breakers and determine if they are properly sized for their circuits.

**fuse/circuit size**  
601-8.1e

If the inspection determines that a hazardous situation exists, inform the customer of the problem. Have the problem corrected if it is possible within the scope of the HWAP.

**hazards**  
601-8.1f



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME INSPECTION</b>
	Subject	<b>Overall Building Shell</b>

### *OVERALL EXTERIOR 602-1.1*

Determine whether the mobile home was manufactured before or after HUD mobile home manufacturing guidelines went into effect in 1976.

**HUD guidelines**  
602-1.1a

Note any permanent or semipermanent additions or alterations to unit.

**alterations**  
602-1.1b

Determine if the mobile home has a removable fire escape window. If so, note its location and ensure that it is not sealed shut.

**fire escape window**  
602-1.1c

Note types of windows, and whether mechanical parts are present and are fully operable to effectively seal windows.

**windows**  
602-1.1d

Note the presence and the condition of all exterior doors.

**exterior doors**  
602-1.1e

Determine the type of the main roof and any addition roof (gable or bowstring truss), and if the unit has been roofed over.

**roof type**  
602-1.1f

Note any drainage problems that may be causing structural damage.

**drainage problems**  
602-1.1g

Note whether the mobile home has draftproofing. Access the area under the mobile home and note any problems or hazards that must be corrected before beginning weatherization. Note whether there is a vapor barrier under a mobile home with draftproofing.

**draftproofing, vapor barrier**  
602-1.1h

If a forced-air system is used, locate the combustion air intake.

**combustion air intake**  
602-1.1i

Determine if the floor cavity (belly) is used as a return air duct.

**belly return**  
602-1.1j

Perform a one-point blower door test (see 1506-1). Unless a valid technical reason exists, this will be the minimum air leakage reduction to be achieved on each job.

**blower door test**  
602-1.1k

Ensure that a distribution system leakage test is performed.

**Distribution System  
Leakage Test**  
602-1.11

Calculate the Building Tightness Limits (BTL) to ensure the minimum level of air leakage necessary for the home.

**BTL Calculation**  
602-1.1m



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Section

**MOBILE HOME INSPECTION**

Subject

**Roof***ROOF 602-2.1*

Inspect the roof for soundness. Note any separation, multiple patching, or general structural deterioration. Note the presence of any obstructions above the roof surface, particularly electrical lines.

**roof surface/  
obstructions**  
602-2.1a

Note any existing roof vents.

**roof vents**  
602-2.1b

Note the condition of flashing and caps. Note any obvious problems.

**flashings, caps**  
602-2.1c

Determine if the chimney has the proper termination configuration and whether the chimney is functioning properly. Examine the chimney for soundness. Note any disconnected, loose, or excessively corroded sections. Determine if the chimney is blocked or crushed, and if it is stable.

**chimney (flue vent  
pipe)**  
602-2.1d

Inspect the gutter and/or drainage system. Note missing gutter system damage, or buildup of debris which may be causing moisture damage to the structure.

**gutter and drainage**  
602-2.1e





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Section

**MOBILE HOME INSPECTION**

Subject

**Ceiling**

### *ELECTRICAL SYSTEM SAFETY 602-3.1*

Note the types of wiring present. If the mobile home has aluminum wiring, be aware that it can be a fire hazard if it is corroded, loose, or exposed. Take special care when working in a mobile home with this type of wiring.

**wiring**  
602-3.1a



Note the presence of all electrical devices in the ceiling which require safety clearance blocking prior to insulating.

**electrical devices**  
602-3.1b



### *HAZARDS 602-3.2*

Note any hazards, such as electrical lines or insect nests, which may pose a danger.

**exterior hazards**  
602-3.2a



Note exterior flues, gas or oil lines, fuel tanks, or electrical lines.

**utility hazards**  
602-3.2b



Note any variations in yard layout, or obstructions which would require special ladder or safety equipment use.

**ground variations**  
602-3.2c



### *INTERIOR SURFACE CONDITION 602-3.3*

Note any water stains, peeling paint, mold, warpage, or other signs of moisture damage. Determine the source of the problem and ensure that it is corrected prior to weatherization, or by weatherization measures (bypass blockage, tight-pack ceiling insulation) if appropriate.

**signs of moisture  
damage**  
602-3.3a

Inspect the ceiling to ensure that it can support the weight of additional insulation.

**ceiling support**  
602-3.3b

### *ATTIC 602-3.4*

Cut or drill holes in a concealed area to allow for an adequate inspection. Determine the amount of existing insulation.

**existing insulation**  
602-3.4a

Note the presence of any holes or gaps through the ceiling which need to be repaired prior to installing insulation.

**ceiling condition**  
602-3.4b

**ceiling penetrations**  
602-3.4c

Note the location of all intentional ceiling penetrations. Ensure that the connection of the ceiling and roof jack is completely sealed.

*VENTS 602-3.5***altering vents**  
602-3.5a

Note the presence of any existing roof or gable vents, and determine whether adding insulation will necessitate blocking or removing vents.

**no additional venting**  
602-3.5b

Do not specify additional venting for mobile home roofs or attics

*ATTIC INSULATION 602-3.6***attic/ceiling condition**  
602-3.6a

Determine the condition of the attic, noting broken or damaged trusses and ceiling damage.

**existing insulation/  
moisture**  
602-3.6b

Inspect for the presence of moisture in the insulation.

**perform audit**  
602-3.6c

Use an approved audit to determine if ceiling insulation is cost-effective (if applicable).

**insulation installing  
method**  
602-3.6d

Determine the most effective-methods of installing additional insulation. Installation options include the side lift method, gable end blow, exterior roof access and interior access.

**estimate insulation**  
602-3.6e

Calculate the amount of insulation necessary.



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Section

**MOBILE HOME INSPECTION**

Subject

**Sidewalls**

### *SIDEWALLS AUDIT 602-4.1*

Mobile home sidewall insulation is an allowable measure. Use an approved audit to determine if sidewall insulation is cost-effective (if applicable).

**allowable measure**  
602-4.1a

### *EXTERIOR INSPECTION 602-4.2*

Note the siding types. Determine if sidewall panels can be removed. Check for the presence of an exterior vapor barrier.

**siding types**  
602-4.2a

Determine the amount of existing sidewall insulation by inspecting around electrical switch and outlet boxes, removing interior window trim, or removing exterior screws.

**existing insulation**  
602-4.2b

Note any missing or severely deteriorated exterior doors.

**deteriorated doors**  
602-4.2c

Note awning or jalousie windows which do not effectively close.

**deteriorated windows**  
602-4.2d

Inspect for excessive moisture damage. Attempt to find the source of the problem. Severe moisture problems must be corrected before weatherization work begins.

**sidewall moisture damage**  
602-4.2e

Inspect for and note any structural damage or missing siding.

**structural damage/  
missing siding**  
602-4.2f

Note the presence and the condition of any structural additions to the mobile home.

**structural additions**  
602-4.2g

### *INTERIOR SURVEY 602-4.3*

Check the condition of interior wall surfaces. Note and record any deteriorated wall sections, and any missing interior wall sections.

**interior wall condition**  
602-4.3a

Note the location and condition of any electrical outlets or switches in the sidewalls.

**electrical outlets/  
switches**  
602-4.3b

**exhaust vents**  
602-4.3c

Note the location and condition of vent fan penetrations, clothes dryer terminations, etc.

**structural details**  
602-4.3d

Note the presence and location of structural details such as interior soffits or ceiling height changes which could interfere with proper installation of insulation.

*INSULATION 602-4.4*

**determine measures**  
602-4.4a

Determine the best method for insulating the sidewalls. Insulation may be installed into mobile home sidewalls by either: a) sliding unfaced 3 1/2" fiberglass batts into place from the bottom, or, b) tubing loose-fill fiberglass into wall cavities. Small areas above windows and doors may remain uninsulated.

**calculate amount to blow**  
602-4.4b

Calculate the amount of blown fiberglass insulation needed to insulate the walls to 1.6 lbs/ft<sup>3</sup>.

**calculate batts**  
602-4.4c

Consider the wall depth when deciding the size of fiberglass batts to be installed. Calculate the amount of batt insulation needed.



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Section	<b>MOBILE HOME INSPECTION</b>
Subject	<b>Belly</b>

*UNDER THE MOBILE HOME 602-5.1*

Note if the mobile home has draftproofing, and if so, the type. Draftproofing may not be installed or repaired with HWAP funds.

**draftproofing**  
602-5.1a

Note the condition of the belly, and if repairs are necessary prior to installing insulation.

**belly**  
602-5.1b

Note moisture problems under or around the mobile home, and determine the source.

**moisture**  
602-5.1c

*FLOOR INSULATION 602-5.2*

Calculate the floor area.

**area calculation**  
602-5.2a

If draftproofing or another enclosure is present, determine if an adequate ground vapor barrier and adequate closeable NFVA vents are present. Mobile homes with draftproofing or another enclosure must have a ground vapor barrier installed on the earth. A vapor barrier is optional if no draftproofing is present.

**ground vapor barrier**  
602-5.2b

Note the condition of existing insulation.

**existing insulation**  
602-5.2c

Calculate the amount of additional insulation needed, and determine the best installation technique. Consider whether the joists run parallel or perpendicular.

**insulation calculation**  
602-5.2d

The two approved installation methods are band joist tubing or belly access installation. Consider the presence of water and sewer lines and the potential for freezing with the addition of insulation.

**installation methods**  
602-5.2e

Estimate the number of 1x3" boards needed to support the weight of fiberglass insulation on the belly board.

**insulation and belly  
board support**  
602-5.2f

**closeable vents**  
602-5.2g

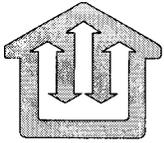
Calculate the amount of closeable NFVA present on mobile homes with continuous draftproofing. Mobile home floor insulation that is enclosed by draftproofing does not need foundation vents if the enclosed area is well drained and dry. Otherwise, specify closeable venting with a NFVA of 1 ft<sup>2</sup> for every 1500 ft<sup>2</sup> of enclosed area.

**forced air furnace ducts**  
602-5.2h

Access the belly area and inspect the duct system if the mobile home has a forced-air system. Note any disconnections, excessive corrosion, holes, or other problems which must be corrected prior to installing insulation.

**dryer vent termination**  
602-5.2i

Inspect for the presence of a dryer or other exhaust vent termination under the mobile home. All exhaust appliances must be vented to the outside with an appropriate termination fixture with a damper.



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Section **MOBILE HOME MECHANICAL  
SYSTEMS INSTALLATION**

Subject **Heating Units**

*TUNE-UPS AND REPAIRS 701-1.1*

A tune-up involves a visual inspection, some testing procedures, cleaning and adjustments to improve the combustion and seasonal efficiency of the heating system.

**tune-up**  
701-1.1a

Repairs involve the replacement or reconstruction of defective or unsafe parts for the purpose of ensuring the safe operation of the heating system.

**repairs**  
701-1.1b

*NON-OPERATIONAL UNITS 701-1.2*

Repair or replace non-operational heating units.

**repair/replace**  
701-1.2a

Replacements of heating units using weatherization funds must be cost justified using an approved mobile home audit.

**cost-effectiveness**  
701-1.2b

All replacement units must be UL listed for use in a mobile home.

**UL listed units**  
701-1.2c

Switching from the existing fuel source to a different fuel source for use by the heating unit is prohibited without the prior written approval of OEE. Requests for fuel switching must describe the technical reasons for the decision and include cost justification and written authorization from the party responsible for fuel payments.

**fuel switching**  
701-1.2d

All new units shall carry a minimum one (1) year warranty on workmanship. Each customer shall receive all manufacturer's product warranty information, clear maintenance instructions, educational information as necessary and a local phone number of who to contact for warranty problems.

**warranty**  
701-1.2e

All units shall be installed in conformance with manufacturer's instructions, local codes, and/or NFPA manuals as required.

**local codes**  
701-1.2f

*FUEL SUPPLY 701-1.3***repair/replace supply lines**

701-1.3a

Repair or replacement of fuel supply lines shall be restricted to the length between the fuel storage tank and the heating unit, or in the case of metered fuels, the length between the meter and the heating unit. Repair leaks in the fuel supply lines. Replacement fuel lines shall meet the applicable NFPA material code for the fuel type being serviced.

**fuel filters, oil**

701-1.3b

Change, clean or add fuel filters in oil fired systems.

**oil nozzle & electrodes**

701-1.3c

Replace the oil nozzle in oil-fired heating units according to the size on the unit data plate or by performing a post-weatherization condition heat loss calculation to determine the new nozzle size. Readjust or replace and adjust the electrodes.

**gas/oil pressure**

701-1.3d

Use a manometer to check the manifold gas pressure and adjust according to manufacturer's instructions. If unable to locate manufacturer's recommended pressures, it is possible to use 11" water column for LP/propane and 3.25-3.75" water column inches for natural gas. Set oil pump pressure to PMI. With oil burners it is too important to give a range.

**Btu input**

701-1.3e

Verify the Btu input of metered-fuel units by clocking the meter. If the unit is over- or under-fired, adjust the gas pressure. Replace orifices in propane and natural gas units with the proper sized orifice, if necessary.

*ELECTRICAL POWER SUPPLY 701-1.4***main power supply**

701-1.4a

Repair or replace an unsafe power supply to the unit.

**dedicated circuit**

701-1.4b

Install a properly sized and fused dedicated circuit for the heating unit if one is necessary based on wire condition, a history of circuit failure, or a new unit is to be installed.

**hazardous wiring**

701-1.4c



Replace any wiring in, or connected to, the heating unit that is charred, frayed, or has damaged insulation. Correct loose or improper wiring connections. Repair or replace defective wiring in, or leading to, the heating unit in accordance with NFPA 70, the National Electric Code.

*HEATING UNIT CLEARANCES 701-1.5*

Ensure that the unit is located so that clearances from combustible materials is PMI.

**heating unit  
clearances**  
701-1.5a

*VENT SYSTEM INTEGRITY 701-1.6*

Repair or replace sections of the venting system that are corroded, rusted, clogged or blocked, contain cracks or holes, or are unsealed, loose or disconnected.

**damaged/corroded**  
701-1.6a

Ensure that all venting materials meet clearances from combustible materials in accordance with the applicable NFPA code. Correct any instances where vent clearances are not met.

**clearances**  
701-1.6b

Securely fasten vent-to-roof jack connections. Ensure that the connection of the ceiling and the roof jack is completely sealed.

**vent connections**  
701-1.6c

Repair or replace any vent system parts necessary so that there are no elbows in the vent system.

**vent elbows**  
701-1.6d

Clean solid fuel chimneys that contain creosote, soot, scale or other debris.

**solid fuel chimneys**  
701-1.6e

*DRAFT 701-1.7*

Perform a draft test on all vented, combustion-type appliances in accordance with the Table 701-1.7 and correct any draft and venting problems.

**draft test**  
701-1.7a

**Table 701-1.7 Draft Test Locations and Acceptable Readings**

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-69	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc'	-4 Pa -.016 wc"	-3 Pa -.012 wc'	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc'	-13 Pa -.053 wc"	-11 Pa -.045 wc'	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

**draft, "worst case"**  
701-1.7b

Perform the "worst case scenario" draft test (see 1506-4).

**draft, furnace**  
701-1.7c

Start the heating unit. Insert the draft probe into the appropriate location listed in Table 701-1.7. Measure and record the draft at two minutes. Determine whether the draft reading is within the acceptable ranges identified in Table 701-1.7. If draft is not within acceptable limits, determine the reason and correct.

*COMBUSTION SAFETY AND EFFICIENCY 701-1.8*

**clean burners**  
701-1.8a

Clean gas burners of dirt and rust. Repair or replace them if necessary.

**clean combustion chamber**  
701-1.8b

Clean the combustion chamber on oil-fired units, replace or repair any defects in the combustion chamber, and seal the area around the air (blast) tube, inspection port and other areas to reduce uncontrolled, excess air.

**gas power burners**  
701-1.8c

Seal openings around gas power burners.

Insert the sampling probe of a calibrated digital combustion analyzer into the location listed in Table 701-1.8d.i. Adjust the heating unit so that it is within the acceptable combustion gas levels in Table 701-1.8d.ii.

**combustion testing**  
701-1.8d

**Table 701-1.8d.i CO and Combustion Analyzer Probe Placement Locations**

Heating Unit Types	Probe Location
Oil-fired Central Furnaces and Direct Heating Equipment	Vent pipe before barometric damper
Sealed Combustion Units	Exhaust vent pipe

**Table 701-1.8d.ii Acceptable Combustion Test Analysis Measurements**

Heating Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
<b>GAS</b> (Natural Gas, Propane)	4-9%	300-600 F	N/A	100
Fan Assisted	4-9%	300-480 F	N/A	100
Condensing	PMI	PMI	N/A	100
Standard Power Burner	4-9%	275-550 F	N/A	100
<b>OIL</b>				
Standard Oil Burner	4-9%	325-600 F	1 or less	100
Flame Retention	4-7%	325-600 F	1 or less	100
Condensing	PMI	PMI	1 or less	100

With the heating unit operating, insert the sampling probe into the appropriate location listed in Table 701-1.8d.i. Measure and record the amount of CO in the flue gasses. More than 100 ppm in the flue is not permitted. If the cleaning and tuning work does not reduce the CO level below 100 ppm in the unit, repeat the procedures outlined above and retest. If the CO levels are still not below 100 ppm, consult with an OEE representative.

**carbon monoxide (CO)** 701-1.8e

*HEAT EXCHANGER 701-1.9*

Clean the heat exchanger. Remove soot and debris. Reseal with appropriate materials.

**clean heat exchanger**  
701-1.9a

If cracks or holes exist in the heat exchanger, replace the heat exchanger if a new one can be located, or have the unit replaced. No weatherization work can be performed until the replacement or repair is completed.

**heat exchanger, cracks or holes**  
701-1.9b



*TEMPERATURE RISE 701-1.10*

Perform temperature rise test, and take corrective action if the temperature rise is not within the acceptable range listed in the manufacturer's specifications. (Refer to Table 701-1.10a.i and 701-1.10a.ii.)

**corrective action**  
701-1.10a

**Table 701-1.10a.i Typical Solutions for High Temperature Rise**

PROBLEM:	CHECK FOR:	REMEDY:
High Temperature Rise [>90°/PMI]	<ul style="list-style-type: none"> <li>• Fan speed too slow</li> <li>• Obstruction in duct work</li> <li>• Inadequate return/distribution ductwork</li> <li>• Blower belt/filter/AC coil defective or dirty</li> <li>• Unit overfired</li> <li>• Dirty or defective blower</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed higher or replace motor</li> <li>• Remove obstruction</li> <li>• Install proper ductwork</li> <li>• Clean or replace belt/filter/AC coil</li> <li>• Adjust fuel pressure, change orifices</li> <li>• Clean or replace blower</li> </ul>

**Table 701-1.10a.ii Typical Solutions for Low Temperature Rise**

PROBLEM:	CHECK FOR:	REMEDY:
Low Temperature Rise [<60°/PMI]	<ul style="list-style-type: none"> <li>• Fan speed too fast</li> <li>• Excessive air flow from blower</li> <li>• Unit underfired</li> <li>• Low stack temperature (PMI)</li> <li>• Cycling on high limit</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed slower or replace motor</li> <li>• Adjust air flow or replace blower</li> <li>• Adjust fuel pressure or change orifices</li> <li>• Resize the vent pipe</li> <li>• Clean or replace blower, install more or larger duct work</li> </ul>

*CONTROLS 701-1.11*

Replace defective fan/limit controls and test the new control after putting the unit into operation.

**fan/limit control**  
701-1.11a

Move improperly located thermostats to an area free from drafts or heat from the heating system, lights, or appliances.

**thermostat location**  
701-1.11b

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Replace defective thermostats or thermostats that are mercury bulb activated.	<b>thermostat replacement</b> 701-1.11c
Adjust the heat anticipator in the thermostat to match the amp draw of the system controls.	<b>heat anticipator</b> 701-1.11d
<i>AUTOMATIC FUEL SAFETY SHUT-OFF 701-1.12</i>	
Test gas valves to ensure that, in the event of a pilot outage, the flow of gas to the burners is interrupted. For gas valves with 100% safety shutoff, ensure that the flow of gas to the pilot is also interrupted in the event of a pilot outage. Ensure that the tip of the thermocouple is enveloped by the pilot flame. Replace defective gas valves and thermocouples.	<b>test gas valve</b> 701-1.12a
Perform a safety check of the primary control and cad cell in oil fired units. Replace defective primary controls or cad cells.	<b>safety check</b> 701-1.12b
<i>ELECTRIC FURNACES 701-1.13</i>	
Check for proper sequencing and operation of elements. Replace defective elements and other defective components.	<b>sequencing</b> 701-1.13a
Check for adequate line voltage and correct as necessary.	<b>line voltage</b> 701-1.13b
<i>DISTRIBUTIONS SYSTEM 701-1.14</i>	
Clean dirty blower motors, fans and belts. Inspect the blower for excessive free play and correct as necessary. Inspect the pulleys and drive assembly for wear, alignment and proper tension and correct as necessary. Inspect the motor bracket for tightness and alignment and correct as necessary. Lubricate the motor and motor bearing cups if necessary.	<b>forced air and gravity systems</b> 701-1.14a
Test the fan control to ensure that it is functioning properly. Set the fan "on" control to 110° F and the fan "off" control to 90° F after determining that the customer's life-style or this particular installation will permit these settings. Replace defective fan controls.	<b>fan control</b> 701-1.14b
Seal all leaks and/or openings in the supply duct, especially at the ends of the duct and the base/duct interface in typical mobile homes. Seal additional sites at the crossover ducts in a complex mobile home duct system.	<b>supply air ducts</b> 701-1.14c

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Repair or replace any missing, loose fitting, blocked, leaky, or unsealed blower compartment or return air ducts and seal with compatible duct sealing materials. Belly return systems shall be eliminated. Seal all return air registers, and provide sufficient return air opening area at the furnace closet door by installing a louvered door.

**return air ducts**  
701-1.14d

Install or replace missing or dirty return air filters. Instruct the customer on filter replacement.

**air filters**  
701-1.14e

CEE

Insulate uninsulated duct work passing through non-conditioned areas so that the duct is completely covered and the insulation is not compressed. Terminate duct insulation at the floor register boots in such a manner that the register boot is completely covered and the duct insulation fits snugly against the floor. Secure sections of duct insulation with staples, straps, or wires and tape any exposed fiberglass.

**insulate ducts**  
701-1.14f

Vacuum the heat transfer fins on electric baseboard units.

**electric baseboard**  
701-1.14g

#### *CERTIFICATION 701-1.15*

Once the unit has been serviced, the installer must place a sticker on the heating unit, in plain view, certifying that the system has been properly serviced. The sticker shall indicate the date of service, name of the service contractor and the phone number of the service contractor.

**identification  
sticker**  
701-1.15a



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Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSTALLATION</b>
Subject	<b>Electric Heat Pump/ Central Air Systems</b>

*TUNE-UPS AND REPAIRS 701-2.1*

A tune-up involves a visual inspection, some testing procedures, cleaning and adjustments to improve the combustion and seasonal efficiency of the heating system.

**tune-up**  
701-2.1a

Repairs involve the replacement or reconstruction of defective or unsafe parts for the purpose of ensuring the safe operation of the heating system.

**repairs**  
701-2.1b

*NON-OPERATIONAL UNITS 701-2.2*

Repair or replace non-operational heating units.

**repair/replace**  
701-2.2a

Replacements of heating units using weatherization funds must be cost justified using an approved mobile home audit.

**cost-effectiveness**  
701-2.2b

Switching from the existing fuel source to a different fuel source for use by the heating unit is prohibited without the prior written approval of OEE. Requests for fuel switching must describe the technical reasons for the decision and include cost justification and written authorization from the party responsible for fuel payments.

**fuel switching**  
701-2.2c

If the size of the replacement unit differs from the existing unit, the output rating must be sized according to Manual J or an authorized mobile home audit calculations. Documentation of sizing calculations shall be maintained in the customer file.

**sizing**  
701-2.2d

All units shall carry a minimum one (1) year warranty on workmanship. Each customer shall receive all manufacturer's product warranty information, clear maintenance instructions, educational information as necessary and a local phone number of who to contact for warranty problems.

**warranty**  
701-2.2e

All units shall be installed in conformance with manufacturer's instructions, local codes, and/or NFPA manuals as required.

**local codes**  
701-2.2f

*THERMAL FLUID LEAKAGE 701-2.3*

**thermal fluid leakage**  
701-2.3a

If there is a refrigerant leak in the central air conditioning system, promptly contact an EPA-certified technician to repair the leak(s).

*ELECTRICAL POWER SUPPLY 701-2.4*

**main power safety**  
701-2.4a

Repair or replace the main electrical supply wiring to the unit if it is unsafe.

**dedicated circuits**  
701-2.4b

Add a dedicated circuit that is properly sized and fused to a heat pump/AC unit that does not have one.

**hazardous wiring**  
701-2.4c



Replace any unsafe wiring to the heat pump/AC unit.

*UNIT CLEARANCES 701-2.5*

**unit clearances, indoors**  
701-2.5a

Move any unit or combustible material where clearances are not PMI.

**unit clearances, outdoors**  
701-2.5b

Move any unit or obstruction that is not PMI. Clean the cooling fins if they are dirty.

*BACK-UP SYSTEM 701-2.6*

**back-up system**  
701-2.6a

Address the back-up system based on fuel and unit type in accordance with the standards in 601-1.

*AIR HANDLER 701-2.7*

**condensate drainage**  
701-2.7a

If the condensate drains improperly, make any changes necessary to ensure proper drainage.

**a-coil**  
701-2.7b

If any holes or cracks are visible in the A-coil, have an EPA-certified technician make repairs.

**fins/filters/ducts**  
701-2.7c

Clean the fins, filters, and ducts as needed. Remove any obstructions.

**temperature rise/drop problem**  
701-2.7d

If the temperature rise/drop is out of the range specified by the manufacturer, determine what the problem is and remedy it. Consult Tables 701-2.7.i and 701-2.7.ii for some possibilities.

**Table 701-2.7.i Typical Solutions for High Temperature Rise**

PROBLEM:	CHECK FOR:	REMEDY:
High Temperature rise Rise[>70° PMI]	<ul style="list-style-type: none"> <li>• Fan speed too slow</li> <li>• Obstruction in duct work</li> <li>• Inadequate returnsSupply ductwork</li> <li>• Blower belt/filter/AC coil defective or dirty</li> <li>• Dirty or defective blower</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed higher or replace motor</li> <li>• Remove obstruction</li> <li>• Install proper ductwork</li> <li>• Clean or replace belt/filter/AC coil</li> <li>• Clean or replace blower</li> </ul>

**Table 701-2.7.ii Typical Solutions for Low Temperature Rise**

PROBLEM:	CHECK FOR:	REMEDY:
Low Temperature Rise [<40° PMI]	<ul style="list-style-type: none"> <li>• Fan speed too fast</li> <li>• Excessive air flow from blower</li> <li>• Cycling on high limit</li> </ul>	<ul style="list-style-type: none"> <li>• Set fan speed slower or replace fan</li> <li>• Adjust air flow or replace blower</li> <li>• Clean or replace blower, install more or larger duct work</li> </ul>

*CONTROLS 701-2.8*

Clean the blower motor, belt, and fan, and/or replace parts, if needed. Lubricate the motor if it is needed.

**blower**  
701-2.8a

Replace or reposition the thermostat, if needed.

**thermostat**  
701-2.8b





State of Ohio  
Weatherization Program  
Standards

Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSTALLATION</b>
Subject	<b>Other Combustion Appliances</b>

*FUEL SUPPLY 701-3.1*

Repair all gas leaks in combustion appliances and in the pipes leading to them. Replace all illegal or defective flexible range connectors.

**gas leaks**  
701-3.1a

Replace shut-off valves to cookstove(s) and other combustion appliances if they are faulty.

**gas shut-off**  
701-3.1b

*OVEN VENT 701-3.2*

If the oven is vented to the outside, repair or replace the vent pipe and fixtures if needed.

**vent to outside**  
701-3.2a

*GAS COOK STOVE EXHAUST FAN 701-3.3*

If there is an existing exhaust fan that is vented to the outside, and it is inoperable or incorrectly installed, repair or replace it.

**exhaust fan, vented to outside**  
701-3.3a

*CARBON MONOXIDE ACTION LEVELS 701-3.4*

Clean and adjust or replace each burner that has a CO level higher than 25 ppm (see section 1506-2).

**stove top burners**  
701-3.4a

The oven test is not necessary if the oven is vented to the outside.

**oven vented to outside**  
701-3.4b

If the oven/broiler is producing 25 ppm or more CO in the ambient air, or 100 ppm or above in the vent (that is not vented to the outside), clean and adjust the oven burners to reduce the CO below these levels (see section 1506-2).

**oven/broiler testing**  
701-3.4c

If the CO output from the oven cannot be reduced to acceptable levels, testing of all other combustion appliances may continue.

**continue testing**  
701-3.4d

**No weatherization work may be started until the problem is corrected.**



**cook stove ventilation**  
701-3.4e



If repeated attempts prove unsuccessful in reducing the CO levels to those specified above, install a properly sized and rated ventilation system to exhaust the CO. Educate the resident on the proper use of the ventilation system.

*CLOTHES DRYERS (ALL ENERGY SOURCES) 701-3.5*

**vent to outside**  
701-3.5a

All clothes dryers shall be vented outside to daylight.

**horizontal vent slope**  
701-3.5b

All clothes dryers that are vented horizontally under a mobile home shall have 1/8" per foot downward slope toward the termination hood.

**dryer vent duct material (rigid-metal)**  
701-3.5c

Dryer vent ducts for clothes dryers must be smooth surfaced, rigid duct, are not to be insulated, is a minimum of 30 gauge galvanized steel or aluminum, and is equipped with a backdraft damper. Run duct with joints in the direction of the airflow. Do not fasten duct with screws or other fasteners that extend into the duct.

**dryer vent duct material (flexible-metal)**  
701-3.5d

Vent clothes dryer with a flexible-metal duct that is approved for use with the applicable energy source. Install it in a manner that minimizes overall length, and is sufficiently supported to eliminate sagging.

**dryer vent duct sizing (rigid-metal)**  
701-3.5e

If the diameter of the dryer vent duct is not at least the diameter of the appliance outlet, install one that is at least the diameter of the appliance outlet. Determine the length of a 4-inch diameter dryer vent duct. The maximum length shall not exceed 25 feet from the clothes dryer outlet to the termination point (a reduction in maximum length of 2.5 feet for every 45-degree bend and 5 feet for every 90-degree bend shall apply).



State of Ohio  
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Section **MOBILE HOME MECHANICAL  
SYSTEMS INSTALLATION**

Subject **Domestic Hot Water**

*FUEL SUPPLY 701-4.1*

Repair leaks in the fuel supply lines. Replacement fuel lines shall be in accordance with the applicable NFPA material code for the fuel type being serviced.

**fuel leaks**

701-4.1a

Use a manometer to check the manifold gas pressure and adjust according to manufacturer's instruction. If unable to locate manufacturer's recommended pressures, it is possible to use 11" water column for LP/propane and 3.25-3.75" water column inches for natural gas. Set oil pump pressure to PMI. With oil burners, it is too important to give a range.

**gas pressure**

701-4.1b

Adjust the gas pressure if the DHW tank is under- or over-fired. Replace the orifice in a propane or natural gas system with the proper sized orifice, if necessary.

**gas orifices**

701-4.1c

*ELECTRICAL POWER SUPPLY 701-4.2*

Repair or replace the main electrical power supply to an electric tank if it is unsafe.

**main power supply**

701-4.2a

Install a properly sized and fused dedicated circuit for the DHW if one is necessary based on wire condition, a history of circuit failure, or if a new unit is to be installed.

**dedicated circuit**

701-4.2b

Replace any wiring in or connected to the heating unit that is charred, frayed, or has damaged insulation. Correct loose or improper wiring connections. Repair or replace defective wiring in, or leading to, the DHW unit in accordance with NFPA 70, the National Electric Code.

**hazardous wiring**

701-4.2c



*DHW UNIT CLEARANCES 701-4.3*

If a combustion-type DHW tank is not located with the required clearance from combustibles PMI, move it to achieve the required distance.

**unit clearances**

701-4.3a

*VENT SYSTEM INTEGRITY 701-4.4*

**damaged/corroded**  
701-4.4a

Repair or replace sections of the venting system that are corroded, rusted, clogged or blocked, contain cracks or holes, and are unsealed, loose or disconnected, PMI, or Part 3280.707 (d) (1) or (2) of HUD Mobile Home Construction and Safety Standards for Energy Efficiency.

**vent connections**  
701-4.4b

Securely fasten vent-to-chimney connections.

*DRAFT 701-4.5*

**draft problems**  
701-4.5a

Correct any vent or combustion appliance zone pressure problem that prevents the proper draft from a combustion DHW tank. Refer to Table 701-4.5 for acceptable draft measurements.

Table 601-1.7 Draft Test Locations and Acceptable Readings

DHW Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		< 20	21-40	41-60	61-80	> 80
Gas Atmospheric Appliances	Flue (after diverter)	-5 Pa	-4 Pa	-3 Pa	-2 Pa	-1 Pa
Gas Power Burners		-.02 w. c."	-.016 w. c."	-.012 w. c."	-.008 w. c."	-.004 w. c."
Oil Burners	Flue (before Barometer Damper) or draft diverter	-15 Pa -.06 w. c."	-13 Pa -.053 w. c."	-11 Pa -.045 w. c."	-9 Pa -.038 w. c."	-7 Pa -.03 w. c."

*COMBUSTION SAFETY & EFFICIENCY 701-4.6*

**CO abatement**  
701-4.6a

Clean, repair, or adjust the DHW burner and fire tube to reduce CO amount in the vent pipe if they are higher than 100 ppm.

**O<sub>2</sub> and stack temperature**  
701-4.6b

Clean, repair, or adjust the DHW burner and fire tube if the O<sub>2</sub> and the net stack temperature readings are not within the acceptable limits according to manufacturer's specifications, or the applicable code, Part 3280.707 (d) (1) or (2) of HUD Mobile Home Construction and Safety Standards for Energy Efficiency.

*WATER TANK CONDITION 701-4.7*

Replace the tank if it is leaking. It may be replaced using HWAP Health and Safety funds.

**tank leakage**  
701-4.7a

If the pressure relief valve and/or the discharge pipe is not present and there is an existing location for them, install them. If the relief valve and/or discharge pipe are not present and there is no existing location for them, install them in the hot water line.

**pressure relief valve/  
discharge pipe**  
701-4.7b

Insulate the DHW tank, unless there is a written warning on the tank stating not to insulate. Do not wrap the tank if there is no pressure relief valve and no way to install one.

**DHW tank insulation**  
701-4.7c

If flame roll-out is occurring, clean and tune the DHW, and retest.

**flame roll-out**  
701-4.7d

Replace the gas valve if it is not functioning properly.

**gas valve**  
701-4.7e

Replace the thermostat if it is not operating properly.

**thermostat**  
701-4.7f

*DHW DISTRIBUTION 701-4.8*

If water lines are leaking, inform the customer and repair the leaks.

**water line leaks**  
701-4.8a

Insulate the first six feet of the hot and cold water lines with foam pipe wrap.

**water line insulation**  
701-4.8b

NOTE: Keep the insulation at a safe clearance from gas or oil vent pipes, if the pipes are near the water lines. Refer to Table 301-4.4 for NFPA Venting Codes.

Repair hot water fixture leaks. If cold water fixtures are leaking, inform the customer, and repair cold water fixture leaks that contribute to moisture problems.

**water fixture leak**  
701-4.8c

CEE

Install appropriate low-flow devices if the customer has agreed.

**low-flow devices**  
701-4.8d

CEE





State of Ohio  
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Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSTALLATION</b>
Subject	<b>Heat Distribution System</b>

*FORCED-AIR DISTRIBUTION SYSTEM 701-5.1*

Clean the blower motor and fan if they are dirty. Replace or tighten the belt if it needs it. Check that the unit is operating properly.

**fan operation/  
condition**  
701-5.1a

Adjust, repair or replace the fan control, as necessary, so that it properly activates the fan.

**fan control**  
701.5.1b

Uncover any blocked registers. Explain to the customer why this is important.

**register blockage**  
701-5.1c

CEE

Test for duct leakage, and locate duct leak sites (see 1506-5) using only the taped duct test.

**duct leakage test**  
701-5.1d

Connect disconnected duct sections and replace missing as well as severely corroded, punctured or crushed duct sections.

**missing or  
disconnected sections**  
701-5.1e

Use hangar straps to eliminate sags in flex duct runs. Rehang flex duct sections in which strapping is constricting the duct and reducing air flow.

**flex duct**  
701-5.1f

If the mobile home has return registers in the floor, close them off, and allow the return air to go directly into the furnace closet where the blower fan is located. Install properly sized louvers in the furnace closet door, or install a louvered door. Block off the floor return opening in the furnace closet.

**return ducts**  
701-5.1g

NOTE: Do not block combustion air inlets (see 1506-7.2).

NOTE: If a central air conditioner is present, be sure that there is enough return air so that the A-coils are not damaged by insufficient return air. If necessary, correctly install additional return air.

**supply ducts**

701-5.1h

Access the supply duct from the under side of the mobile home by cutting an opening in the belly board under the furnace, and at both ends of the supply duct. Seal the furnace-to-duct connection, and both ends of the supply duct. If the mobile home has cross over ducts, seal the cross over sites and the ends of the cross over ducts.

**furnace filter**

701-5.1i

CEE

Remove each register in the living area and seal any gaps between the duct, the register boot, and the floor. Seal any other holes that were discovered in the inspection process.

Change the furnace filter if it is needed. Demonstrate the filter changing procedure to the customer, whenever possible.

*ELECTRIC BASEBOARD DISTRIBUTION SYSTEM*  
*701-5.2*

**heat transfer fins**

701-5.2a

Clean dirty heat transfer fins. Straighten bent fins.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSTALLATION</b>
	Subject	<b>Mechanical Ventilation</b>

*EXISTING EXHAUST FANS 701-6.1*

Install rigid or flexible vent duct to the outside of the house on each exhaust vent fan that is not vented to the outside. Ensure that the vent duct is properly-sized and pitched towards the outside, if possible. Flexible ducts must be installed tightly, with minimal sagging. Dryer vent ducts for clothes dryers must be smooth surfaced, rigid duct and are not to be insulated. Dryer vents must be sloped downward 1/8” towards the termination.

**vent to outside**  
701-6.1a

Install a working damper and tighten or replace any loose connections on the exhaust vent pipe. Install a weather-protective termination fixture if one is not present.

**damper and connection**  
701-6.1b

If the exhaust fan is not operational or effective, repair or replace it if it is needed according to the OVERALLS Scale, Building Tightness Limits, or IAQ needs. If the exhaust fan is not operational or effective, and it is not needed according to the determinations mentioned above, do not work on it.

**determination of need**  
701-6.1c

**The following standards assume that the exhaust fan is needed.**

Use a rigid or flexible duct for any duct replacement and new exhaust fan installation. Use of smooth-surfaced, rigid ducts or non-combustible metal, flexible ducts are needed for clothes dryer vent duct replacements.

**vent duct material**  
701-6.1d

Replace any switch or control that is not operational.

**control**  
701-6.1e

Repair or replace any fan and switch wiring and connections that are improper.

**power to fans**  
701-6.1f

Instruct the customer on the proper use of exhaust fans. Perform a worst-case draft test if units present are not sealed combustion (see 1506-4). Install passive venting if necessary.

**proper use**  
701-6.1g



*NEW EXHAUST FANS 701-6.2*

**proper fan size**  
701-6.2a

Determine the proper fan size PMI in CFM for the area to be ventilated.

**potential need**  
701-6.2b

Install a properly-sized exhaust fan where needed according to the OVERALLS Scale, Building Tightness Limits, or IAQ needs.

**vent duct material**  
701-6.2c

Install rigid or flexible vent duct to the outside of the house on each exhaust vent fan. Ensure that the vent duct is properly-sized and is pitched downward towards the outside, if possible. Flexible ducts must be installed taut.

**termination**  
701-6.2d

Install a weather-protective termination fixture to the outside end of the vent pipe.

**proper use**  
701-6.2e

CEE

Instruct the customer on the proper use of exhaust fans. Perform a worst-case draft test if units present are not sealed combustion (see 1506-4). Install passive venting if necessary.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS INSTALLATION</b>
	Subject	<b>Electrical Efficiency</b>

*FLUORESCENT LIGHTING 701-7.1*

Install screw-in compact fluorescent lighting per manufacturer’s instructions in the fixtures determined by the initial inspection. Never install fluorescent lighting in fixtures with dimmers unless specifically allowed by the bulb manufacturer.

**fluorescent lighting**  
701-7.1a

*OTHER ELECTRIC ENERGY EFFICIENCY IMPROVEMENTS 701-7.2*

The customer's specific needs and habits must be considered in the repair or replacement of efficiency measures. All material installed must be installed PMI and in compliance with local codes.

**improvements**  
701-7.2a

*CONSUMER ENERGY EDUCATION 701-7.3*

Education should be provided concerning such matters as the impact of dirty filters on electric clothes dryers, the impact of dirty coils on refrigerators and freezers, behavior impacts on refrigerator energy use, and the impacts of water leaks on well pumps.

**consumer energy education**  
701-7.3a



*REQUIRED ELECTRIC ENERGY EFFICIENCY MEASURES 701-7.4*

The waterbed cover shall be installed to cover the entire exposed surface of the mattress. The foam must be placed directly on the mattress surface under any and all covers. The thermostat temperature for the appliance must be reduced at the time of installation. Normal operating temperature with the foam insulation in place should be between 70° and 80° F. Foam waterbed covers must be purchased with non-HWAP funds.

**required measures**  
701-7.4a

*REFRIGERATOR/FREEZER REPLACEMENTS 701-7.5*

**install refrigerators/  
freezers**  
701-7.5a

Install refrigerators/freezers per manufacturer's instructions in a location acceptable to the customer.

**recycle old units**  
701-7.5b

Refrigerator and freezers taken out of service must be discarded in an environmentally-sensitive manner. Old appliances contain refrigerant gasses that must be reclaimed only at licensed stations. No appliances taken out of service may be returned to service by sale, barter, or for free.



State of Ohio  
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Section **MOBILE HOME MECHANICAL  
SYSTEMS INSTALLATION**

Subject **Electrical Safety**

*SERVICE ENTRY BOX/CIRCUITS 701-8.1*

Have the electric utility company replace the main electrical supply if it is unsafe.

**main power supply**  
701-8.1a

When needed, replace the main service panel according to the NEC considering amp size, number of circuits, and wire size of circuits.

**main supply panel**  
701-8.1b

Circuit wiring must be installed in conformance to the NEC.

**circuits**  
701-8.1c



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME INSTALLATION</b>
	Subject	<b>Overall Building Shell</b>

*AIR TIGHTNESS TESTING 702-1.1*

Perform a 1 point blower door test. Ensure that the Building Tightness Limits (BTL) minimum level of air leakage is available within the home. Ensure that the home will not be brought below the BTL or that mechanical ventilation of pressure relief is added. Use the blower door as a tool to assist in finding and sealing air leakage sites. Continue to locate and seal air leakage sites until the target reduction goal is met or surpassed. Document valid technical reasons which prevented the target reduction goal from being achieved.

**target reduction level**  
702-1.1a

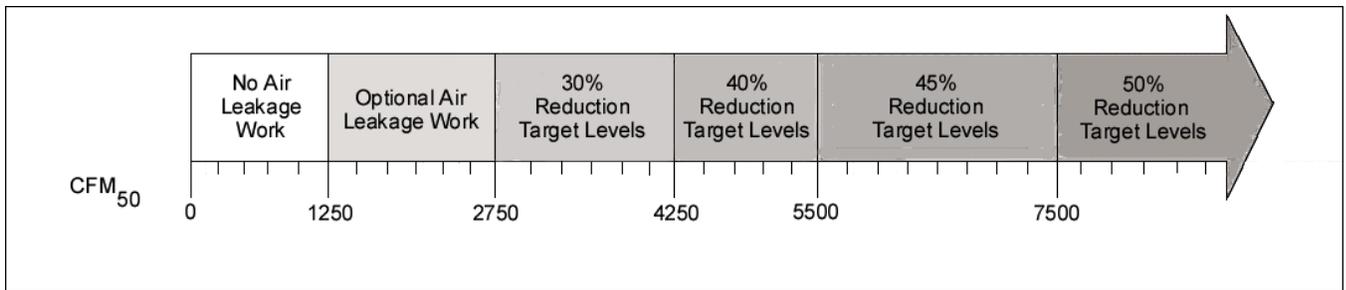
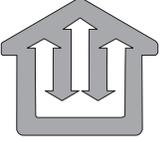


Figure 702.1.1 OVERALLS Scale



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME INSTALLATION</b>
	Subject	<b>Roof</b>

*ROOF REPAIRS 702-2.1*

Make any necessary repairs to damaged roofing materials or structural roofing members.

**roof/structural repairs**  
702-2.1a

Do not add venting to a mobile home roof. Repair missing or damaged flashing, caps, or roof jacks as necessary or appropriate depending on which roof access technique is used.

**venting**  
702-2.1b





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Section **MOBILE HOME  
INSTALLATION**

Subject **Ceiling**

*ELECTRICAL SYSTEM SAFETY 702-3.1*

Correct, or have corrected, electrical problems such as unsafe attic wiring prior to installing ceiling insulation.

**electrical problems**   
702-3.1a

Install proper-sized fuses or breakers prior to installing insulation.

**proper sized fuses/  
breakers**  
702-3.1b

Install shielding around non-insulation contact rated electrical devices such as recessed lights.

**shielding**   
702-3.1c

*PERSONAL PROTECTIVE EQUIPMENT 702-3.2*

Use appropriate personal protective equipment to ensure personal safety. Use work practices which ensure the safety of the residents and the crew.

**personal protective  
equipment**   
702-3.2a

*CEILING 702-3.3*

Repair or replace missing or damaged ceiling sections to hold the weight of added insulation.

**damaged ceiling**  
702-3.3a

Do not install cellulose insulation where it will come in contact with an exposed metal roof.

**exposed metal roof**  
702-3.3b

*ATTIC PREPARATION 702-3.4*

Locate and seal any thermal bypasses or chaseways. Determine how to best deal with ceiling height changes prior to insulating, and use appropriate techniques.

**thermal bypasses**  
702-3.4a

Install a working damper with positive closure on any appliance that exhausts to the outside if one does not exist, or exists but is not in working order.

**exhaust appliances**  
702-3.4b

**blocking around electrical devices**  
702-3.4c



Block around recessed lights without an IC rating and other electrical devices such as fan units. Blocking must be at least as high as the finished insulation product, and must be installed in such a manner so that devices remain accessible for service or maintenance after the insulation is installed. A minimum clearance of 3 inches must be maintained between the fixture and the insulation.

**blocking around metal flue pipes**  
702-3.4d

Block around metal flue pipes and chimneys with fire-rated material maintaining clearance from combustible materials in accordance with NFPA requirements.

**no roof vents**  
702-3.4e

Do not install roof venting in mobile homes. Leave any existing venting as it is.

**damaged structural components**  
702-3.4f

Repair or replace any damaged structural components prior to insulating. Ensure that the ceiling will safely hold the weight of added insulation. Repair or replace any missing, weakened, or damaged ceiling component, using compatible materials. When walking or working on the roof of a mobile home, a walkboard must be used at all times.

#### *CEILING INSULATION 702-3.5*

**ceiling insulation, allowable techniques**  
702-3.5a

If attic insulation is called for, determine which attic insulation technique to use. There are four allowable options: The Side Lift Method, the Interior Method, the Bowstring Truss Roof Method, and the Pitched Shingle or Metal Roof Method.

**side lift**  
702-3.5a.i



- i. Side Lift Method:
  - Remove the gutters, trim, and roof fasteners. It may be necessary to remove plumbing and heating vent stacks.
  - Lift the edge of the roof and slide wedges under it to expose the cavity to be insulated. Use a rigid ABS plastic tube to install the loose fill insulation.
  - When completed, re-secure the roof and all trim, gutters, and stacks. Seal or coat as necessary to prevent moisture from entering the cavity.

**Do not attempt the side-lift method in excessively rainy or windy conditions.**

**interior drilling**  
702-3.5a.ii

- ii. Interior Method:
  - Cover the floors and all furniture with 6 mil polyethylene or drop cloths prior to beginning.

- Drill 2 inch holes in the interior ceiling surface in an adequate number of places to ensure complete insulation coverage.
- Install a flexible tube into the hole to install loose-fill insulation. Block around heat producing devices. NOTE: In addition to covering the floors and furniture, the area where insulation is being installed must be sealed off from the rest of the structure.
- Patch holes with plastic plugs and an acceptable interior sealant.

**interior drilling (con't)**  
702-3.5a.ii

iii. Bowstring Truss Roof

- Center 10" square holes in the middle of the metal roof on top of every other truss to allow access to roof cavities on both sides of the truss. Cut through the metal, taking care to avoid cutting wiring or cutting into or through the roof truss.
- Remove existing roof coating from the area to be cut out *prior* to cutting through the metal roof to provide a clean surface for the new patch to adhere to.
- Install fiberglass insulation through a 2" or a 2 1/2" inside diameter (ID) blowing hose to a density of 1.6 pounds per cubic foot, filling the cavity entirely.
- Apply a patch cut from a compatible material that is 4" larger on each side than the opening (bowstring truss roofs are commonly covered with galvanized sheet metal.) Apply a generous bead of a high quality, copolymer adhesive designed for metal-to-metal bonding to the perimeter of the hole. Center the patch over the hole and secure the patch to the roof with #6 or #8 x 1/2" or 3/4" sheet metal screws. Do not screw patches to the trusses. Do not use sealants such as roof cement or silicone caulk. Trim away excess sealant.
- Apply a layer of rubberized asphalt membrane to the perimeter of the patch with approximately 2" overlapping onto the old roof surface (ensure that the adhesive backed asphalt tape adheres to a clean, dry surface).

**bowstring truss roof**  
702-3.5a.iii

**bowstring truss roof  
(con't)**

702-3.5a.iii

- Apply a coat of elastomeric roof coat (not aluminized roof coating) to the patched area. Check the manufacturer's recommendations for drying requirements.

**pitched shingle or  
metal roof**

702-3.5a.iv

- iv. Pitched shingle or metal roof
  - Verify that the roof pitch is sufficient for roof vents to be installed.

Note any changes in interior ceiling elevation (flat and cathedral ceilings) and record the appropriate measurements. Also, determine, measure and record the location of any exhaust fans that vent through the roof.

- Ensure that exhaust and plumbing venting materials are securely fastened.
- Cut roof vents into one slope of the roof as close to the ridge as possible, spacing them approximately 6' apart.
- Install blown fiberglass into the attic area using a 3" ID hose. Do not fill the area to capacity. Install an even blanket that will allow room for air movement between the top of the insulation and the roof. Ensure complete coverage over the top plate, and against the interior walls where the interior ceiling changes from flat to cathedral.
- Install attic insulation. Place a large piece of fiberglass batting inside the vent hole, to keep the blown insulation from clogging the vent.
- For metal roofing, apply a copolymer adhesive to the perimeter of the hole. Attach the vent with sheet metal screws (# 6 or # 8 x ½" or ¾") spaced every 2-3 inches. Do not screw patches to the trusses. Install a rubberized asphalt membrane prior to applying a neat application of white, elastomeric roofcoating to the perimeter of the vent as an added precaution against water leakage.
- If called for, insulate the attic to the required amount. If using blown-in fiberglass, ensure complete coverage.

**required amount of  
insulation**

702-3.5b

**certificate of  
insulation**

702-3.6a

*CERTIFICATE OF INSULATION 702-3.6*

Post a consumer information card or certificate of insulation which complies with OAC 109:4-3-14 on, or adjacent to, the electric service panel.



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Section	<b>MOBILE HOME INSTALLATION</b>
Subject	<b>Sidewalls</b>

### *HAZARDS 702-4.1*

Correct electrical hazards prior to insulating.

**electrical hazards**  
702-4.1a



Correct problems at flues, gas or oil lines, or fuel tanks prior to insulating. Have any water hazards corrected before insulating.

**exterior hazards**  
702-4.1b



Employ appropriate safety measures before setting up near insect, plant or animal hazards.

**health hazards**  
702-4.1c



Set up ladders in a safe manner. Use padding on ladder ends to prevent damage to mobile home walls.

**ladder safety**  
702-4.1d



### *SIDEWALL CONDITION 702-4.2*

Repair damaged exterior doors, if possible. Replace missing exterior doors.

**doors**  
702-4.2a

Replace missing prime window glass. Repair jalousie windows that do not fully close by installing clips to hold the windows closed. The clips should be fastened to the frame, and be easily disengaged so that the resident may open the window. Do not clip fire escape windows closed.

**windows**  
702-4.2b

Determine the source of and correct any moisture problem in sidewall cavities prior to insulating.

**moisture problem in  
sidewall cavities**  
702-4.2c

Repair or correct any gaps or openings in the sidewall prior to insulating, using compatible materials.

**siding repair**  
702-4.2d

### *SIDEWALL INTERIOR 702-4.3*

Repair or replace damaged or missing drywall, paneling, etc. prior to insulating. Repair or replace damaged or missing baseboard, casing, etc., which could allow insulation to be blown into the house.

**interior wall surface**  
702-4.3a

**interior mechanicals**  
702-4.3b

Locate all wall-mounted outlets and switches prior to beginning insulation work. Locate wall heaters, vent fans and utility runs prior to insulating. Block around electrical and heat producing devices.

**structural repair**  
702-4.3c

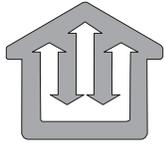
Correct any structural problems prior to insulating.

*INSULATION 702-4.4***appropriate insulation techniques**  
702-4.4a

Determine appropriate sidewall insulation technique(s) and insulate wall cavities, ensuring complete coverage in all cavities. It is not necessary to access the sidewalls above doors and windows. Two methods may be used to insulate sidewall cavities in mobile homes. The first method involves stuffing fiberglass batts into wall cavities. The second involves loosening the siding and blowing loose-fill fiberglass into the cavities. Consider weather conditions (i.e., high winds or heavy rain) prior to performing the insulation of sidewalls on mobile homes.

*CERTIFICATE OF INSULATION 702-4.5***certificate of insulation**  
702-4.5a

Post a consumer information card or certificate of insulation which meets the requirements of OAC 109:4-3-14 on, or adjacent to, the electric service panel.



State of Ohio  
Weatherization Program  
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Section **MOBILE HOME  
INSTALLATION**

Subject **Belly**

*INSULATION PREPARATION 702-5.1*

Observe health and safety regulations, and use proper PPE including, at a minimum, a nuisance dust rated respirator and goggles.

**personal protective equipment**  
702-5.1a

Make repairs to the bellyboard to stop air movement or protect the insulation.

**repair bellyboard**  
702-5.1b

If there is draftproofing, gain access to the underside of the mobile home. Remove any stored items. Draftproofing may not be installed or repaired with HWAP funds.

**draftproofing**  
702-5.1c

Determine the source of any moisture problem, and correct the problem prior to insulating.

**foundation moisture problems**  
702-5.1d

Cut access holes in the belly. Repair or replace all ductwork as necessary, and seal with mastic prior to insulating. Register boots may also need to be sealed from the inside.

**duct repair**  
702-5.1e

If the floor cavity is used as the heating/cooling unit air return, seal off return air registers, and install grill(s) of equal area in the furnace closet door.

**floor cavity/air return**  
702-5.1f

Repair or replace damaged sections of floor, subfloor, or framing as needed.

**damaged floor/framing**  
702-5.1g

If draftproofing exists, install a continuous ground cover vapor barrier, if one is not present. A vapor barrier is not required if draftproofing is not present.

**ground vapor barrier**  
702-5.1h

Install 1 ft<sup>2</sup> of closeable NFVA for every 1500 ft<sup>2</sup> of area enclosed by draftproofing unless the area is well drained and dry.

**foundation vents**  
702-5.1i

Determine the most appropriate insulation installation technique. Insulation may be installed through holes cut in the belly or by drilling the rim joist in an adequate number of places to ensure complete coverage.

**insulation installing techniques**  
702-5.1j

**furring strip stabilizers**  
702-5.1k

If the belly is not rigid, install lath strips or furring strips perpendicular to the floor joists to prevent excessive belly sag.

*INSULATION 702-5.2***insulation amount**  
702-5.2a

Install loose-fill fiberglass between the belly and the floor to a density of 1.6 lbs/ft<sup>3</sup>.

**surface finish**  
702-5.2b

Patch holes in the belly with a compatible material and secure with mechanical fasteners. If installing insulation with a rigid tube through the rim joist, glue wood plugs into the holes after installing the insulation.

*CERTIFICATE OF INSULATION 702-5.3***certificate of insulation**  
702-5.3a

Post a consumer information card or certificate of insulation which meets the requirements of OAC 109:4-3-14 on, or adjacent to, the electric service panel.



State of Ohio  
Weatherization Program  
Standards

Section **MOBILE HOME MECHANICAL  
SYSTEMS FINAL INSPECTION**

Subject **Heating Units**

*APPROVED MOBILE HOME HEATING UNITS 801-1.1*

Determine whether the existing heating unit is approved for use in mobile homes.

**approved unit**  
801-1.1a

*OPERATIONAL UNITS 801-1.2*

Ensure that primary heating unit is operational.

**operational heating  
unit**  
801-1.2a

*FUEL SUPPLY 801-1.3*

Ensure that fuel is available (except for solid fuel units) to begin final inspection.

**fuel availability**  
801-1.3a

Ensure that solid fuel units are UL rated for mobile home use, and are free from heat exchanger leakage, excessive corrosion, and unsafe wiring (when applicable).

**solid fuel heaters**  
801-1.3b

Ensure that all venting materials meet clearances from combustible materials in accordance with the applicable NFPA code.

Use a combustible gas leak detector to ensure that there are no propane or natural gas leaks.

**fuel leakage, gas**  
801-1.3c

Ensure that there are no kerosene or fuel oil leaks.

**fuel leakage, oil**  
801-1.3d

Ensure that heating units are not over- or under-fired. Clock the meter on natural gas units. Calculate the actual Btu input by performing a gas pressure test and measuring the orifice.

**Btu input**  
801-1.3e

*ELECTRICAL POWER SUPPLY 801-1.4*

Ensure that the main electrical power supply to the heating unit is safe.

**main power safety**  
801-1.4a

Ensure that the electrical line to the unit is a dedicated circuit that is properly sized and fused, if called for in the initial inspection.

**dedicated circuit**  
801-1.4b

**safe wiring**  
801-1.4c  
Ensure that all the wiring in or at the heating unit is properly insulated and in good condition, and that there are no improper or loose connections.

*HEATING UNIT CLEARANCES 801-1.5*

**unit clearances**  
801-1.5a  
Ensure that clearances from combustibile materials are in accordance with appropriate NFPA codes.

*VENT SYSTEM VISUAL INSPECTION 801-1.6*

**vent system visual inspection**  
801-1.6a  
Ensure that the vent system extends from the heating unit to the outside of the mobile home, extends to the proper height, and has no holes, cracks, or loose, unsealed or disconnected sections. Ensure that there is no excessive corrosion or rust on the venting.

**vent connections**  
801-1.6b  
Ensure that any vent/chimney connection is securely fastened. Ensure that the connection of the ceiling and the roof jack is completely sealed.

**vent elbows**  
801-1.6c  
Ensure that there are no elbows.

*DRAFT TESTING 801-1.7*

**draft, "worst case"**  
801-1.7a  
Set up and perform the worst case draft test scenario (see 1506-4). Ensure that draft is within acceptable limits.

Table 801-1.7 Draft Test Locations and Acceptable Readings

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		< 20	21-40	41-60	61-80	> 80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa -.02 wc"	-4 Pa -.016 wc"	-3 Pa -.012 wc"	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Gas Fan-Assisted Appliances	Flue (1 1/2 times the diameter of the flue from the flue collar or elbow)	-5 Pa -.02 wc"	-4 Pa -.016 wc"	-3 Pa -.012 wc"	-2 Pa -.008 wc"	-1 Pa -.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa -.06 wc"	-13 Pa -.053 wc "	-11 Pa -.045 wc"	-9 Pa -.038 wc"	-7 Pa -.03 wc"
Gas 90+ Furnace	Exhaust Pipe	PMI	PMI	PMI	PMI	PMI

*COMBUSTION SAFETY AND EFFICIENCY TESTING*

801-1.8

With the heating unit operating, collect a flue gas sample. Ensure that the flue gas CO reading is 100 ppm or less.

**carbon monoxide (CO)**  
801-1.8a

With heating unit operating, use a combustion analyzer to measure and record O<sub>2</sub> and net stack temperature. Ensure that they are within limits of Table 801-1.8.

**combustion analysis**  
801-1.8b

Table 801-1.8 Acceptable Combustion Test Analysis Measurements

Heating Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
<b>GAS</b> (Natural Gas, Propane) Atmospheric	4-9%	300-600 F	N/A	100
Fan-assisted	4-9%	300-480 F	N/A	100
Condensing	PMI	PMI	N/A	100
Space Heaters	5-15%	300-650 F	N/A	100
Standard Power Burner	4-9%	275-550 F	N/A	100
<b>OIL</b>				
Standard Oil Burner	4-9%	325-600 F	1 or less	100
Flame Retention	4-7%	325-600 F	1 or less	100
Condensing	PMI	PMI	1 or less	100

*HEAT EXCHANGER INTEGRITY 801-1.9*

**visual inspection**  
801-1.9a      Ensure that heat exchanger is free of deterioration, cracks or holes.

**carbon monoxide (CO)**  
801-1.9b      Test the distribution system and the ambient air for the presence of CO, and ensure that combustion devices are not producing CO.

**oxygen fluctuation, forced-air systems**  
801-1.9c      During combustion efficiency test on forced-air systems, ensure that there is no fluctuation in the O<sub>2</sub> reading during blower operation. If fluctuation is observed, use an approved method to confirm the existence of a cracked heat exchanger.

**cracked heat exchanger**  
801-1.9d      Ensure that a cracked heat exchanger has been replaced with a new heat exchanger or that a new heating unit has been installed.

*TEMPERATURE RISE 801-1.10*

**measurement**  
801-1.10a      Ensure that the temperature rise is between 40° F and 70° F, or PMI.

*CONTROLS 801-1.11*

**fan control, forced-air units**  
801-1.11a      Ensure that the fan control properly activates the fan.

**high limit control, forced-air units**  
801-1.11b      Ensure that the high limit setting is within applicable code limits and PMI.

**blower operation/condition**  
801-1.11c      Ensure that the blower motor, belt, and fan are clean and operating properly.

**thermostat**  
801-1.11d      Ensure that the thermostat is a proper type for mobile home use and is functioning effectively.



State of Ohio  
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Section	<b>MOBILE HOME MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Electric Heat Pump/ Central Air Systems</b>

*OPERATIONAL UNITS 801-2.1*

Ensure that heat pump, when it is the primary heating unit, is properly operational.

**operational units**  
801-2.1a

Do not test a heat pump when the exterior air temperature is above 70°F.

**heat pump test**  
801-2.1b

Do not test a central air conditioning unit when the exterior air temperature is below 70°F.

**central air conditioner test**  
801-2.1c

*THERMAL FLUID LEAKAGE 801-2.2*

Ensure that any thermal fluid or refrigerant leaks have been corrected by an EPA-certified technician.

**thermal fluid leakage**  
801-2.2a

*ELECTRICAL POWER SUPPLY 801-2.3*

Ensure that the main power supply to the mobile home is safe according to the NEC.

**main power safety**  
801-2.3a

Ensure that the heat pump/AC unit has a dedicated circuit that is properly sized and fused.

**dedicated circuit**  
801-2.3b

Ensure that there is an operating disconnect switch present on an outdoor unit.

**disconnect switch**  
801-2.3c

Ensure that wiring at or in the heat pump/AC unit is not charred, frayed, missing, insulation or has loose or improper connections.

**safe wiring**  
801-2.3d

*UNIT CLEARANCES 801-2.4*

Ensure that the unit has clearance from combustible material that are in PMI.

**unit clearances, indoors**  
801-2.4a

Ensure that the outdoor unit clearances are PMI. Ensure that cooling fins are clean and not obstructed.

**unit clearances, outdoors**  
801-2.4b

*BACK UP SYSTEM INSPECTION 801-2.5*

**back up  
system**  
801-2.5a

Ensure that the back-up system meets appropriate heating unit standards (see 801-1.1).

*AIR HANDLER 801-2.6*

**condensate drainage**  
801-2.6a

Ensure that condensate is draining properly and that there is no puddling or residue present.

**a-coil**  
801-2.6b

Ensure that the A-coil is clean and functional. Ensure that any cracks or holes have been corrected by an EPA-certified technician.

**unobstructed air  
flow**  
801-2.6c

Ensure that air flow is not obstructed.

**temperature rise/  
drop**  
801-2.6d

Ensure that temperature rise or temperature drop of the heat pump/AC unit is within manufacturer's specifications.

*CONTROLS 801-2.7*

**fan-on, fan-off  
switches**  
801-2.7a

Ensure that the fan-on and fan-off switches are functioning correctly.

**thermostat**  
801-2.7b

Ensure that the thermostat functions correctly.



State of Ohio  
Weatherization Program  
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Section	<b>MOBILE HOME MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Other Combustion Appliances</b>

*FUEL SUPPLY 801-3.1*

Ensure that there are no gas leaks at the combustion appliances, or in the pipes leading to them. Ensure that all flexible range connectors are in good condition and functioning properly.

**gas leaks**  
801-3.1a

Ensure that all shut-off valves to cookstove and other combustion appliances are in good condition and functioning properly.

**gas shut-off valve**  
801-3.1b

*OVEN VENT 801-3.2*

If the oven is vented to the outside, ensure that it is vented safely and effectively.

**vent to outside**  
801-3.2a

*GAS COOK STOVE EXHAUST FAN 801-3.3*

If there is an existing exhaust fan that is vented to the outside, ensure that it is properly installed and functioning effectively and safely.

**exhaust fan, vented to outside**  
801-3.3a

*CARBON MONOXIDE ACTION LEVELS 801-3.4*

Ensure that the amount of CO is less than 25 ppm at each burner or that there is a properly sized and rated ventilation system to exhaust the CO (see 1506-2).

**stove top burners**  
801-3.4a

Ensure that the oven is producing less than 25 ppm CO in the ambient air, and less than 100 ppm in the vent (that is not vented to the outside) or that there is a properly sized and rated ventilation system to exhaust the CO.

**oven/broiler**  
801-3.4b

*CLOTHES DRYERS (ALL ENERGY SOURCES) 801-3.5*

Ensure that all clothes dryers are vented outside to daylight.

**vent to outside**  
801-3.5a

Ensure that all clothes dryers that are vented horizontally under a mobile home have 1/8" per foot slope toward the termination hood.

**horizontal vent slope**  
801-3.5b

**dryer vent duct material (rigid-metal)**  
801.3.5c

Dryer vent ducts for clothes dryers must be smooth surfaced, rigid duct, are not to be insulated, is a minimum of 30 gauge galvanized steel or aluminum, and is equipped with a backdraft damper. Ensure the duct is run with the joints in the direction of the air-flow and is not fastened with screws or other fasteners that extend into the duct.

**Dryer vent duct material (flexible-metal)**  
801-3.5d

Determine whether the dryer vent duct is a transition duct used to connect the dryer to the exhaust duct. The transition duct may be flexible-metal duct listed for that application, installed in a manner tht minimizes overall length. The preferred material for transition and exhaust duct is rigid-metal.

**dryer vent duct sizing (flexible-metal)**  
801-3.5e

Ensure the diameter of the dryer vent duct is at least the diameter of the appliance outlet. Ensure the 4-inch diameter dryer vent duct does not exceed the maximum length of 25 feet from the clothes dryer outlet to the termination point. If the length exceeds 25 feet, increase the diameter to 5". (A reduction in maximum length of 2.5 feet for every 45-degree bend and 5 feet for every 90-degree bend shall apply).



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Section	<b>MOBILE HOME MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Domestic Hot Water</b>

### *FUEL SUPPLY 801-4.1*

Ensure that fuel is available to begin the final inspection.	<b>fuel availability</b> 801-4.1a
Ensure that there are no propane or natural gas leaks.	<b>fuel leakage, gas</b> 801-4.1b
Ensure that there is no fuel leaks in kerosene or fuel oil fired DHW units.	<b>fuel leakage, oil</b> 801-4.1c
Ensure that natural gas units are not over or underfired by clocking the meter and calculating the actual Btu input.	<b>Btu input</b> 801-4.1d

### *ELECTRICAL POWER SUPPLY 801-4.2*

Ensure that the main electrical power supply to the unit is safe.	<b>main power safety</b> 801-4.2a
Ensure that the electrical line to the unit is a properly sized and properly fused dedicated circuit if one is needed.	<b>dedicated circuit</b> 801-4.2b
Ensure that wiring at or in the DHW unit is not charred, frayed, missing insulation and has no loose or improper connections.	<b>safe wiring</b> 801-4.2c

### *DHW UNIT CLEARANCES 801-4.3*

Ensure that a combustion-type DHW tank is at the required distance from combustible materials PMI.	<b>unit clearances</b> 801-4.3a
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### *VENT SYSTEM VISUAL INSPECTION 801-4.4*

Ensure that the vent system extends from the DHW unit to the outside of the mobile home, has no cracks, holes or disconnected sections, and has no serious corrosion or rust.	<b>vent system, visual inspection</b> 801-4.4a
Ensure that vent to roof to outside connections are securely fastened.	<b>vent connections</b> 801-4.4b

**elbows** 801-4.4c

Ensure that there are no elbows in the venting.

**combustion air**  
801-4.4d

Ensure that combustion air requirements are properly met.

*DRAFT TESTING 801-4.5*

**draft, "worst case"**  
801-4.5a

Perform the worst case draft test (see 1506-4) and ensure that draft is within acceptable range as specified in Table 801-4.5.

Table 801-4.5 Draft Test Locations and Acceptable Readings

DHW Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		< 20	21-40	41-60	61-80	> 80
Gas Atmospheric Appliances	Flue (after diverter)	-5 Pa	-4 Pa	-3 Pa	-2 Pa	-1 Pa
Gas Power Burners		-.02 w. c."	-.016 w. c."	-.012 w. c."	-.008 w. c."	-.004 w. c."
Oil Burners	Flue (before Barometric Damper) or draft diverter	-15 Pa	-13 Pa	-11 Pa	-9 Pa	-7 Pa
		-.06 w. c."	-.053 w. c."	-.045 w. c."	-.038 w. c."	-.03 w. c."

*COMBUSTION SAFETY AND EFFICIENCY TESTING 801-4.6*

**carbon monoxide (CO)**  
801-4.6a

Perform the CO test as required. Ensure that the CO level in the flue gas is at or below 100 ppm.

**combustion analysis**  
801-4.6b

Perform the combustion analysis test as required. Ensure that O<sub>2</sub> and net stack temperature levels are within limits outlined in Table 801-4.6b.

Table 801-4.6 Acceptable Combustion Test Analysis Measurements

DHW Unit Type	(O <sub>2</sub> ) Oxygen	Stack Temp.	Smoke Test	(CO) Carbon Monoxide Max. ppm
GAS (Natural Gas, Propane) Atmospheric	4-9%	300-600° F	N/A	100
	Fan Assisted	300-480° F	N/A	100
OIL	4-9%	325-600° F	1 or less	100
Flame Retention	4-7%	325-600° F	1 or less	100

*WATER TANK CONDITION 801-4.7*

Ensure that the DHW tank is not leaking water.

**tank leakage**  
801-4.7a

Ensure that an operable pressure relief valve, with the discharge pipe extending through the bottom of the mobile home belly, is present.

**pressure relief valve/  
discharge pipe**  
801-4.7b

Document tanks which have a manufacturer's warning against insulating.

**tank insulation  
warning**  
801-4.7c

Ensure that DHW tank has been insulated, if required.

**tank insulation**  
801-4.7d

Ensure that the DHW tank temperature has been lowered, when possible, without affecting the customer's lifestyle.

**temperature setting**  
801-4.7e

Ensure that no flame roll-out occurs when the gas-fired DHW unit is activated.

**flame roll-out**  
801-4.7f

Ensure that DHW gas valve is working properly.

**gas valve**  
801-4.7g

Ensure that the thermostat is operating properly.

**thermostat**  
801-4.7h

*DHW DISTRIBUTION 801-4.8*

**water lines**  
801-4.8a

Ensure that the water lines leading to and from the DHW tank are not leaking.

**water line insulation**  
801-4.8b

Ensure that the first 6 feet of hot and cold water lines are insulated and that clearances from combustion sources are maintained.

**fixture leaks**  
801-4.8c

Ensure that there are no leaks in the hot water fixtures. Ensure that leaks in cold water fixtures have been corrected, if the leaks contribute to moisture problems.

**low-flow devices**  
801-4.8d

Ensure that low-flow devices are installed in the shower and sink fixtures if called for by the initial inspection.

**consumer energy  
education**  
801-4.8e

CEE

Ensure that the customer is provided with consumer energy education regarding DHW management.

 <p>State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME MECHANICAL SYSTEMS FINAL INSPECTION</b>
	Subject	<b>Heat Distribution System</b>

*FORCED-AIR DISTRIBUTION SYSTEM 801-5.1*

Ensure that the blower motor and fan are clean and operating properly. Ensure that the belt is tight.

**fan operation/  
condition**  
801-5.1a

Ensure that the fan control properly activates the fan.

**fan control**  
801.5.1b

Ensure that none of the registers are blocked. Ensure that there are no open ducts or registers either exhausting heat or drawing in return air from outside the heated area. Ensure that the customer knows why it is important that registers are not be blocked.

**register blockage**  
801-5.1c

CEE

Test for duct leakage using only the taped duct method (see 1506-5) to ensure that the ducts do not leak.

**duct leakage test**  
801-5.1d

If flex duct is used, ensure that straps are not restricting air flow.

**flex duct**  
801-5.1e

If the mobile home had return registers in every room, ensure that they are closed off, and the return air is allowed to go directly into the furnace closet where the blower fan is located. Ensure that the furnace closet has louvers in the door, or there is a louvered door there which provides sufficient return air. Ensure that the floor return opening in the furnace closet is sealed closed.

**return ducts**  
801-5.1f

NOTE: Do not block combustion air inlets.

Ensure that supply ducts were sealed, if specified.

**supply ducts**  
801-5.1g

Ensure that the furnace filter is clean and effective, and that the customer knows how to change it.

**furnace filter**  
801-5.1h

CEE

*ELECTRIC BASEBOARD DISTRIBUTION SYSTEM*  
*801-5.2*

**heat transfer fins**  
801-5.2a

CEE

Ensure that the baseboard distribution system is in good working condition. Ensure that the heat transfer fins are clean and not bent. Ensure that the customer has been informed about the importance of keeping the fins clean and that the heaters should not be blocked with furniture or other objects.



State of Ohio  
Weatherization Program  
Standards

Section **MOBILE HOME MECHANICAL  
SYSTEMS FINAL INSPECTION**

Subject **Mechanical Ventilation**

*EXHAUST FANS 801-6.1*

Ensure that there is an operable exhaust fan system if it is needed according to the OVERALLS Scale, Building Tightness Limits, or indoor air quality (IAQ) needs.

**effectiveness**  
801-6.1a

Ensure that all exhaust fans are properly vented to a weather-protective termination fixture located on the outside of the house, either through an attic or sidewall, by means of rigid metal (no vinyl) ductwork. This ductwork must be insulated with at least an R-6 material or buried under the attic insulation, and if possible, pitched toward the outside. Flexible duct must be installed tightly, so that minimal sagging occurs. Dryer vent ducts for clothes dryers must be smooth surfaced, rigid duct and are not to be insulated.

**venting and  
termination**  
801-6.1b

Ensure that the exhaust vent system has a working damper and tight connections on the exhaust vent pipe.

**damper and  
connections**  
801-6.1c

Ensure that the fan and switch wiring and connections are effective and in good condition.

**wiring**  
801-6.1d

Ensure that the switch or the control for the exhaust fan is operable.

**control**  
801-6.1e

Ensure that the exhaust fan is properly sized PMI in CFM for the area to be ventilated.

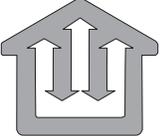
**proper fan size**  
801-6.1f

Ensure that the customer knows how to properly use the exhaust fan. Ensure that passive venting has been installed, if needed.

**proper use**  
801-6.1g

CEE



	<p>State of Ohio Weatherization Program Standards</p>	<p>Section <b>MOBILE HOME MECHANICAL SYSTEMS FINAL INSPECTION</b></p>
		<p>Subject <b>Electrical Efficiency</b></p>

### *FLUORESCENT LIGHTING 801-7.1*

Ensure that screw-in, compact fluorescent lighting was installed per manufacturer's instructions in the fixtures determined by the initial inspection. Ensure no fluorescent lighting was installed in fixtures with dimmers unless specifically allowed by the bulb manufacturer.

**fluorescent lighting**  
801-7.1a

### *REFRIGERATOR/FREEZER REPLACEMENTS 801-7.2*

Ensure that refrigerators/freezers were install per manufacturer's instructions in a location acceptable to the customer.

**refrigerators/freezers**  
801-7.2a

Ensure refrigerators and freezers taken out of service were discarded in an environmentally- sensitive manner. Ensure that old units were reclaimed only at licensed stations. Ensure that no units taken out of service were returned to service.

**old units**  
801-7.2b

### *OTHER ELECTRICAL ENERGY EFFICIENCY MEASURES 801-7.3*

Ensure that all materials have been installed PMI and in compliance with local codes. Ensure that the benefit expected in the estimation (repairing water leaks to reduce well water pump operation) has been achieved.

**improvements**  
801-7.3a

### *REQUIRED MEASURES 801-7.4*

Ensure that the foam insulation blanket is installed to cover the entire exposed surface of the mattress and that it is placed directly on the mattress surface under any and all covers. Ensure that the thermostat temperature for the appliance is reduced to between 70° and 80° F with the customer's permission. Ensure that they have been purchased with non-HWAP funds and installed.

**waterbeds**  
801-7.4a

*CONSUMER ENERGY EDUCATION 801-7.4*

**consumer energy  
education**  
801-7.4a

CEE

Ensure that education has been provided concerning such matters as the impact of dirty filters on electric clothes dryers, the impact of dirty coils on refrigerators and freezers, behavior impacts on refrigerator energy use, and the impacts of water leaks on well pumps.



State of Ohio  
Weatherization Program  
Standards

Section	<b>MOBILE HOME MECHANICAL SYSTEMS FINAL INSPECTION</b>
Subject	<b>Electrical Safety</b>

*SERVICE ENTRY BOX 801-8.1*

Ensure the main service entry box is properly mounted in an appropriate location (away from dampness and other hazards).

**location of box**  
801-8.1a

Ensure the main service entry box is properly grounded according to the NEC.

**grounding**  
801-8.1b

Ensure existing wire types, and that the location and condition of each type is hazard free.

**type of wiring**  
801-8.1c

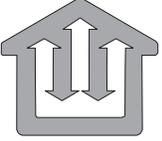
Ensure the existing fuses/breakers are properly sized for their circuits.

**fuse/circuit size**  
801-8.1d

Ensure that a copy of the Certificate of Insulation is present at the service box if applicable.

**certificate of insulation**  
801-8.1e



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME FINAL INSPECTION</b>
	Subject	<b>Overall Building Shell</b>

*VERIFICATION 802-1.1*

Ensure that any additions have been documented and inspected.

**additions**  
802-1.1a

Ensure that fire escape windows have not been sealed shut. Ensure that jalousie windows operate correctly, or have clips added if they do not.

**windows**  
802-1.1b

Ensure that prime doors are present and operate correctly.

**doors**  
802-1.1c

Ensure that drainage problems, if any, have been corrected or documented.

**drainage**  
802-1.1d

Ensure that a continuous ground vapor barrier is in place if there is existing draftproofing.

**vapor barrier**  
802-1.1e

Ensure that combustion air intake is operational and not obstructed.

**combustion air intake**  
802-1.1f

Perform a final blower door test (see 1506-1) and compare it with the results of the Building Tightness Limits calculation. Decide if additional ventilation equipment needs to be installed to assure safe indoor air quality.

**blower door test**  
802-1.1g

Ensure that a distribution system leakage test is performed and that the results are acceptable.

**Distribution System  
Leakage Test**  
802-1.1h

Ensure that the BTL minimum level of air leakage is available within the home.

**target reduction**  
802-1.1i





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Weatherization Program  
Standards

Section	<b>MOBILE HOME FINAL INSPECTION</b>
Subject	<b>Roof</b>

*ROOF ELEMENTS 802-2.1*

Ensure that roof is in sound condition.

**roof condition**  
802-2.1a

Ensure that roof caps and flashing are correctly installed and watertight.

**watertight flashing**  
802-2.1b

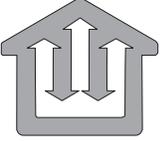
Ensure that any chimney functions properly. Ensure that all chimney components are sound.

**chimney**  
802-2.1c

Ensure that gutter and other drainage components are in place and that no moisture damage is occurring.

**drainage elements**  
802-2.1d



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>MOBILE HOME FINAL INSPECTION</b>
	Subject	<b>Ceiling</b>

*ELECTRICAL SYSTEM SAFETY 802-3.1*

Ensure that any unsafe wiring problems have been corrected. Ensure that any aluminum wiring is not nicked, loose or exposed.

**wiring**  
802-3.1a

Ensure that electrical devices have the required safety clearance shielding.

**clearance shielding**  
802-3.1b

Ensure that circuits are properly fused. Explain to the customer the importance of properly fused circuits.

**fuse size**  
802-3.1c

CEE
-----

*CEILING 802-3.2*

Ensure that interior moisture problems have been corrected.

**interior ceiling  
moisture problems**  
802-3.2a

Ensure that the ceiling is safely supporting the insulation.

**ceiling support**  
802-3.2b

Ensure that the connection of the ceiling and the flue vent is completely sealed.

**seal connection**  
802-3.2c

*INSULATION 802-3.3*

Ensure that the proper amount of insulation was installed in the roof cavity.

**insulation amount**  
802-3.3a

Ensure that there are no holes or gaps left in the insulation.

**complete coverage**  
802-3.3b

Ensure that attic insulation has not drifted into inappropriate areas, such as around recessed lights.

**blocking verification**  
802-3.3c

Ensure that attic insulation is not obstructing any existing open vents. Ensure that no roof venting was installed.

**vents**  
802-3.3d

Ensure that any damaged trusses or other attic structural members have been repaired or replaced.

**damaged trusses**  
802-3.3e

**moisture in insulation**  
802-3.3f

Ensure that there is no moisture in the attic insulation.

**proper finish**  
802-3.3g

Ensure that any building components removed, lifted or drilled, for the installation of attic insulation, have been returned to proper condition.



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Section	<b>MOBILE HOME FINAL INSPECTION</b>
Subject	<b>Sidewalls</b>

*ELECTRICAL SAFETY 802-4.1*

Ensure that any bare, frayed or other improper wiring has been corrected. Pay particular attention to mobile homes which have aluminum wiring.

**electrical wiring**  
802-4.1a



*EXTERIOR INSPECTION 802-4.2*

Ensure that doors and door components have been repaired or replaced, if specified.

**doors**  
802-4.2a

Ensure that missing glass has been replaced and that windows and window components have been repaired, if specified.

**windows**  
802-4.2b

Ensure that any moisture problem affecting the sidewalls has been addressed.

**moisture problems**  
802-4.2c

Ensure that siding panels have been properly reattached if they have been removed or loosened for the addition of sidewall insulation. Ensure that any missing siding has been replaced.

**siding panels**  
802-4.2d

Ensure that stick-built additions have received sidewall insulation, if required.

**additions**  
802-4.2e

*INTERIOR WALL SURFACES 802-4.3*

Ensure that switchbox and outlet covers and any interior trim removed to install sidewall insulation have been properly reinstalled.

**outlet covers/trim**  
802-4.3a

If there are primary air leakage sites, ensure that any missing or deteriorated interior wall surfaces have been repaired or replaced.

**repair**  
802-4.3b

Ensure that the clothes dryer is vented to the outside with an operable positive damper. Ensure that the vent fans have an operable positive damper.

**clothes dryer**  
802-4.3c

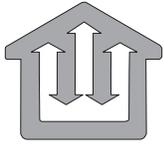
**ceiling height changes**  
802-4.3d

Ensure that areas of ceiling height changes, dropped soffits, etc., have been properly addressed.

*SIDEWALL INSULATION 802-4.4*

**insulation**  
802-4.4a

Ensure that sidewall insulation is installed correctly and effectively.



State of Ohio  
Weatherization Program  
Standards

Section **MOBILE HOME  
FINAL INSPECTION**

Subject **Belly**

*UNDER THE MOBILE HOME 802-5.1*

Ensure that draftproofing was not installed or repaired with HWAP funds.

**draftproofing**  
802-5.1a

Ensure that holes in the bellyboard have been patched to stop air movement effectively.

**patched bellyboard**  
802-5.1b

Ensure that moisture problems under or around the mobile home have been corrected, if possible.

**ground moisture/  
drainage**  
802-5.1c

Ensure that any crawlspace that is enclosed with draftproofing has a 6 mil polyethylene vapor barrier installed effectively. If there is excessive moisture present, ensure that adequate closeable venting is present.

**ground vapor barrier**  
802-5.1d

Ensure that insulation has been installed to the proper density, and that there is complete coverage.

**insulation/proper  
density**  
802-5.1e

Ensure that water and sewage lines have been treated, as necessary.

**water/sewer**  
802-5.1f

Ensure that the duct system has been thoroughly sealed.

**duct system**  
802-5.1g

Ensure that combustion air intakes are not blocked or obstructed.

**combustion air  
intakes**  
802-5.1h

Ensure that all exhaust appliances are exhausted to the outside and have positive dampers.

**exhaust fans**  
802-5.1i





State of Ohio  
Weatherization Program  
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Section	<b>ADMINISTRATION</b>
Subject	<b>General</b>

### GENERAL 901

No multi-family project may commence without the prior written approval for the project from OEE.

**prior approval**  
901-1.1

Weatherization work shall be performed in the entire building provided the building is qualified based on applications that meet HWAP Policies & Procedures 66% eligibility guidelines.

**eligibility**  
901-1.2

All buildings falling within the scope of this section of the WPS (MULTI-FAMILY/HIGH-RISE BUILDING - 4 OR MORE STORIES ABOVE GRADE, OR CENTRALLY-HEATED BUILDINGS WITH 5 OR MORE UNITS) are by definition commercial buildings, and as such are covered by the Ohio Basic Building Code (whether jurisdiction is granted to a local building department or remains with the State Division of Buildings and Factories). All required permits and certifications of plans and specification and inspections must be acquired and documentation must be available in the customer file.

**permits**  
901-1.3

All audits, including EA-QUIP, must consider the interactive effects of retrofits. Audit procedures must calculate the savings-to-investment ratio using the following calculation for life cycle costs:

**audit parameters**  
901-1.4

$$D_{\text{life}} = E * P/C_f * \sum_{i=1}^L \left( \frac{I_i}{(1+d)^i} \right)$$

Where,

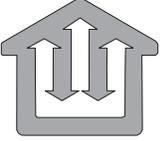
- $D_{\text{life}}$  = discounted dollar savings of each EEM over its lifetime
- $E$  = the first year estimated energy savings of the EEM
- $P$  = unit price of energy saved by the EEM
- $C_f$  = conversion factor for the fuel price
- $L$  = life of each EEM in years
- $I_i$  = energy price index for the i'th year
- $d$  = fractional discount rate.

**audit parameters**  
**cont'd 901-1.4**

The  $c_f$  factor merely provides consistency of units between the savings and energy prices. For an example, if the first year savings,  $E$ , is in kWh and the fuel price,  $P$ , is in \$/kWh, then  $c_f$  would equal 1 since no conversion of energy units is necessary.

Energy price indices currently (1999) are as follows:

$i$	$I_i$	$i$	$I_i$
1	1.00	15	0.95
2-6	1.01	16	0.95
7	1.00	17-20	0.93
8-9	0.99	21-22	0.92
10-11	0.98	23-24	0.91
12-13	0.97	25-26	0.90
14	0.96		

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Expenditure Level/Budgeting</b>

*EXPENDITURE LEVEL/BUDGETING 902*

Landlords must contribute financially based on current HWAP policies and procedures.

**landlord contribution**  
902-1.1

Only EEMs with a SIR of 1 or greater may be performed.

**cost-effectiveness**  
902-1.2

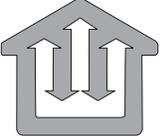
Any contracted work must be reflected in the contractor materials and labor sections of the current Grantee/Provider Management Plan.

**management plan**  
902-2.1

A budget amendment must be approved prior to any contracted work if no plans exist.

**budget**  
902-2.1a



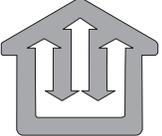
 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Method</b>

*METHOD 903*

The provider must choose if it will maintain control of the entire project or if it will contract out any or all of the following steps. The provider may elect to follow either the provider method or the contracting method.

**choose method**  
903-1.1



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
	Subject	<b>Provider Method</b>

*PROVIDER METHOD 904*

All work must be cost justified using the EA-QUIP auditing tool

**EA-QUIP**  
904-1.1

A person certified to use the EA-QUIP auditing tool must perform the inspection of the building.

**certified personnel**  
904-1.2

All applicable EEMs specified in the audit must be evaluated regardless of the agency's ultimate ability to complete the energy efficiency measures.

**all energy efficiency  
measures evaluated**  
904-1.3

EEMs must be performed in order of their cost-effectiveness, from highest to lowest SIR.

**order of performance**  
904-1.4

For those allowable energy efficiency measures outside the provider's abilities to perform the work, the provider must contract with another party to perform the work before going on to other energy efficiency measures.

**perform or contract**  
904-1.5

For any EEM contracted out, the provider must follow the applicable procedures listed in section 905 .

**contracting**  
904-1.6

Any contracted work must follow the procurement/contracting rules for the expenditure level of the work to be contracted out.

**procurement**  
904-1.7



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>ADMINISTRATION</b>
		Subject	<b>Contracting Method</b>

### *CONTRACTED METHOD 905*

Once the provider has determined that the project will proceed, it may begin searching for an architectural, engineering, or mechanical contracting firm to bid on: 1) auditing services, 2) providing plans and specifications, 3) contract management, 4) materials installation, or 5) any or all of the above.

**contracted method**  
905-1

A Request for Qualifications (RFQ) should seek information on the expertise of a firm and determine whether the firm is interested in bidding on the various aspects of upcoming projects. The RFQ should give the potential bidder an idea of what specifications will be imposed on the project. A RFQ should result in the development of a list of bidders.

**request for  
qualifications (RFQs)**  
905-2

All procurement must follow the appropriate procurement rules for the level of the cost of the services to be performed. Large purchases (those over \$5,000) must always follow the Request for Proposals (RFP) formal bidding guidelines. Specific services (auditing, plans and specifications, etc.) may be bid separately. If the same firm bids on several aspects of a project, or if several projects will be considered during the same program year, the rules governing aggregation of costs must be followed.

**request for proposals/  
procurement rules**  
905-3.1a

A comprehensive energy analysis must be performed on each building in order to determine the feasibility of entering into an agreement to provide for the installation and implementation of EEMs at the building.

**feasibility/energy  
analysis**  
905-3.1.b

Any request for proposals must include with the description of the project a notification that all applicable codes must be followed, that all permits are required for the customer file, and that all life/safety codes will be adhered to.

**notification/codes**  
905-3.1c

Any request for proposals must include with the description of the project a notification that all work must be cost-justified using an approved energy auditing tool. The energy auditing tool must consider the following and must evaluate the interactive effects of the various EEMs.

**notification/auditing  
tool**  
905-3.1d

**EEMs**  
905-3.2

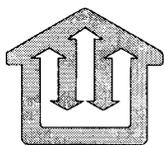
EEMs are of three general types: 1) general weatherization, including insulation retrofits, air sealing, window and door repair and replacement, 2) heating/cooling system retrofits including zone controls and thermostat installation, burner tune-up and replacement, boiler replacement, and 3) electrical EEMs including the lighting retrofits, motor, pump and fan replacements (HVAC, elevators, etc.) and appliance replacements (non-HWAP-funded).

**notification/audit  
parameters**  
905-3.3a

Any RFPs must include with the description of the project a notification that the SIR calculations embedded in the audit must incorporate the current DOE fuel escalation rates and must evaluate the discounted lifetime savings using the current HUD discount rate.

**notification/report  
contents**  
905-3.3b

Any RFPs must include with the description of the project a notification that the firm will perform the analysis and prepare a detailed engineering report that specifically identifies the energy efficiency measures and operational changes and maintenance changes that are recommended to be installed or implemented at the building. The report shall contain detailed projections of energy and cost savings to be obtained by the buildings' energy purchaser as a result of the installation of the recommended EEMs and shall itemize all anticipated project, operational and maintenance costs. The report shall describe the firm's plan for installing or implementing the measures at the building. The primary purpose of the report is to provide an engineering basis for negotiating an energy services agreement between the HWAP and the firm.



State of Ohio  
Weatherization Program  
Standards

Section	<b>ADMINISTRATION</b>
Subject	<b>Prioritization Standards</b>

*TASKS AND ANALYSIS FOR PREPARING THE REPORT*  
906

The firm selected to perform the audit shall thoroughly evaluate utility, energy, water and sewage costs, and consumption, demand and time-of-use data in order to properly evaluate the economics of specific energy efficiency measures and to formulate an accurate energy/demand baseline. The baseline shall be weather-normalized using a heating degree-day adjustment factor and shall be based on at least 12 months, but preferably 2 years of utility data.

**energy consumption  
and facility data**  
906-1.1

The firm shall compile and deliver to the HWAP provider an inventory based on a physical inspection of the major electrical, plumbing, HVAC and other mechanical systems, as well as building shell systems including:

**inventory existing  
systems and  
equipment**  
906-1.2

- a. cooling and cooling distribution systems and related equipment,
- b. heating and heat distribution systems,
- c. automatic temperature control systems and equipment,
- d. outdoor ventilation systems and equipment,
- e. exhaust systems and equipment,
- f. domestic hot and cold water systems,
- g. electric motors, transmission and drive systems,
- h. interior and exterior lighting,
- i. water usage equipment,
- j. rated and performance insulation values at walls, floors, and attics; and
- k. estimated natural infiltration rate for all buildings.

The firm shall evaluate the following data for performing the inventory:

**inventory data**  
906-1.3

- a. the actual loads, proper sizing, operating efficiency, and hours of operation for each system,
- b. a list of major air leakage sites and description of how natural infiltration was estimated,
- c. current operating condition for each system,
- d. remaining useful life of each system (exclusive of premature equipment failure),

## OWPS 906 ADMINISTRATION—Tasks and Analysis for Preparing Report

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<b>inventory data (cont'd)</b> 906-1.3	<ul style="list-style-type: none"><li>e. a catalog of current indoor air quality and comfort problems in the buildings; and</li><li>f. an evaluation of feasible replacement/upgrades to address the efficiency, indoor air quality and comfort concerns that were identified.</li></ul>
<b>survey</b> 906-1.4	<p>The firm shall work with the HWAP provider and the building management to develop a questionnaire to be used in conducting interviews with building operation and maintenance staff regarding the mechanical systems operation, occupancy and building-use patterns and problems with comfort levels or equipment reliability as defined and identified by the operation and maintenance staff. It is expected of the building management that all systems such as those listed above shall be fully disclosed to the firm.</p>
<b>list energy efficiency measures</b> 906-2.1	<p>The firm shall:</p>
<b>diagnostic testing</b> 906-2.1a	<p>Perform diagnostic testing on a representative sample of buildings and equipment to determine current building performance. This sample will not exceed 10% of apartments or individual heating systems, but will include 100% of central heating systems. These tests shall include combustion appliance zone testing for back drafting potential:</p> <ul style="list-style-type: none"><li>1) standard and worst-case draft testing,</li><li>2) blower door testing to determine infiltration,</li><li>3) pressure testing for connections between apartments, apartments and attics, and apartments and crawl spaces,</li><li>4) combustion efficiency analysis; and</li><li>5) carbon monoxide ambient and flue gas testing.</li></ul> <p>Tests shall be performed in accordance with the WPS Section 1506.</p>
<b>identify EEMs</b> 906-2.1b	<p>Identify potential EEMs for installation or implementation at the building, including potential solutions for indoor air quality and comfort concerns.</p>
<b>estimate costs</b> 906-2.1c	<p>Estimate the EEM costs, including an itemized listing of design, engineering, installation and hardware costs and any other costs outlined below;</p>

1. dollar, consumption, and demand savings on a monthly basis,
  2. life expectancy of each proposed EEM.
- estimate costs (cont'd)**  
906-2.1c

Data shall be presented by measure and in total, in terms showing interaction of measures. The firm shall provide life-cycle cost, net present value and savings-to-investment ratios for each energy efficiency measure and for the EEM package as a whole.

**describe maintenance procedures**  
906-2.1d

Specify and describe impacts on building operations and maintenance procedures that will be affected by the installation/implementation of the proposed EEMs.

**estimates of project cost**  
906-3.1

The firm shall provide detailed estimates of all costs and energy savings associated with the project, including, but not limited to:

- a. engineering/design costs
- b. contractor/vendor estimates for EEMs (labor, materials, equipment)
- c. construction management
- d. maintenance/monitoring services
- e. commissioning
- f. training
- g. estimated financing costs
- h. estimated monitoring services
- i. savings guarantee options and costs

The preliminary audit report shall include all items outlined in Section 906. The firm will present this report to the HWAP provider at a meeting at a date and location to be determined by the HWAP provider. At this meeting, the firm will work with the HWAP provider, in consultation with OEE staff, to rapidly finalize chosen measures EEMs.

**the audit report**  
906-4.1



 <p>State of Ohio Weatherization Program Standards</p>	Section <b>HIGH-RISE/CENTRALLY HEATED MULTI-FAMILY INSPECTION</b>
	Subject <b>General Information</b>

*GENERAL INFORMATION 1001-1.1*

Determine the following inputs for use in the EA-QUIP audit. Where the data is listed, use only that value for the audit. An asterisk (\*) denotes required information for input for EA-QUIP.

**EA-QUIP inputs**  
1001-1.1a

- a. maximum expenditure (\$)\*
- b. economic time horizon (years)..... 20\*
- c. real discount rate (%)..... 4.7\*
- d. space heating energy type\*
- e. domestic hot water energy type\*
- f. consider switching to gas?\*
- g. actual heating degree-days (degdays)\*
- h. actual yearly energy use (gal/ccf/kWh)\*
- i. actual base energy use (gal/ccf/kWh)\*
- j. actual yearly electricity use (kWh)\*
- k. energy price per unit (\$/gal/ccf/kWh)\*
- l. heating energy price escalation rate (%)\*
- m. electricity price (\$/kWh)\*
- n. electricity price escalation rate (%)\*

EA-QUIP

Collect the following general information. See the EA-QUIP instruction manual for specific requirements or allowable answers for each field.

**general information**  
1001-1.2a

- a. dwelling ID/location\*
- b. city for weather data\*
- c. terrain\*
- d. shielding\*
- e. ground surface\*
- f. number of heated floors\*
- g. number of dwelling units\*
- h. average heated space per floor (sqft)\*
- i. ceiling height (feet)\*
- j. dwelling mass\*
- k. average public space per floor (sqft)\*
- l. type of public lighting\*
- m. average public wattage per floor (watts)\*
- n. cooling equipment\*

EA-QUIP





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Air Leakage Measurements**

*AIR LEAKAGE MEASUREMENTS 1001-2*

Collect the following information concerning the blower door measurements (where applicable):

**blower door  
information**  
1001-2.1a

EA-QUIP

- a. infiltration measured\*
- b. mechanical ventilation\*
- c. blower door type\*
- d. pressurization/depressurization\*
- e. inside temperature (degf)\*
- f. outside temperature (degf)\*
- g. low flow rings on\*
- h. a or b ring installed\*
- i. test number\*
- j. house pressure (pa)\*
- k. fan gauge (pa or cfm)\*
- l. flow (cfm)\*
- m. flow goal (cfm)\*

Determine the ventilation supplied to the building. Conditioned living areas require 15 cfm/person or 0.35 air changes per hour, which ever is greater. Office areas require 20 cfm per person. Reference the Ohio Basic Building Code (OBBC), Mechanical Code for ventilation air requirements and estimated occupant loads per area. Reference the Ohio Basic Building Code (OBBC) for ventilation air requirements for passive or natural ventilation air areas.

**ventilation/occupants**  
1001-2.2a

Where an approved indoor air quality method for controlling air contaminants is implemented in the ventilation system design, the minimum required rate of outdoor air shall be in accordance with section 6 of the "ASHRAE 62, Ventilation for Acceptable Indoor Air Quality".

**existing indoor air  
quality (IAQ) system**  
1001-2.2b

Use a commercially-available volumeter or pressure pan with a calibrated hole (see attachment) to determine the airflow at each outlet of the mechanical ventilation system.

**testing**  
1001-2.2c

Reference the Ohio Basic Building Code, Mechanical Code for ventilation air requirements for mechanical rooms, elevators, commercial kitchens, etc.

**mechanical room  
ventilation air**  
1001-2.2d





State of Ohio  
Weatherization Program  
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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Distribution System**

*DISTRIBUTION SYSTEM 1003*

Determine the type of distribution system\*:

**type of distribution  
system**

1003-1

EA-QUIP

- a. 1-pipe steam w/o vents
- b. 1-pipe steam w/vents
- c. 2-pipe steam w/o vents
- d. 2-pipe steam w/vents

**steam**

1003-1.1

- a. number of risers
- b. no. radiator/riser valves to be replaced
- c. condition of master venting
- d. no. radiator/riser vents to be replaced

**steam risers and valves**

1003-1.1a

EA-QUIP

- a. hot water
- b. forced air
- c. gravity air
- d. in room

**other types**

1003-1.2

EA-QUIP

- a. total uninsulated pipe/duct length (ft)\*
- b. avg uninsulated pipe/duct diameter (in)\*

**pipe insulation**

1003-2

EA-QUIP

Determine the type of heating controls or thermostatic valves and note the following:

**controls**

1003-3

EA-QUIP

- a. Outdoor Temp Sensor\*
- b. Indoor thermostat(s)\*
- c. Thermostatic Valves\*
- d. Outdoor & Indoor Temp Sensors\*
- e. Outdoor Sensor/Bad Indoor Sensor\*
- f. None

Determine the condition of Sensor/Controls. Inspect/determine each of the following:

**condition**

1003-3.1

EA-QUIP

- a. modulating aquastat\*
- b. heating day thermostat setting (degf)\*
- c. heating night setting (degf)\*
- d. percent of dwelling out of balance (%)\*
- e. avg out-of-balance temperature (deg f)\*
- f. location of imbalance \*





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Domestic Hot Water**

*DOMESTIC HOT WATER 1004*

Inspect or determine the following:

- a. avg daytime occupants in dwelling\*
- b. avg night occupants in dwelling\*
- c. total daily hot water use (gal/day)\*
- d. number of showers\*
- e. type of shower heads/flow restrictors\*

**occupant information**

1004-1

EA-QUIP

Determine the water heater type:\*

- a. Gas - no insulation
- b. Gas - insulated
- c. Gas-insulated w/storage
- d. Oil - no insulation
- e. Oil - insulated
- f. Electric - no insulation
- g. Electric - insulated
- h. Propane Heater
- i. Tankless Coil
- j. Heat Pump

**water heater type**

1004-2.1

EA-QUIP

Determine/inspect for the following:

- a. consider separate hot water heater\*
- b. estimated summer efficiency (%)\*
- c. hot water temperature (degf)\*
- d. total length of uninsulated hw pipe (ft)\*
- e. average hot water pipe diameter (in)\*

**other information**

1004-2.2

EA-QUIP





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Appliances**

*APPLIANCES 1005*

Determine the number and type of each of the following:

**appliances**  
1005

EA-QUIP

- a. dryer type\*
- b. stove/oven type\*
- c. typical refrigerator type\*
- d. average annual refrigerator usage (kWh)\*
- e. number of refrigerators to be replaced\*
- f. determine the typical refrigerator type:
  1. Manual defrost & freezer
  2. Automatic defrost & freezer
  3. Manual defrost & separate freezer
  4. Automatic defrost & separate freezer
  5. None





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Lighting**

### *LIGHTING 1006*

Determine the incandescent watts/unit to be replaced.

**incandescents lamps**  
1006-1.1

Survey and note all interior lighting fixtures. Note the location, existing wattage and number of bulbs per fixture and whether this is common lighting or tenant lighting. Determine the hours per day the fixture is on from interviewing the client.

**survey existing  
lighting**  
1006-1.2a

Using the information gathered and the replacement chart (see 1506-6), determine which bulbs may be replaced and note that on the inspection form.

**determine  
replacements**  
1006-1.2b

The customer's specific needs and habits must be considered in the replacement decision. Light quality must not be compromised. Fluorescent bulbs must not be installed in fixtures equipped with dimmers unless the bulb manufacturer specifically allows for it.

**customer needs**  
1006-1.3a

Lumen output at the lamp should be sufficient to assure these illuminance levels *at the working surface*.

**lumen output**  
1006-1.3b

<u>Activity</u>	<u>Foot-candle Level</u>
General or ambient lighting	5-20
Task lighting (non-critical)	20-50
Reading or close work	50-100

Lumen output is measured at 1 foot from the source and is the total output in all directions. Foot-candles measured at the surface considers light output, distance from the light source and reflectance of the surrounding surfaces.

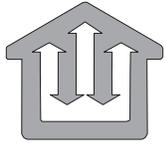
Approximate lumen output of incandescent lamps.

<u>Watts</u>	<u>Lumens</u>
42	505
54	800
62	870
77	1190
92	1620
100	1750

**consumer education**  
1006-1.4

Consumer education must be provided concerning matters such as:

- a. Fluorescent bulbs are most cost-effective in applications where the light remains on for long periods of time.
- b. Fluorescent bulbs may take 60-90 seconds to reach full brightness.
- c. Fluorescent bulbs last approximately 10 times longer and are therefore beneficial in hard to reach places.
- d. Fluorescent bulbs are applicable where safety is an issue, such as fixtures where incandescent bulbs exist that are overrated for the wattage of the fixture and therefore create a fire hazard.



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Section	<b>HIGH-RISE/CENTRALLY HEATED MULTI-FAMILY INSPECTION</b>
Subject	<b>Other Electrical Energy Efficiency Measures Improvements</b>

*OTHER ELECTRICAL ENERGY EFFICIENCY  
MEASURE IMPROVEMENTS 1007*

All electric energy efficiency measure improvements paid for using HWAP dollars must have a material cost of \$150 or less per unit or less. Only improvements determined to be cost-effective using EA-QUIP may be installed. Savings potential must be documented and usage levels of the pre-existing condition should be metered if at all possible. Those electric energy efficiency measure improvements paid for using other funds must meet the applicable cost-effectiveness test described in 1506-6.

**funding**  
1007-1

For any heated waterbed, add (or have the customer add) a foam insulation blanket directly above the water filled mattress. Replace any halide torchier lamp with a fluorescent torchier.

**required electric  
energy efficiency  
measures**  
1007-2





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Section	<b>HIGH-RISE/CENTRALLY HEATED MULTI-FAMILY INSPECTION</b>
Subject	<b>Refrigerator/Freezer Replacement</b>

*REFRIGERATOR/FREEZER REPLACEMENT 1008*

Survey and note each existing refrigerator and freezer. Note the location and meter the existing wattage for at least 2 hours.

**survey existing  
appliances**  
1008-1.1a

Using the information gathered and the replacement chart (see 1506-6), determine which units can be replaced and note that on the inspection form.

**determine  
replacements**  
1008-1.1b

The customers' specific needs and habits must be considered in the replacement decision. Observe the existing appliance and discuss with the customer whether downsizing of the replacement appliance is appropriate.

**customer needs**  
1008-1.1c

Refrigerator and freezers taken out of service must be discarded in an environmentally-sensitive manner. Old appliances contain refrigerant gasses that must be reclaimed only at licensed stations. No appliances taken out of service may be returned to service by sale, barter, or for free. Disposal/recycling costs are to be added to the replacement cost and considered in the cost-effectiveness testing.

**recycle old units**  
1008-1.1d





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Section	<b>HIGH-RISE/CENTRALLY HEATED MULTI-FAMILY INSPECTION</b>
Subject	<b>Above Grade Walls</b>

*ABOVE GRADE WALLS 1009*

For each above grade wall, inspect for/determine the following:\*

**general information**  
1009-1

- a. name of wall.
- b. wall orientation.
- c. azimuth of north face (degrees)

EA-QUIP

**NOTE:**

Azimuth is the compass direction the house faces. It is used to calculate the solar energy that falls on each window and wall. Depending on the house orientation, enter:

- 0 if the north wall of the house faces exactly north;
- 10 if it faces 10 degrees east of north;
- 20 if it faces 20 degrees west of north;
- and so on, up to 45 or down to -45.

Allowable responses for Wall TYPE:

1. 2x2 Wood
2. 2x3 Wood
3. 2x4 Wood
4. 2x6 Wood
5. 8" Concrete
6. 8" Concrete & Brick
7. 8" Brick
8. 12" Concrete
9. 12" Concrete & Brick
10. 12" Brick
11. Block & Brick
12. Block; Cavity & Brick
13. 8" Brick & air space
14. 12" Brick & air space
15. Shared w/Garage

**wall type\***  
1009-2.1a

EA-QUIP

wall insulation\*

1009-2.1b

EA-QUIP

1. insulatable wall thickness (in)\*
2. north wall area (sqft)\*
3. east wall area (sqft)\*
4. south wall area (sqft)\*
5. west wall area (sqft)\*
6. air leakage through wall\*
7. area of any hole in wall (sqin)\*



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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Windows**

*WINDOWS 1010*

For primary, rooftop, or other windows, inspect or determine the following:

- a. name of windows\*
- b. window orientation\*
- c. window type\*
- d. number of glazings\*
- e. curtains & blinds\*
  - allowable responses for curtains & blinds:
    - none
    - drapes
    - shades or blinds
    - curtains & shades
    - outside shutters
    - shades & shutters
    - curtains & shades & shutters
- f. average sash fit\*
- g. physical condition of frame\*
- h. cracks between frame & wall\*
- i. area of any holes in windows (sqin)\*
- j. window area (sqin.)\*
- k. number of: \*
  - north windows
  - east windows
  - south windows
  - west windows
- l. December solar exposure\*
  - east (%)
  - south (%)

**general information**  
1010-1.1

EA-QUIP





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject **Exterior Doors**

*EXTERIOR DOORS 1011*

For entrance, rooftop, basement, storm doors, vestibule or other doors, inspect for or determine the following: **general information**  
1011-1.1

- a. door type\*  
allowable responses for door type:  
plain (hinged)  
sliding  
French  
hatched  
fixed
- b. door material\*  
allowable responses for door material:  
wood solid core  
wood hollow core  
hollow metal  
glass w/metal or wood frame  
steel (solid)  
steel w/mineral fiber core  
steel w/urethane foam core  
steel w/polystyrene core
- c. door fit\*
- d. door area (sqft)\*
- e. approximate glass area (%)\*

EA-QUIP





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSPECTION**

Subject  
**Attic/Roof**

*ATTIC/ROOF 1012*

Inspect for and determine the following:

**roof/attic information**  
1012-1

- a. roof type
  - allowable responses for roof type:\*
    - flat roof
    - unfinished attic
    - finished attic
    - pitched roof
- b. insulation type\*
  - allowable responses for insulation type:
    - no insulation
    - user-specified r-value
    - fiberglass batts
    - fiberglass loose
    - fiberglass boards
    - cellulose fill
    - uf-foam
    - polyurethane boards
    - rock wool
    - polystyrene boards
    - vermiculite fill
- c. insulatable air space (in)\*
- d. roof area (sqft)\*
- e. number of rooftop windows\*
- f. number of rooftop doors\*
- g. number of leaking penetrations\*
- h. water leakage through roof\*
- i. portion of roof to be replaced (%)\*
- j. roof top material\*
  - allowable responses for roof top material:
    - asphalt shingles or sheeting
    - built-up
    - metal
    - rubber
    - slate
    - tar & gravel
    - wood shingles
    - Spanish tiles
- k. roof color\*

EA-QUIP





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Section	<b>HIGH-RISE/CENTRALLY HEATED MULTI-FAMILY INSPECTION</b>
Subject	<b>Basements</b>

*BASEMENTS 1013*

Inspect for and determine the following:

- a. basement type:\*
  - basement
  - crawlspace
  - slab-on-grade
  - platform
- b. basement insulation\*
  - allowable responses for base insulation:
  - no insulation
  - fiberglass batts
  - fiberglass loose
  - fiberglass boards
  - cellulose fill
  - uf-foam
  - polyurethane boards
  - polystyrene boards
  - vermiculite fill
- c. floor area (sqft)\*
- d. no. of floor penetrations\*
- e. base wall insulation\*
- f. above-grade height (ft)\*
- g. exterior perimeter (ft)\*
- h. number of windows\*
- i. number of doors\*
- j. number of leaky penetrations\*
- k. air leakage through base\*
- l. area of windows to be sealed (sqft)\*
- m. r-value of window seal (f-sqft/btuh)\*

**basement information**

1013-1.1

EA-QUIP





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Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSTALLATION**

Subject **Mechanical Systems Installation**

*MECHANICAL SYSTEMS INSTALLATION 1101*

Licensed mechanical contractors must perform all mechanical system installations, tune-ups and repairs. All work performed on mechanical systems must be approved by the authority having jurisdiction and must be authorized by permit.

**permits/licensing**  
1101-1





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Section	<b>HIGH-RISE/CENTRALLY HEATED MULTI-FAMILY INSTALLATION</b>
Subject	<b>Building Shell</b>

*BUILDING SHELL 1102-1*

See illustrations HR - 1 through 7, I - 1 through 7, C - 1 and 2, and LR - 1 through 9 (see 1102-1).

Note: Each illustration may have information that is valuable whatever the category of building.

**air leakage/high-rise  
residential**  
1102-1.1

Provide for continuity of the air/vapor barrier. Guided by a blower door or smokegun, air seal the following:

**air/vapor barrier**  
1102-1.1a

1. Gypsum board at roof slab, floor and around perimeter of sliding patio door.
2. Wall/roof junctions at drain scuppers, and at other mechanical equipment including vent stacks located on the roof.
3. All basement, corridor and parking garage penetrations made vertically through floor or horizontally through walls.
  - a. Plumbing and duct penetrations in corridors and behind fire hose cabinets.
  - b. Junctions between block walls.
  - c. In cavity wall construction at the parapet, around perimeters of windows, and at exhaust vents and soffits.
  - d. Where mechanical and electrical services penetrate the roof.
  - e. At expansion joints.
  - f. In cavity wall construction at intermediate slab and low roof junctions.

**SPECIAL NOTE:** *The following clauses are applicable to all window types e.g. vinyl, wood, and metal, for high-rise residential buildings. See HR - 1 through 7 in 1102-2.*

**window retrofit  
(replacement  
windows)**  
1102-1.1b

1. Ensure the continuity of the air and vapor seal between wall and window frames in accordance with the requirements of the 3/10/97 draft of ASTM E06.51.11 "Standard Practice for Installation of Windows and Doors", and CSA A440.4 "Window and Door Installation" standard.

**roof/wall joints**  
1102-1.1c

*SPECIAL NOTE: The following clauses are applicable to existing or new high-rise residential buildings with flat metal deck roofs to prevent uncontrolled air leakage. See HR -1, 2, 4, 5, 6, 7, C -1, 2 in 1101-2.*

Inspect the roof perimeter for air leakage paths such as the fluted deck, truss and structural beam penetrations above and below the top of the wall, open mortar joints, and conduit and pipe penetrations. Use a blower door and/or smoke guns to identify and locate leakage.

- a. Use an air-impermeable material such as foam sealant or other material or in combination with foram to create a continuous seal between the wall and the roof air/vapor barrier.
- b. Where deck flutes run perpendicular to the wall, seal the open flutes completely out to the fascia.
- c. Where closed flutes occur, punch flutes and inject foam through holes. Locate holes as close to all as possible so that the plane of injected and cured foam within the closed flute is level with the plane of the exposed foam in the open flutes.
- d. Where the steel deck is parallel in the wall, fill the void with either one component or two component materials, depending on gap size.

**air sealing/low-rise residential**  
1102-1.2

Reduce air leakage into and out of building(s) by sealing gaps, leaks and holes in interior and exterior surfaces. Provide for continuity with the air/vapor barrier, guided by a blower door or smokegun (see LR - 1 through 9 in 1102-2).

**cleaning**  
1102-1.3

Clean and repair surfaces soiled or damaged by work performed in accordance with this section. Remove excess sealant with a recommended solvent. Remove debris and surplus materials upon completion of work.

**baseboard sealing with caulking or foam**  
1102-1.4

Roll away any carpet or provide suitable masking to protect adjacent surfaces from spillage.

Seal the top of baseboards to the wall and seal both edges of other trim such as quarter round, or, if baseboards are removed, apply a uniform and continuous bead of sealant in the first floor/wall joint. Place a sealant bead at floor/sole plate joint.

For gaps wider than 25mm (1 in.), apply one bead at the sole plate/floor joint and one bead at the sole plate/wall joint.

**sealing door trim**  
1102-1.5

Apply sealant and joint fillers according to manufacturer's instructions.

Form the surface of the sealant with a full smooth bead, free from ridges, wrinkles, sags, air pockets, and embedded impurities. Neatly tool the surface to a slight concave joint.

Apply the sealant to the joints between the door trim and the wall finish, between the door trim and the doorframe or jamb, at all joints in the trim, and on all sides including the sill in the schedule, if they are determined to be leaking.

Clean adjacent surfaces immediately and leave the work area neat and clean. Remove excess sealant.

See C-2, HR-1, 5, 7, LR-4 in 1102-2.

Run a continuous bead of sealant around the gap between the window trim and the wall. Adjust the width of the bead according to the size of the gap.

**sealing window trim**  
1102-1.6

Run a needle bead into the trim miter joints, where required. Similarly, run a needle bead into any gap between the trim and the window frame. Remove excess sealant and wipe clean.

Remove the cover plates.

**sealing electrical receptacles**  
1102-2.7

Apply a thin bead of caulking to back of an outlet/switch plate gasket, and stick the gasket to the wall, over the electrical outlets/switch plate. Ensure that caulk effectively seals the flanges at top and bottom of receptacle.

Re-install the receptacle over plates.

Locate all services such as pipes, electrical wiring, stacks, plumbing and heating lines, and ductwork that may penetrate the attic ceiling(s), sidewalls, foundation walls and floor(s).

**locate service penetrations**  
1102-1.8

Seal Penetrations using caulking (See HR - 2, 3, 4, 5, 6) in 1102-2:

**seal penetrations**  
1102-1.9

- a. If the gap around the service penetration is 6mm (1/4") or less, apply a uniform and continuous bead of sealant in the gap.
- b. If the average gap around the service line is greater than 6mm (1/4"), use single component polyurethane foam.

**weather-stripping a hinged wood or metal door**

1102-1.10

Measure all the dimensions of the jambs and sill, and pre-cut the weather-stripping.

**baseboard heaters**

1102-1.11

Apply the weather-stripping to prepared surfaces in accordance with the manufacturer's instructions.

Remove all baseboard heaters to expose the floor/wall crack as well as the wire penetrations servicing the heater.

- a. Switch off the power at fuse box.
- b. Remove screws holding the heater against wall and pull heater forward.
- c. Seal the floor/wall gap.
- d. Seal electrical wire penetrations through the wall.
- e. Re-install the baseboard heater.
- f. Be careful not to push the sealant into the wall cavity with the electrical wire.
- g. Switch on the power.

**weatherstrip and tighten casement and awning (metal and wood)**

1102-1.12

These techniques apply to casement, hopper, and awning windows. To keep the descriptions as simple as possible, the techniques described below refer only to outward opening units. The techniques assume the window has a wood frame, although with minor modifications, the techniques will apply to wood-frame windows clad in vinyl.

**GAPS OF 6.0 MM (1/4") OR LESS**

- a. Install weather-stripping. Apply it to the window stop on all sides of the window.

- b. At the corner, cut the ends of the weather-stripping at an angle to allow for a tight fit and a continuous seal.

**GAPS GREATER THAN 6.0 MM (1/4")**

- a. Install weather-stripping on the frame so that it makes contact with the edge of the sash.

**weather-strip  
moveable sash of hung  
window**  
1102-1.13

Three locations require weather-stripping:

- a. Between the checkrails.
- b. Between the bottom rail and sill on a lower sash (or the top rail and head jamb of an upper sash).
- c. Between the stiles and the side jamb.

Balloon frame wall construction leaves very large air passages between each floor joint and into the stud cavity, which may be open to the attic space. Foam as well as caulking materials must usually be used to effectively control air leakage at the main floor header.

**control air leakage at  
a balloon framewall**  
1102-1.14

Foamed-in-place polyurethane foam may be used as an alternative to the sealing procedure just described.

- a. Stuff a piece of glass fiberglass batt up into the stud cavity just above the header area. This will act as temporary blocking to stop the flow of foam into the stud cavity.
- b. Foam the joint between the exterior sheathing and the studs and the joint between the sheathing and the sill plate.
- c. Apply sealant or foam to the exterior sheathing across the top of the header space. As the foam is setting up, apply additional foam to it to create a block at the top of the header cavity. Perform a visual inspection to ensure proper coverage
- d. Once all of the header spaces have been sealed, apply a continuous bead of sealant or foam to the joint between the sill plate and the top of the foundation.

**sill plate: all situations**  
1102-1.14.1

Seal the entire length of the joint between the sill plate and the top of the foundation wall. If the joint is wide, install the appropriate sized backer material along the entire sill length first. Apply a high-solids content butyl-rubber or polysulphide sealant or single-component foam to the joint around the top of the entire length of the foundation wall.

**where fire stops block stud cavity at main floor level**  
1102-1.14.2

- a. Apply a bead of sealant to the joints between the exterior sheathing and the studs reaching as high as possible into the stud cavity. Apply sealant to the joint between the exterior sheathing and the sill plate.
- b. Apply sealant around the entire perimeter of each fire stop to complete the air leakage control measures.

**control air leakage at box sill main floor headers**  
1102-1.14.3

Apply appropriate sealants to the following areas:

- a. Apply a uniform and continuous bead sealant to the joint between the top of the foundation wall and bottom of the sill all of the way around the foundation. Where necessary, install backer material before applying the sealant.
- b. Workings within each box sill header area seal all visible joints. Apply a uniform continuous bead of sealant at the joints between:
  - the header and the seal plate,
  - the header and the sub floor,
  - the header and the joists; and
  - the joists and the sill plate, including the little bank under each joist.

On the end walls, where the wall runs parallel to the floor joists, seal the header area at the joists between:

- the sill plate and the top of the foundation wall,
- the header and the sill plate; and
- the header and the sub floor.

- c. Apply a uniform and continuous bead of sealant to joints around the main support beam where it meets the foundation wall, sill plate, and end joists.
- d. Single-component foam can be used in any or all of the above-mentioned areas to seal.

If the space above the foundation is large enough to work in with a caulking gun (perhaps with an extension nozzle), then an adaptation of the box sill technique can be used. Check the joints between the header and the foundation and between and the joists and the foundation. If the gaps are wider than 6mm, install single component polyurethane foam.

**control air leakage at  
cast-in or beam-in-fill  
joists**

1102-1.14.4

Apply sealant to the joints between:

- the header and the sub floor,
  - the header and the joists; and
  - the joists and the sub floor.
- a. If the space between the foundation and the sub floor is crack size, install backer material where needed and apply a continuous bead of sealant along all joints, including the areas under the joist where it meets the foundation.
  - b. If the space is large – up to 100 mm – the cavity can be completely filled with a one-part or two-part urethane foam sealant.
  - c. Seal joints between the joists and the concrete using urethane foam, or sealant.
  - d. Apply a uniform and continuous bead of sealant to joints around the main support beam where it meets the foundation wall, sill plate, and end joists.

Party walls are a potential attic air leakage site. Common walls often have an air space either in the form of an uninsulated cavity or between the wall finish and a masonry fire separation. These spaces are often open to the basement and allow heated house air to easily escape into the attic. Party walls can be sealed either at the top or bottom, but both are preferable.

**party walls**

1102-1.15

- a. Seal party walls at the bottom similar to balloon frame sills and headers.
- b. To seal from the attic usually requires the use of single- or two-component foam, depending on gap size.
  - Remove insulation from the party wall area.
  - Install sealant uniformly along entire length of wall where it enters the attic.
  - Replace insulation carefully.

**floor drain sealing**  
1102-1.16

In some instances, air leakage may be detected from floor drains. There is also the possibility of radon to enter the building through floor drains. Therefore, it is necessary to be able to seal this opening with a Dranjer.

- a. Remove the floor drain cover from the hole.
- b. Clean the rim of the hole.
- c. Lay a bead of caulking compound around the rim of the hole.
- d. Hold the Dranjer and the cover plate together so that their centers are aligned and the cover plate is on top. Allow enough slack in the rubber flange of the Dranjer so that it hangs down about 12.5 mm (1/2").
- e. Lower the Dranjer and the cover plate back into the hole. Push the floor drain cover plate back into position, pinching the rubber flange of the Dranjer underneath it as shown in Figure 4.
- f. Stand on top of the floor drain plate to set it firmly.
- g. Trim off the surplus rubber around the edge of the flange with a knife.
- h. Leave a heavy weight on top of the floor drain cover plate until the caulking compound has dried.
- i. Pour about one pint of water into the drain to fill the Dranjer.

Note: If dirty water flows routinely through the Dranjer, deposits may stop the sliding ring seal from working properly. Regular cleaning of the Dranjer will prevent this. Provide owner/customer education.

Remove all insulation from around the chimney and inspect the structure. Look for a wood frame running around the chimney.

**chimneys, brick or  
factory-built metal**  
1102-1.17

- a. Check that the space between the wood frame and the chimney is clear of combustibles and that the wood frame is at least 50 mm (2") away from the chimney.
- b. Clear all dust and debris from around the chimney using rags. Clean all surfaces to which the sealant will be applied.
- c. Apply a thin bead of high-temperature silicone sealant along the top of the wood frame surrounding the chimney.
- d. Cut strips of sheet metal or drywall (1/2") to fit around the chimney. Nail (or screw) these in place on top of the sealant bead, so they butt tightly to each other and against the chimney.

Apply muffler cement or another non-combustible sealant to the sheet metal or drywall joints and to the joints between the metal or drywall and the chimney.

- e. Apply silicone sealant to the joints in the wood frame around the chimney.
- f. Replace the original insulation up to the sheet metal.

These aren't ESPs. In addition to the air leakage gap around the electrical conduit itself, there is the gap between the electrical conduit and the electrical cable running inside the conduit. Special sealant must be used when sealing the electrical cable.

**electric service  
penetrations**  
1102-1.18.1

- a. If there is a large gap around the duct, pipe, etc., install single-component foam.
- b. If the duct, pipe, etc., passes through a wood header, or concrete wall, seal the gap (in order of preference), with silicone or single component foam.

**general**  
1102-1.18.2

If the service conduit is easily accessible where it passes through the foundation wall or header, seal it using the general techniques above, if the conduit passes through the foundation wall straight into the back of the service panel, making the air gap inaccessible from the inside. Apply the above sealing techniques outside of the foundation wall.

**electrical service inlets**  
1102-1.18.3

Where applicable, remove the cover plate from the exterior service entrance. Apply sealant around cables to make an airtight seal, using an approved sealant type such as Uxseal. Note: Great caution should be taken when working in this area. All local codes and regulations should be followed. In some jurisdictions, only licensed persons can perform this work.

**seal attic hatch**  
1102-1.19

If the attic hatch trim is easily removed, apply a uniform and continuous bead of sealant to the joint between the ceiling surface and the frame of the attic hatch. Re-install the trim using finishing nails.

If the trim is not easily removed, seal the joints between the trim and the ceiling and between the trim and the attic hatch frame. Seal the corner joints in the trim and in the attic hatch frame.

- a. Apply a self-adhesive closed-cell foam weather-stripping material to the top of the surface of the framework, that supports the hatch cover. Ensure that the corners of the weather-stripping fit tightly.
- b. Glue a piece of rigid insulation to the hatch cover. Be sure to use an adhesive compatible with the insulation material. Alternatively, construct a wood frame around the hatch cover and install a glass fiber insulation batt within the frame. Cover the frame and insulation with a plywood top.
- c. Attach some sort of clamp or lock to the hatch cover and frame. The device, when installed, should be able to pull the hatch tightly into the weather-stripping material, thereby providing a better seal.

**seal heating duct**  
1102-1.20

This work is carried out beneath the floor, if accessible. It applies to both warm air and return air ducts.

- a. Apply mastic to all joints in the ducts, including joints between the ducts and the sub floor, as shown. Staple the duct tape to the sub floor.

Locate the partition walls from a map showing the floor below. Remove or brush aside the attic insulation from above the walls. Use a small brush or whiskbroom to clear all cracks of insulation or debris.

**partition and  
perimeter walls with  
top plates**  
1102-1.21

- a. Apply a uniform and continuous bead of caulking sealant and/or one or two component polyurethane foam, along the entire length of the partition wall on both sides of the top plate.
- b. Replace the original insulation.

Weather-strip the door perimeters. Weather-strip the meeting rails of the double doors. This will be fastened to the exterior face of both doors and provide a seal from top to bottom through adjustment and butting of the finseal pile tongues.

**double commercial  
doors** 1102-1.22

If cutting of the metal components is necessary to accommodate the handles and locks, the cut edges shall be smoothed and the gaps sealed using silicone caulking of the appropriate color.

Remove existing weather-stripping.

Measure sides and top of doorframe and cut pieces of weather-stripping to match.

**overhead garage doors**  
1102-1.23

Install weather-strip with screws into wood jambs and use ramset for metal jambs.

Door bottom seals will be a bubble seal with aluminum holder fastened on the bottom edge of the door.

Weatherstrip operable sections of chutes and inspection hatches with open cell foam tape with adhesive backing. Reinforce adhesive backing with contact adhesive.

**attic hatches (garbage  
chutes, inspection  
hatches, service  
hatches)**  
1102-1.24

- a. Install weatherstripping on doors of chute and hatches as per metal so that upon closing a positive seal is achieved on all sides.
- b. Seal metal frames of chute and hatch which to surrounding wall surface with caulking sealant.
- c. Wipe off excess sealant.

**elevator cable  
penetrations**  
1102-1.25

These are operating elevators and therefore must be shut down before any work is started.

- a. Clean floor and frame areas around cables.
- b. Install good quality aluminum duct tape across the opening, being sure not to touch cable.

Apply enough tape to provide solid seal that will not blow off due to elevator operation.



State of Ohio  
Weatherization Program  
Standards

Section **HIGH-RISE/CENTRALLY HEATED  
MULTI-FAMILY INSTALLATION**

Subject  
**Illustrations**

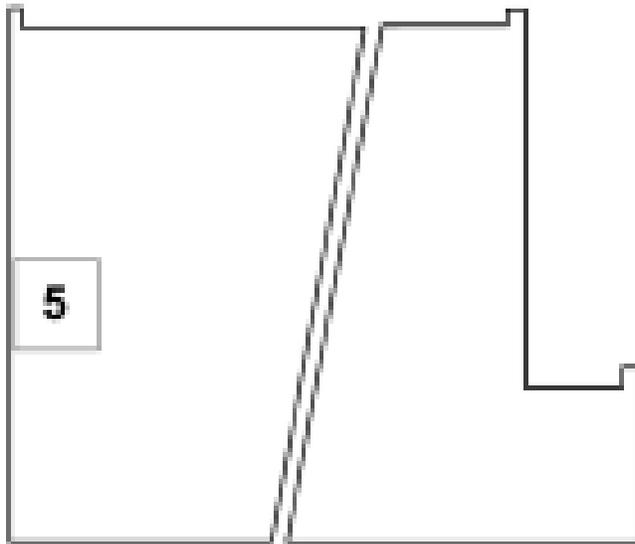


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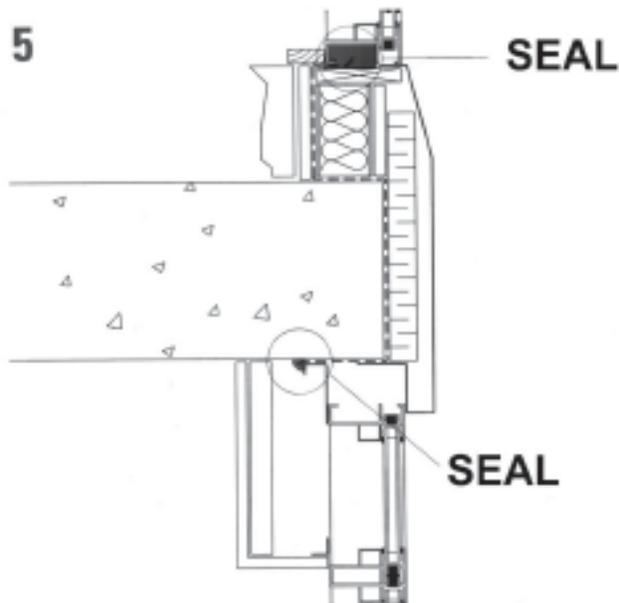


Illustration C-5

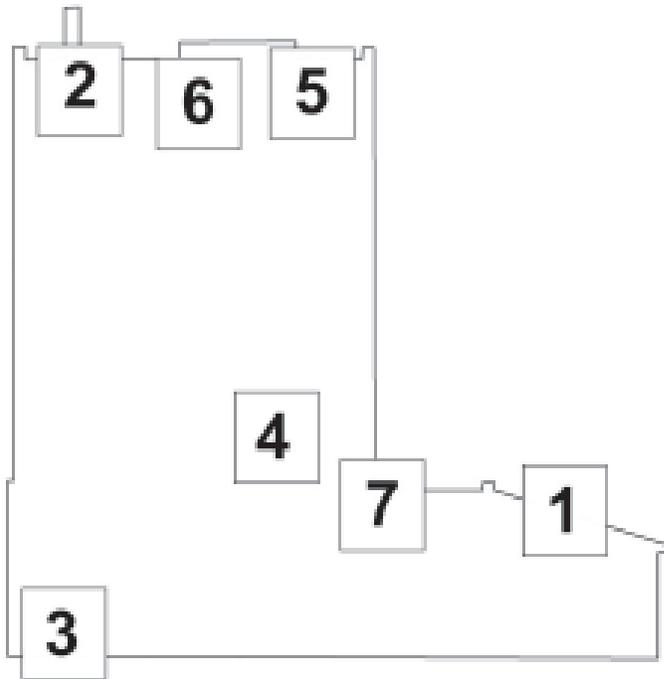
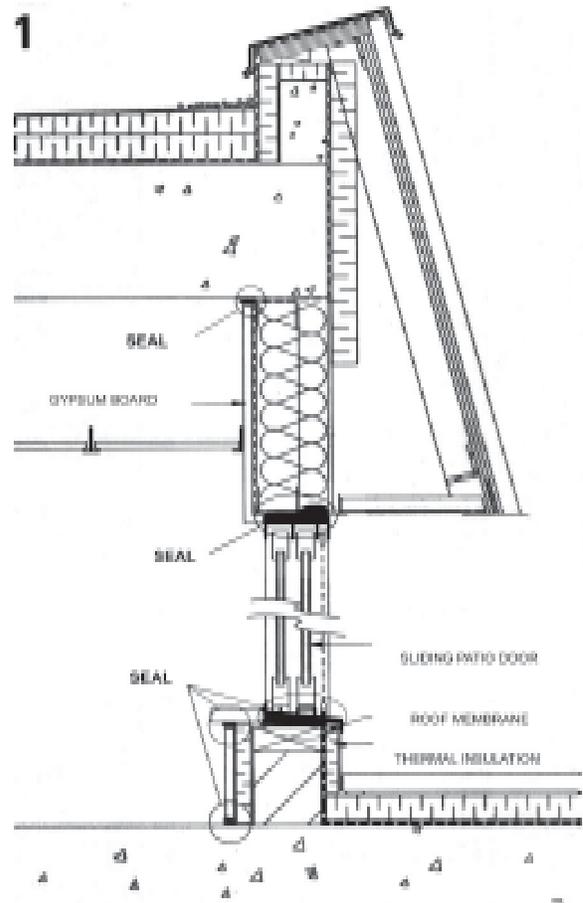


Illustration HR (High Rise)

Illustration HR-1



2

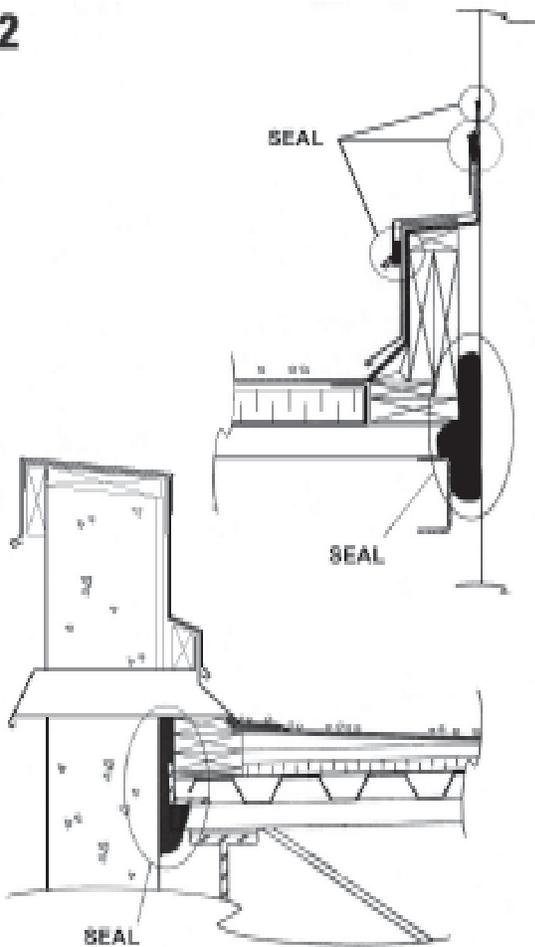


Illustration HR-2

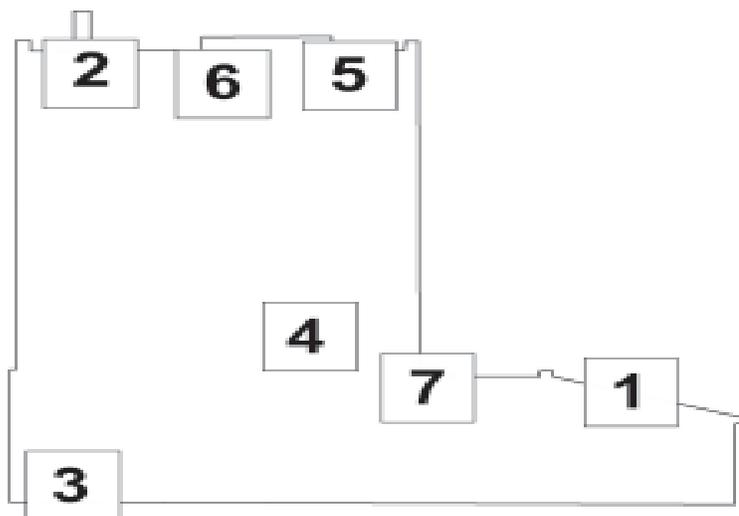


Illustration HR-3

4

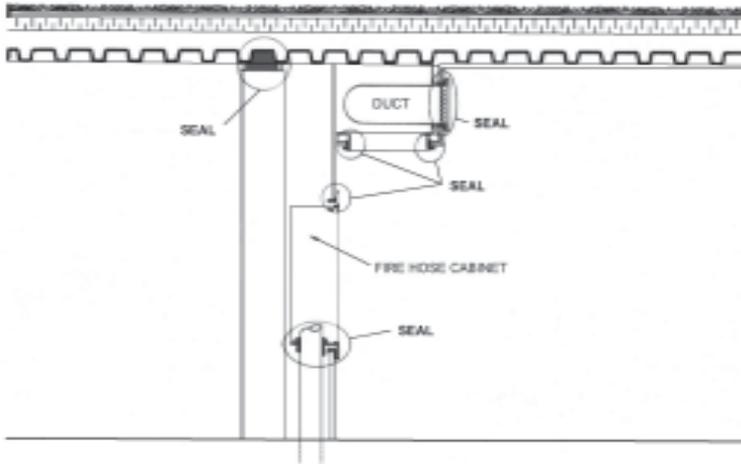
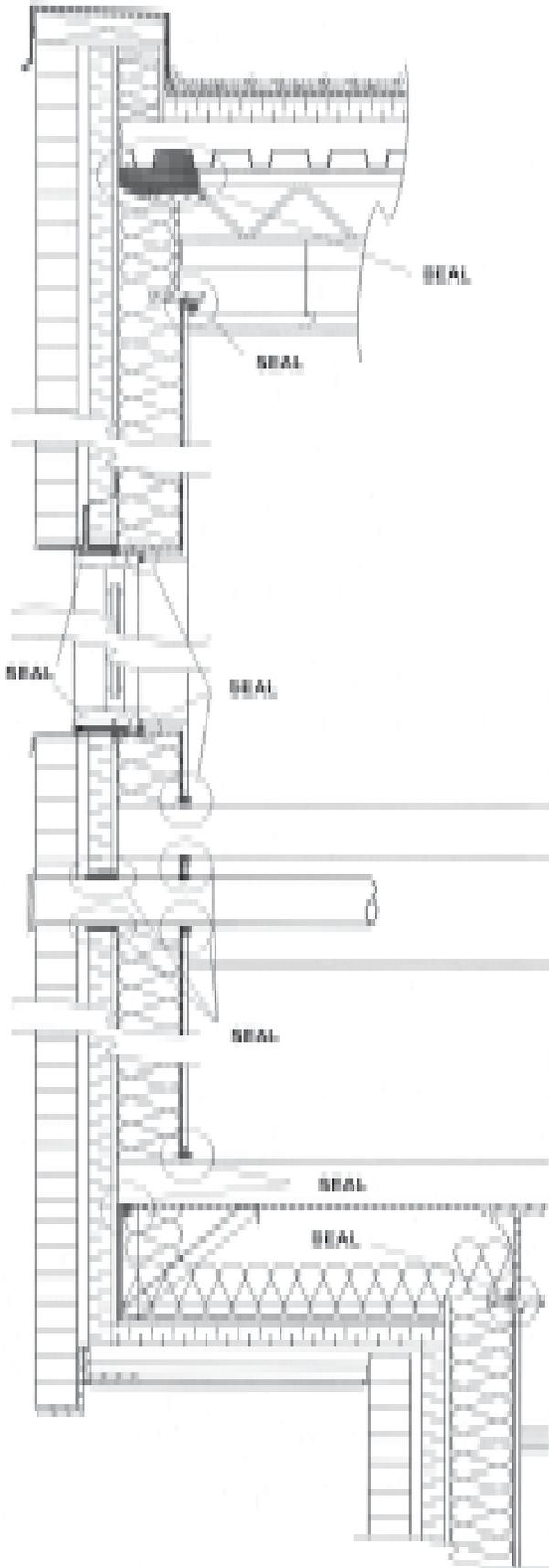


Illustration HR-4

6

Illustration HR-5



6

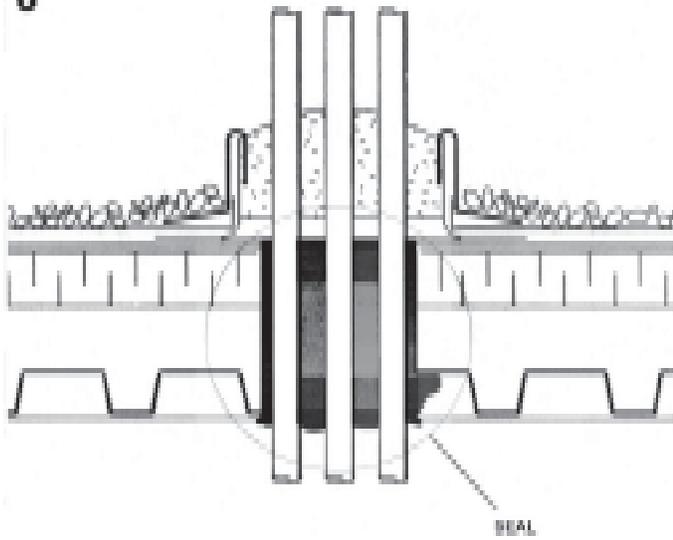
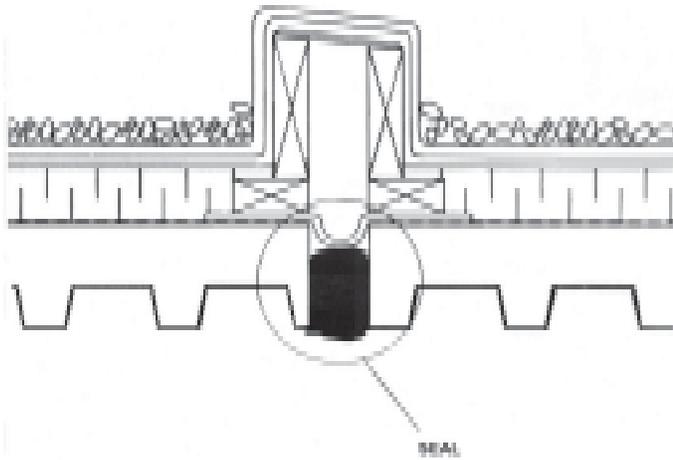
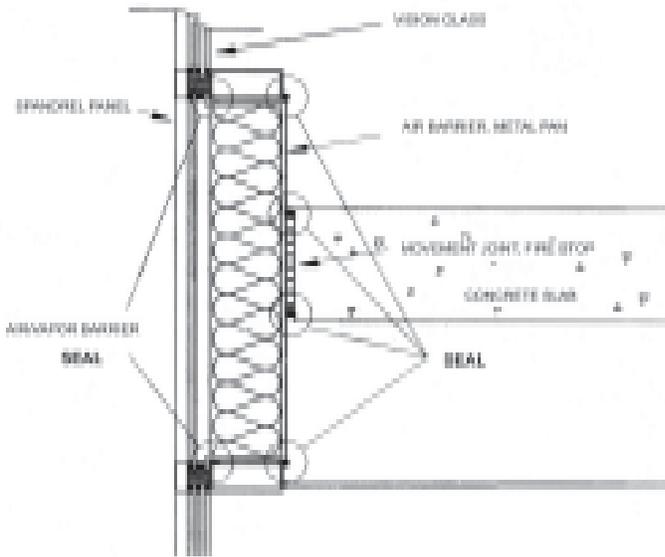
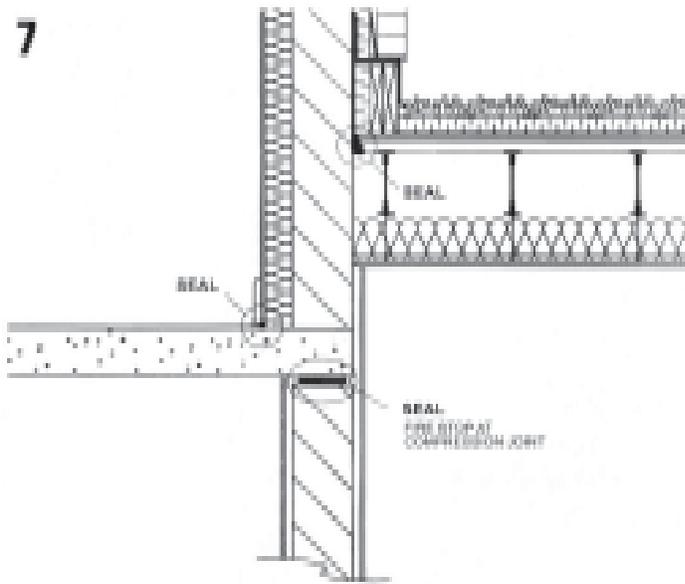


Illustration HR-6



7

Illustration HR -7



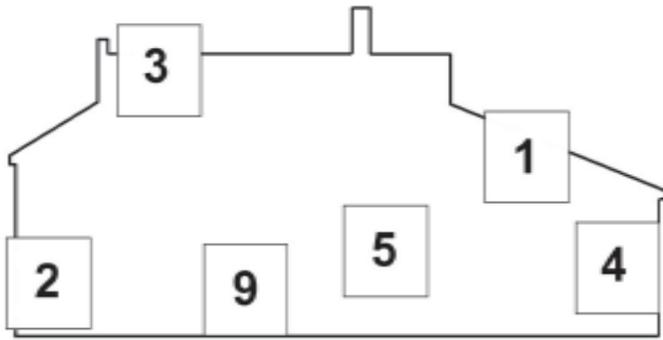


Illustration I (Industrial)

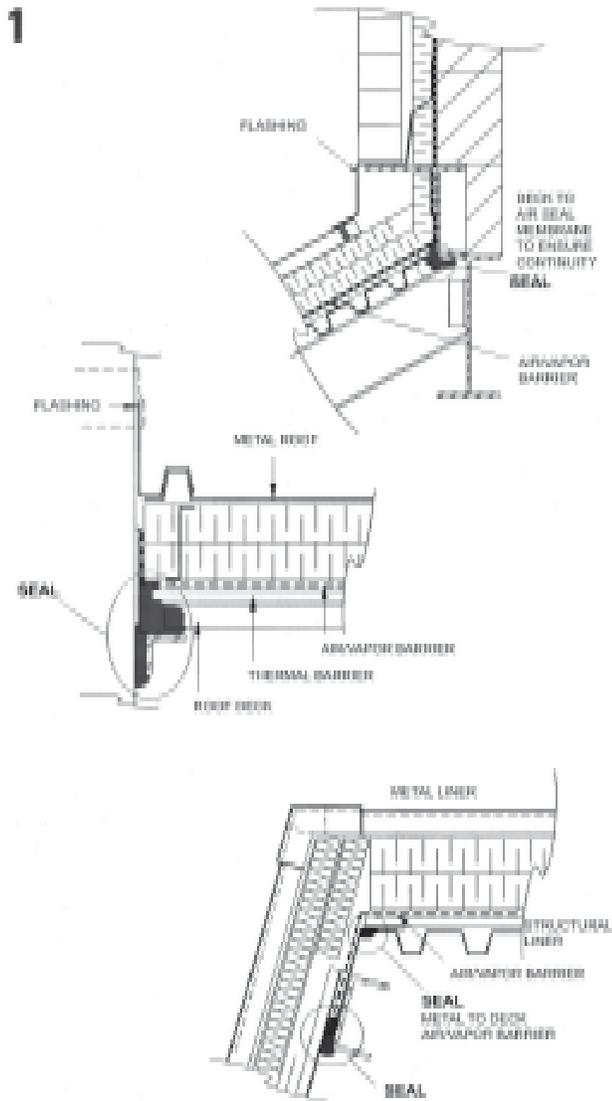


Illustration I -1

2

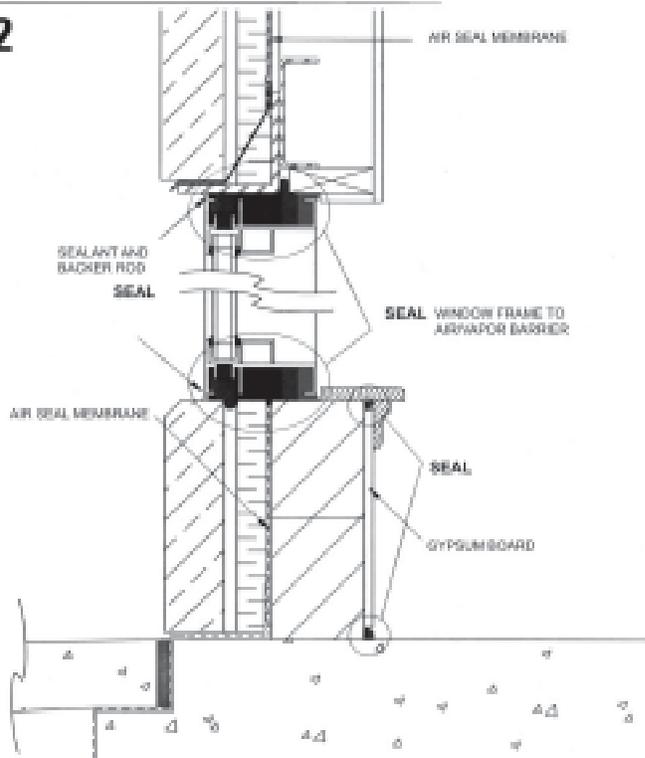


Illustration I - 2

3

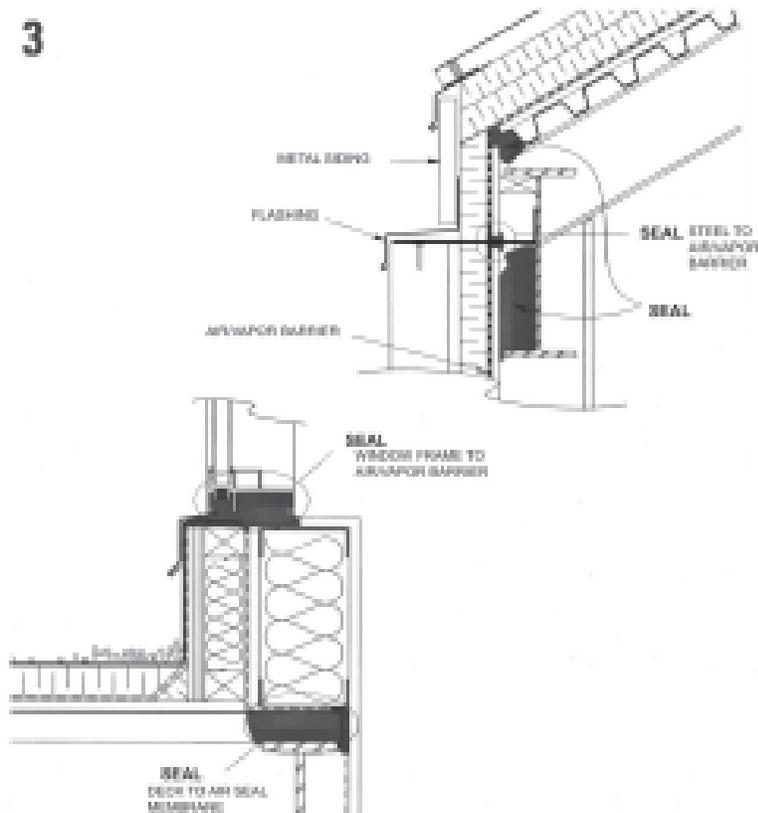


Illustration I - 3

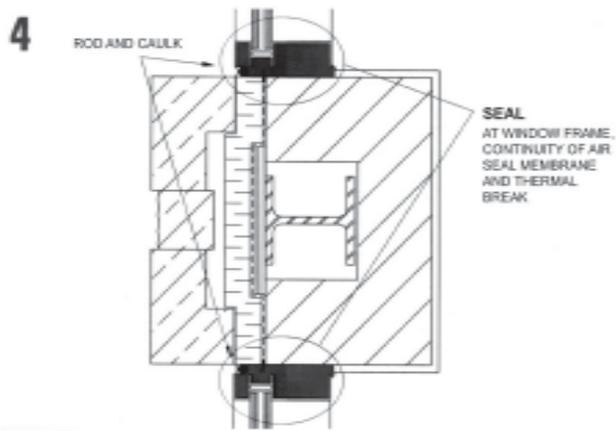


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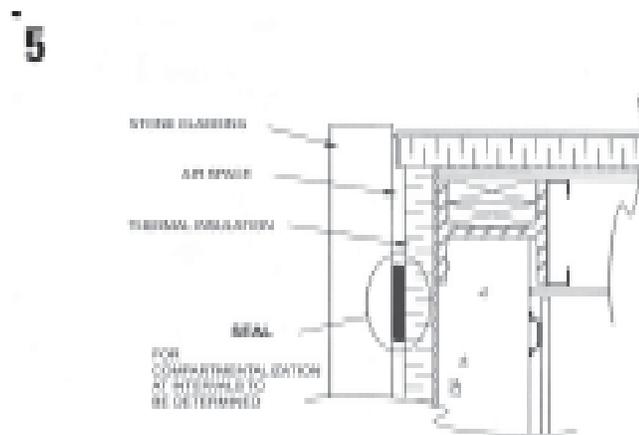
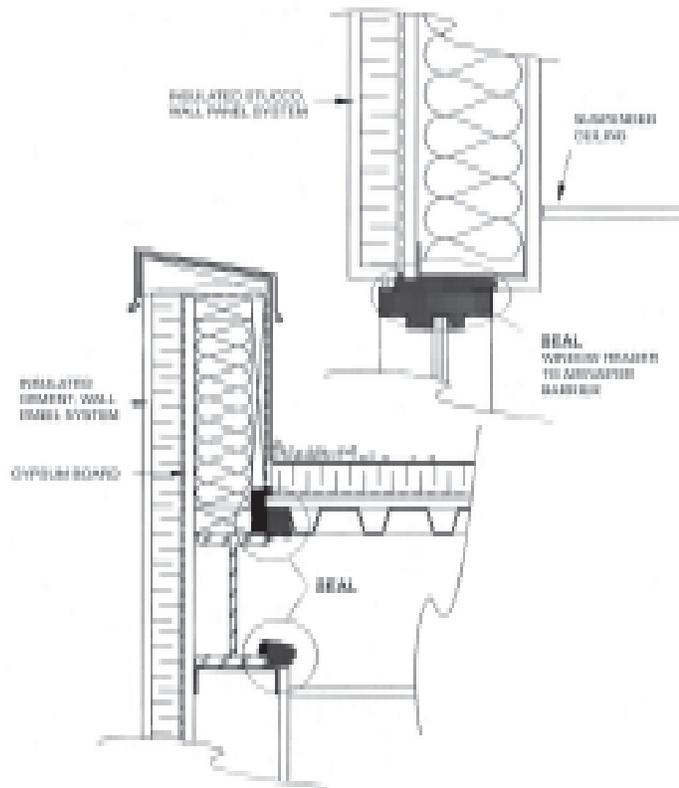
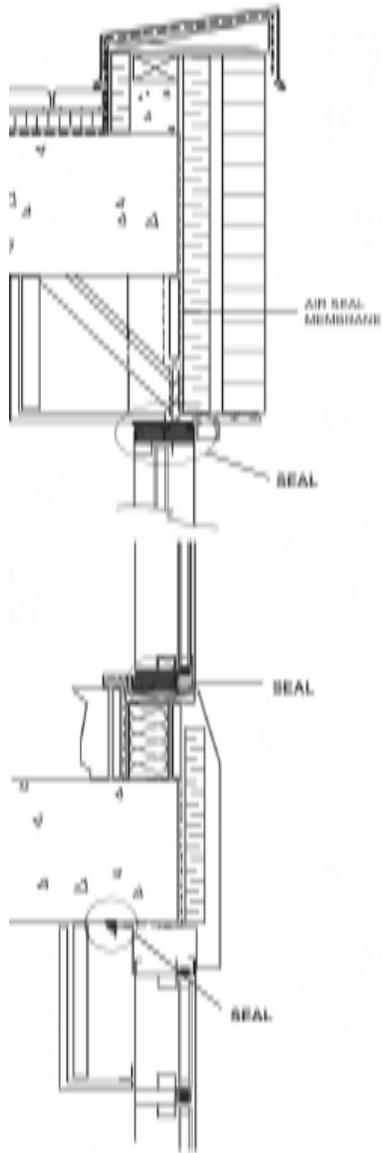


Illustration I - 5



9

Illustration I - 9



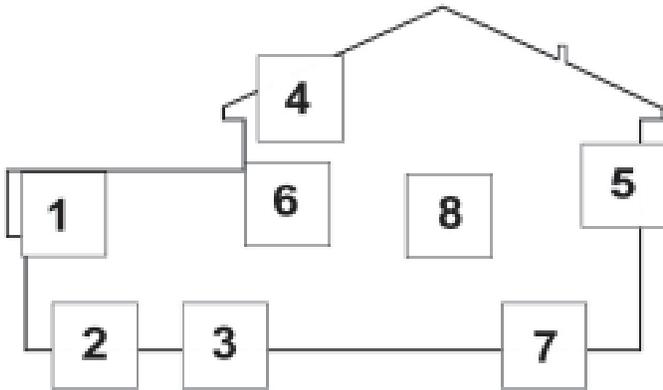


Illustration LR (Low Rise)

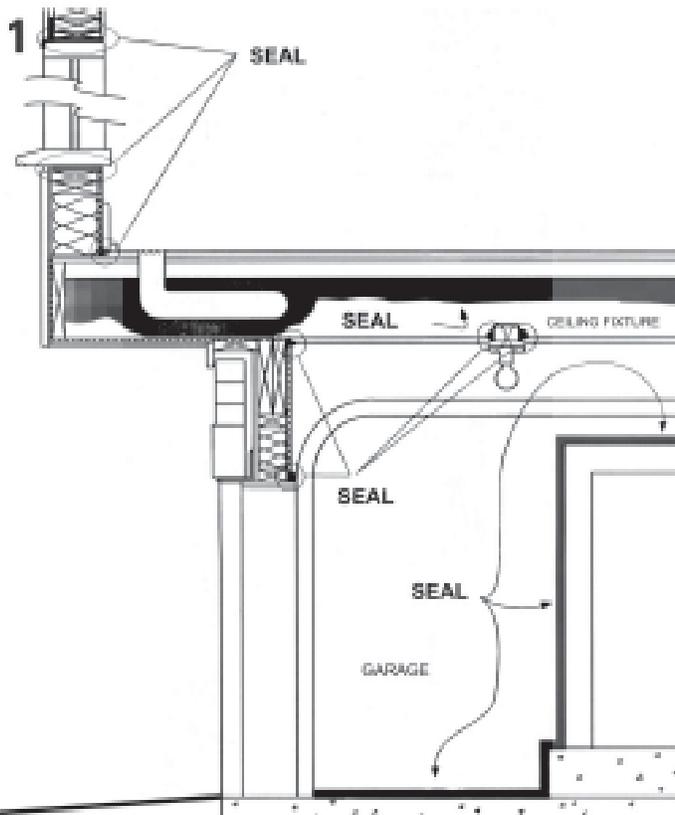


Illustration LR - 1

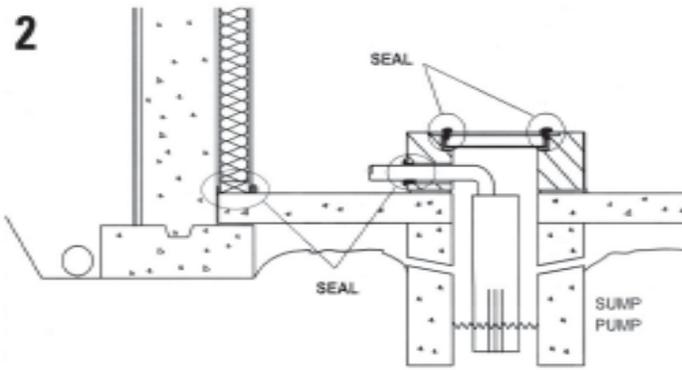


Illustration LR - 2

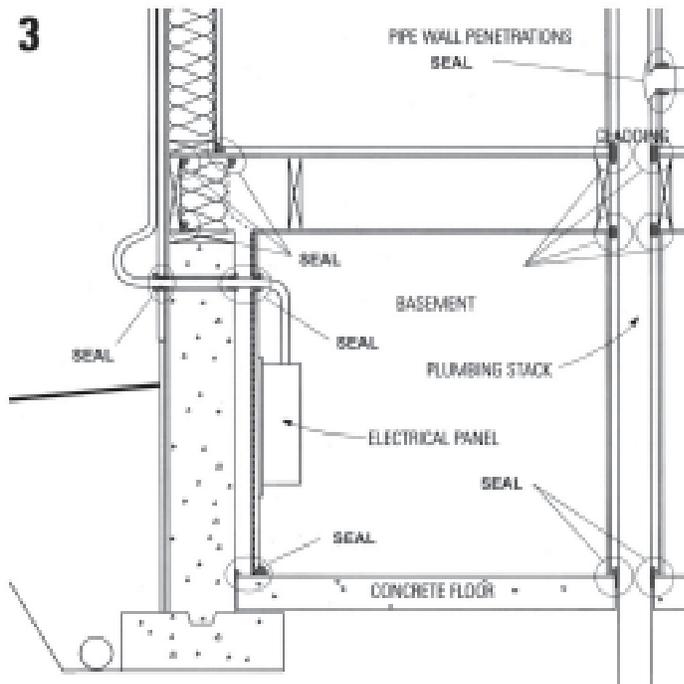


Illustration LR - 3

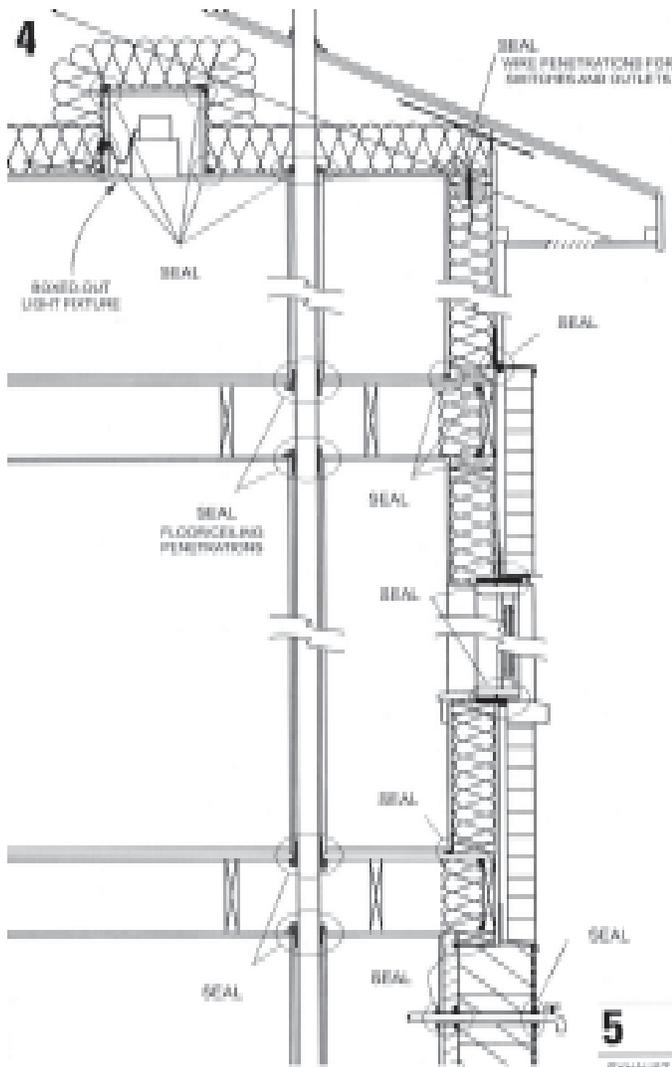
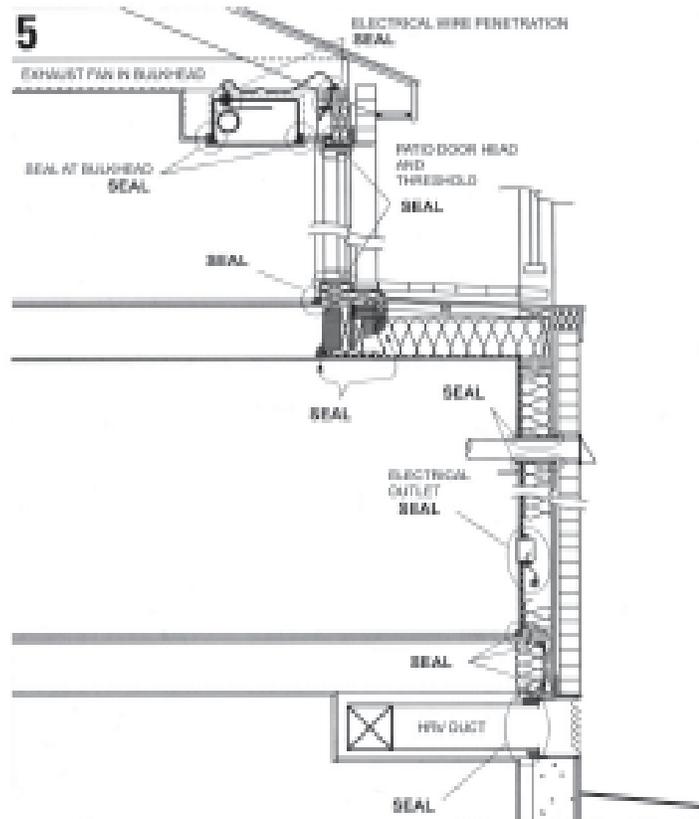


Illustration LR - 4

Illustration LR - 5



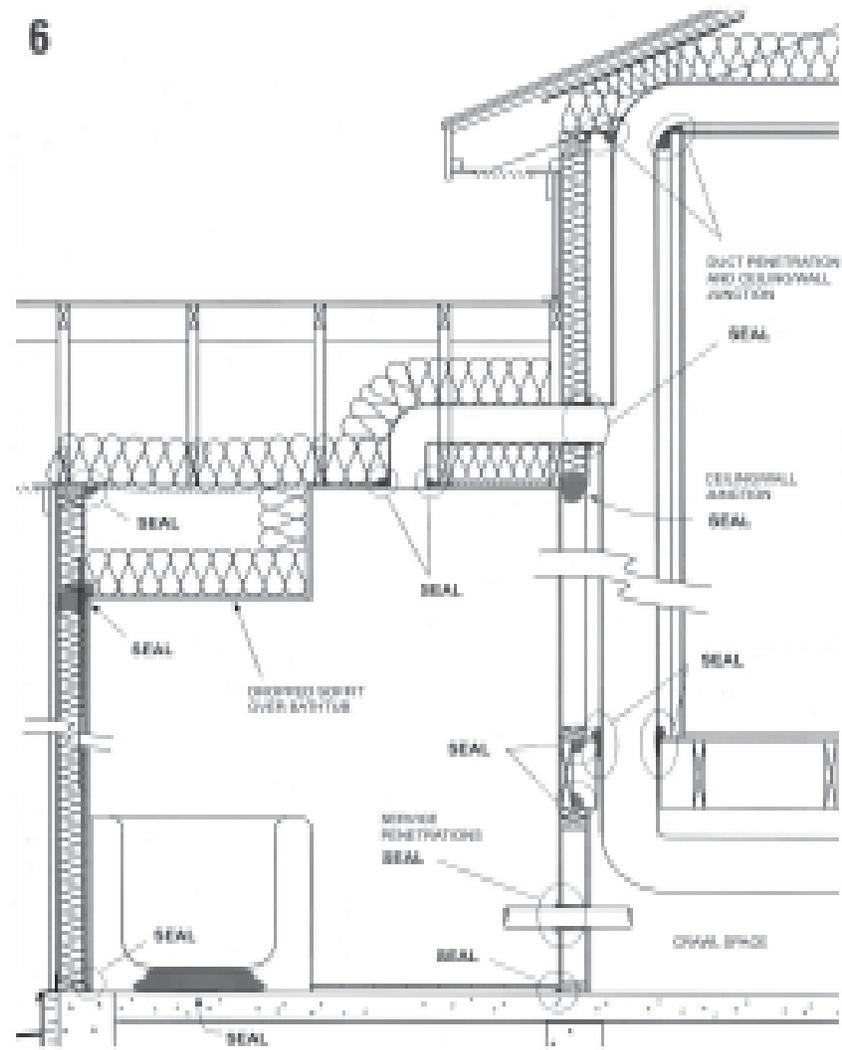


Illustration LR - 6

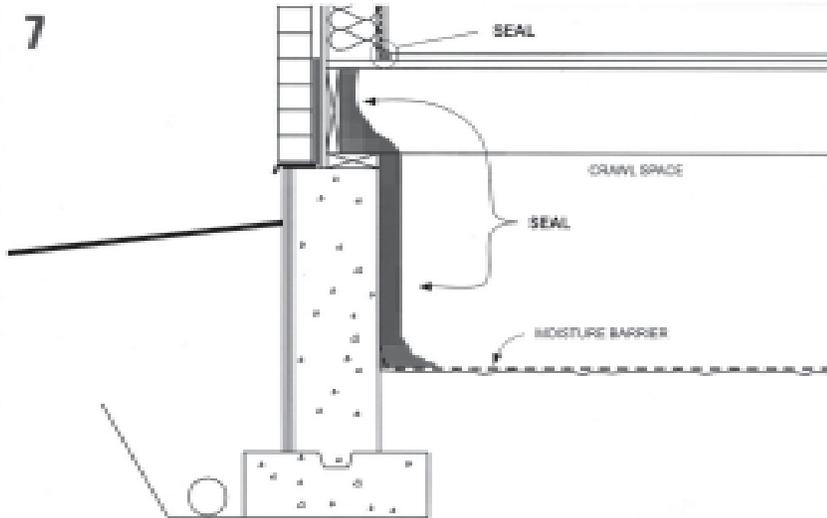


Illustration LR - 7

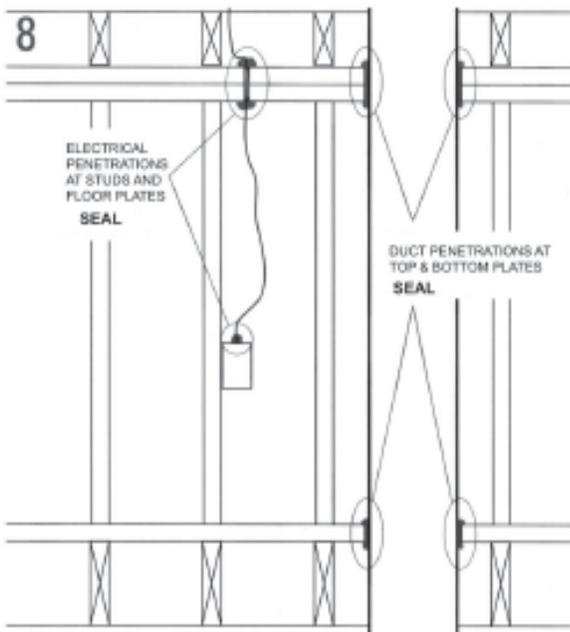


Illustration LR - 8

	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BASIC SAFETY STANDARDS</b>
		Subject	<b>General Application</b>

*GENERAL APPLICATION 1401-1*

Note: These basic Safety Standards in no way supercede or abrogate in any way the full force or complete requirements of any state or federal laws or regulations.

All grantees, delegate agencies or contractors for grantees who perform weatherization services shall comply with these standards.

**general application**  
1401-1.1

Every employer shall furnish employment which is safe for the employees engaged therein, shall furnish a place of employment which shall be safe for the employees therein and the frequenters thereof, shall furnish safety devices and safeguards, shall adopt and use methods and processes, shall follow and obey orders, shall prescribe hours of labor reasonably adequate to render such employment and places of employment safe, and shall do every other thing reasonably necessary to protect the life, health, safety, and welfare of such employees and frequenters.

**duty to protect employees**  
**ORC 4101.111**  
1401-1.2

No employer shall require, permit or suffer any employees to go to or be in any employment or place of employment which is not safe and such employer shall obey and follow orders or adopt and use methods and processes reasonably adequate to render such employment or place of employment safe.

**safe place of employment**  
**ORC 4101.12**  
1401-1.3

The employer shall do every thing reasonably necessary to protect the life, health, safety and welfare of such employees or frequenter. No employer or other person shall construct, occupy or maintain any place of employment that is not safe.

**protect life, health, safety**  
1401-1.3a

No employee shall remove, displace, damage, destroy or carry off any safety device or safeguard furnished or provided for use in any employment, or place of employment, or interfere in any way with the use of any method or process adopted for the protection of any employee in such employment or place of employment, or fail to follow and obey orders and do every other thing reasonably necessary to protect the life, health, safety, and welfare of such employees and frequenters.

**duty of employees**  
1401-1.4



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BASIC SAFETY STANDARDS</b>
	Subject	<b>Safety Program Requirements</b>

*SAFETY PROGRAM REQUIREMENTS 1402-1*

All providers or contractors for providers that perform weatherization services shall comply with the applicable regulations and requirements of the standards set by the Occupational Safety and Health Administration of the Department of Labor.

**OSHA compliance**  
1402-1.1

All providers shall require that all contractors and/or delegates comply with the applicable regulations and requirements of the standards set by the Occupational Safety and Health Administration of the Department of Labor.

**delegates/contractors**  
1402-1.2

Providers must have a written safety policy in effect (see section 1506-3, Sample Safety Policy); and it must be kept on file by the program coordinator at all times.

**written safety policy**  
1402-1.3

All new and present employees must receive orientation training on the grantee’s safety policy.

**employee orientation**  
1402-1.4a

A copy of the providers safety policy must be provided to each weatherization employee.

**grantee safety policy**  
1402-1.4b

The provider’s safety policy must be posted in conspicuous places frequented by crew members.

**policy must be posted**  
1402-1.4c

Note: If a provider has no general orientation program for new employees, then safety training must be provided as minimum orientation for weatherization personnel.



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BASIC SAFETY STANDARDS</b>
		Subject	<b>Accident Reports</b>

*ACCIDENT REPORTS 1403-1*

Specific requirements of General Application (Ohio Revised Code, Section 4107.13) Every employer shall, within three days after the happening of any accident in his establishment resulting in death, or bodily injury of such a nature that the person does not return to his employment in said establishment within two (2) days or more after occurrence of the accident, forward to the Chief of the Office of Energy Efficiency, a report containing the following particulars in full:	<b>specific requirements</b> 1403-1.1a
Name and address of employer (person, firm or corporation);	1403-1.1b
Nature of business in which the employer is engaged and place where the accident occurred;	1403-1.1c
Name, address, sex, age and kind of employment of person killed or injured and whether such person is married or single;	1403-1.1d
Time of day deceased/injured began work on day of accident, time of day accident occurred and date of accident or death.	1403-1.1e
What task employee was performing when killed or injured, whether such person was familiar with the work at which he/she was engaged or the machinery he/she was operating, whether such machinery was in good order and guarded so as to prevent accidents under ordinary circumstances, and if machinery was not guarded, reasons for not guarding same;	1403-1.1f
Description of manner in which such person was killed or injured;	1403-1.1g
Description of nature and extent of injury;	1403-1.1h
Number of persons deprived of support in consequences of such death or injury.	1403-1.1i

**record of injuries**  
1403-1.2

Agency record of injuries; report (ORC, Section 4123.28)

**injuries or  
occupational diseases**  
1403-1.2a

Every employer in this state shall keep a record of all injuries or occupational diseases, fatal or otherwise, received or contracted by his/her employees in the course of their employment and resulting in seven (7) days or more of total disability.

**within one week**  
1403-1.2b

Within one (1) week after the occurrence of such an injury or death therefrom, or within one (1) week after the occurrence or diagnosis of or death from said occupational disease or of a report to such employer of such occupational disease or death, a report shall be made in writing to the Ohio Industrial Commission upon blanks to be procured from the commission for such purpose.

**reporting  
requirements**  
1403-1.2c

The report shall state:

- i. The name and nature of the business of the employer;
- ii. The location of his/her establishment or place of work;
- iii. The name address nature and duration of occupation of the injured, disabled or deceased employee;
- iv. The time, nature and cause of injury, occupational disease or death and such other information as is required by the commission.

**copy to employee**  
1403-1.3

The employer shall give a copy of each report to the employee it concerns or his/her surviving dependents.

**employer  
responsibility**  
1403-1.4

No employer shall refuse or neglect to make any report required by this section.



State of Ohio  
Weatherization Program  
Standards

Section

**BASIC SAFETY STANDARDS**

Subject

**Medical Services and First Aid**

*MEDICAL SERVICES AND FIRST AID 1404-1*

First aid services and provisions for medical care shall be made available, by the employer, for every employee covered by these standards.

**availability**  
1404-1.1

The employer shall insure the availability of medical personnel for advise and consultation on matters of occupational health.

**occupational health**  
1404-1.2

Provisions shall be made prior to the commencement of the project for prompt medical attention in case of serious injury.

**serious injury**  
1404-1.3

In the absence of an infirmary, clinic, hospital or physician that is reasonably accessible in terms of time and distance to the work site, and which is available for the treatment of injured employees, a person who has a valid certificate in first aid training from the U.S. Bureau of Mines, the American Red Cross or equivalent training, that can be verified by documentary evidence, shall be available at the work site to render first aid.

**certified first aid giver**  
1404-1.4

First aid supplies approved by the consulting physician shall be easily accessible when required.

**required supplies**  
1404-1.5

The first aid kit shall consist of materials approved by the consulting physician in a weatherproof container with individual sealed packages for each type item.

**first aid kit**  
1404-1.5a

The contents of the first aid kit shall be checked by the employer before being sent out on each job site and at least weekly on each job site to ensure that the expended items are replaced.

**contents**  
1404-1.5b

Approved first aid supplies shall be kept available at every weatherization job site, both at houses being weatherized and at warehouse facilities.

**availiability**  
1404-1.5c

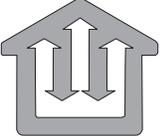
Proper equipment for prompt transportation of the injured person to a physician, hospital, or a communication system for contacting necessary ambulance service, shall be provided.

**communications system provided**  
1404-1.6

## OWPS 1404 BASIC SAFETY STANDARDS—Medical Services and First Aid

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<b>phone numbers posted</b> 1404-1.7	The telephone numbers of physicians, hospitals, and/or ambulances shall be conspicuously posted.
<b>posted in vehicles</b> 1404-1.7a	Telephone numbers must be conspicuously posted in all weatherization vehicles.
<b>posted in warehouse</b> 1404-1.7b	Telephone numbers must be conspicuously posted beside all telephones in the warehouse facilities.
<b>home phone numbers</b> 1404-1.8	The home telephone number of all crew persons shall be kept so that they are accessible in the event of injury.
<b>kept in central file</b> 1404-1.8a	Telephone numbers shall be kept by the energy coordinator in a central file.
<b>emergency phone numbers</b> 1404-1.8b	Telephone numbers of crew persons and/or persons to contact in the event of an extreme emergency shall be accessible to crew leaders at any weatherization job site.

	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BASIC SAFETY STANDARDS</b>
		Subject	<b>Housekeeping, Temporary Storage and Disposal</b>

*HOUSEKEEPING, TEMPORARY STORAGE AND DISPOSAL 1405-1*

This section shall cover all work sites and warehouse facilities.

**job sites and  
warehouses**  
1405-1.1

The employer shall ensure that work sites and warehouse facilities are maintained in a safe and hazard free manner.

**safe and hazard free**  
1405-1.2

All asbestos, lead paint dust, CFC's, solvents or materials containing these or other hazardous materials shall be stored, handled and disposed of in a manner consistent with OSHA, EPA and state and federal laws and regulations.

**hazardous material**  
1405-1.3

All materials stored in tiers shall be stacked, racked, blocked, interlocked or otherwise secured to prevent sliding, falling or collapse.

**materials storage**  
1405-1.4a

Aisles and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or employees.

**aisles/passageways**  
1405-1.4b

Storage shall not obstruct or adversely affect means of exit.

**unobstructed exits**  
1405-1.4c

All materials shall be stored, handled and piled with due regard to their fire characteristics.

**fire characteristics**  
1405-1.4d

A clearance of 24 inches shall be maintained around the path of travel of fire doors unless a barricade is provided, in which case no clearance is needed. Material shall not be stored within 36 inches of a fire door opening.

**clearance**  
1405-1.4e





State of Ohio  
Weatherization Program  
Standards

Section	<b>BASIC SAFETY STANDARDS</b>
Subject	<b>Storage and Disposal Requirements</b>

*STORAGE AND DISPOSAL REQUIREMENTS 1406-1*

Bagged materials shall be stacked by stepping back the layers and cross keying the bags at least every 10 bags high. **materials storage**  
1406-1.1

Used lumber shall have all nails withdrawn before stacking. **lumber**  
1406-1.2a

Lumber shall be stacked on level and solidly supported sills. **solidly supported**  
1406-1.2b

Lumber shall be stacked to be stable and self supporting. **stable**  
1406-1.2c

Lumber piles that are handled manually shall not be stacked more than sixteen feet high. **lumber piles**  
1406-1.2d

All scrap lumber, waste material and rubbish shall be removed from the immediate work area, as the work progresses. **disposal**  
1406-1.3

During the course of construction, alteration or repairs, form and scrap lumber with protruding nails and all other debris shall be kept cleared from work areas, passageways and stairs, in and around buildings or other structures. **clear work area**  
1406-1.4

Disposal of waste material or debris by burning shall comply with local fire regulations and state regulations. **burning waste**  
1406-1.5

Containers shall be provided for the collection of waste, trash, oily and used rags, and other refuse. Containers used for oily, flammable or hazardous wastes such as caustics, acids and harmful dusts shall be designed for such purposes and equipped with covers. **containers**  
1406-1.6





State of Ohio  
Weatherization Program  
Standards

Section	<b>BASIC SAFETY STANDARDS</b>
Subject	<b>Fire Protection and Prevention</b>

*FIRE PROTECTION AND PREVENTION 1407-1*

The employer shall be responsible for the development and maintenance of an effective protection and preventive program at job sites and warehouses throughout all phases of the construction, repair, alteration or demolition work.

**fire protection program**  
1407-1.1

The employer shall ensure the availability of fire protection and suppression equipment required by this section.

**fire suppression equipment**  
1407-1.1a

As fire hazards occur, there shall be no delay in providing the necessary equipment.

**providing equipment**  
1407-1.1b

Access to all available fire-fighting equipment shall be maintained at all times.

**access**  
1407-1.1c

All fire-fighting equipment, provided by the employer, shall be conspicuously located:

**location**  
1407-1.1d

- i. In each truck/vehicle.
- ii. In the warehouse(s).

All fire-fighting equipment shall be periodically inspected and maintained in operating condition. Defective equipment shall be immediately replaced. Portable fire extinguisher shall be inspected periodically, and maintained in accordance with Maintenance and Use of Portable Fire Extinguisher, NFPA 10.

**inspection/  
replacement**  
1407-1.2

Fire extinguisher and small hose line.

**equipment required**  
1407-1.3

A fire extinguisher, rated not less than 2A, shall be provided for each 3,000 square feet of the protected building area or major fraction thereof.

**fire extinguisher**  
1407-1.3a

Travel distance from any point of the protected area to the nearest fire extinguisher shall not exceed 100 feet.

**distance to  
extinguisher**  
1407-1.3b

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**OWPS 1407 BASIC SAFETY STANDARDS—Fire Protection and Prevention**

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**multi-story buildings**

1407-1.3c

One or more fire extinguisher, rated not less than 2A, shall be provided on each floor. In multistory buildings, at least one fire extinguisher shall be located adjacent to the stairway(s).

**recognized testing lab**

1407-1.3d

Fire extinguisher which have been listed or approved by a nationally recognized testing laboratory shall be used to meet the requirements of this subpart.

**open drums**

1407-1.4

One 55 gallon open drum of water with two fire pails may be substituted for a fire extinguisher having a 2A rating. Water drums and fire extinguisher subject to freezing shall be protected from freezing.

**vehicles**

1407-1.5

All vehicles shall be equipped with a fire extinguisher rated not less than 2A.



State of Ohio  
Weatherization Program  
Standards

Section	<b>BASIC SAFETY STANDARDS</b>
Subject	<b>Personal Protective Equipment</b>

*PERSONAL PROTECTIVE EQUIPMENT 1408-1*

The requirements of this rule relate to the personal protective equipment listed immediately below, as required for employees on operations described in this rule, in which there is a known hazard, recognized as injurious to the health or safety of the employee:

**required for employees**  
1408-1.1

Eye and face protection.

**eye and face protection**  
1408-1.1a

Foot (toe) protection.

**foot (toe) protection**  
1408-1.1b

Respiratory protection includes respirators, masks, canister type masks, supplied air helmets, etc., for protection of the respiratory system from inhalation of particulate matter, noxious gases and vapors and oxygen deficiency.

**respiratory protection**  
1408-1.1c

Head and hair protection includes all operations where employees are required to be present in areas where a hazard to their head exists from falling or flying objects, from physical contact from rigid objects, from exposures where there is a risk of injury from electrical shock or hair entanglement.

**head and hair protection**  
1408-1.1d

Hearing protection.

**hearing protection**  
1408-1.1e

Personal protective equipment furnished by the employer shall be issued to the employee in sanitary and proper condition so that it will effectively protect against the hazard involved.

**equipment condition**  
1408-1.2

Where employees provide their own protective equipment, such equipment shall give equal or greater protection than that furnished by the employer.

**equal or greater protection**  
1408-1.3

Employee's responsibility. It shall be the responsibility of the employee to properly use the equipment provided by the employer as required in this rule.

**employee responsibility**  
1408-1.4

**employer  
responsibility**  
1408-1.5

The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions or where this part indicates the need for using such equipment to reduce the hazards to the employees. The employer is also responsible for training and testing of employees for such equipment use when applicable.

	<p>State of Ohio Weatherization Program Standards</p>	Section	<b>BASIC SAFETY STANDARDS</b>
			Subject

### *EQUIPMENT REQUIREMENTS 1409-1*

Employees shall be provided with eye and face protection equipment when machines or operations present potential eye or face injury from physical, chemical, or radiation agents.

**eye and face protection**  
1409-1.1

Eye and face protection equipment required by this Part shall meet the requirements specified in American National Standards Institute, 287.1 1968, Practice for Occupational and Educational Eye and Face Protection.

**requirements**  
1409-1.1a

Face and eye protection equipment shall be kept clean and in good repair. The use of this type of equipment with structural or optical defects is prohibited.

**good repair**  
1409-1.1b

Face shields may be used in lieu of other forms of eye protection, if they provide the required protection against the particular hazards for which they are designed. They shall be provided where additional protection for the face is necessary.

**face shields**  
1409-1.1c

Eye protection shall be provided to employees performing the following operations:

**operations requiring eye protection**  
1409-1.1d

- i. When using hand tools or mechanical equipment to cut, chip, drill, clean, buff, grind, polish, shape or surface masonry, plaster, stone, plastic or other hardened substances;
- ii. Cleaning operations where wire wheels are used;
- iii. Cutting, drilling, turning, planing, jointing and sanding of wood with power tools;
- iv. Operations requiring the use of compressed air for cleaning purposes.

Foot protection should be worn by the employee where an employee is exposed to machinery or equipment that represents a foot hazard or where an employee is handling material which presents a foot hazard.

**foot (toe) protection**  
1409-1.2

**approved respiratory equipment**

1409-1.3

The employer shall furnish approved respiratory equipment where there are air contaminants (hazardous concentrations of fibrosis producing or toxic dusts, toxic fumes, toxic mists, toxic vapors, toxic gases or a combination of these suspended in the atmosphere).

**employee responsibility**

1409-1.3a

It shall be the responsibility of the employee to use the respirator or respiratory equipment provided by the employer, guard it against damage and report any malfunction to the employer.

**exhaust system**

1409-1.3b

This requirement does not apply where an effective exhaust system or other means of equal or greater protection is provided.

**approved devices**

1409-1.3c

Respiratory protective protection is provided.

Respiratory protective devices shall be approved by the U.S. Bureau of Mines or be acceptable to the U.S. Department of Labor for the specific contaminant to which the employee is exposed.

**head and hair protection**

1409-1.4

Whenever employees are required to be present in areas where the potential hazards mentioned in 1408-1.1d of this section are present, employers shall provide suitable protective headgear or hair enclosures.

**accessories**

1409-1.4a

When required, employers shall provide accessories designed for use with protective head gear that are suitable for their intended purpose.

**sanitizing/replacing**

1409-1.4b

Protective helmets, or parts thereof, and hair enclosures shall be sanitized before reissue and damaged parts of protective headgear shall be replaced.

**effectiveness**

1409-1.4c

Employees shall not alter any head or hair protective equipment that lessens its effectiveness and shall use such equipment in accordance with instructions and training.

**protective helmets**

1409-1.5

Protective helmets shall be of the following classes

**classes**

1409-1.5a

**winter liners/chin**

Class A, limited voltage protection; Class B, high voltage protection.

All winter liners shall be fabricated of materials that will not support combustion. Winter liners and chin straps, used in conjunction with Class B helmets for protection from electricity, shall not contain any metallic or other conductive material.

**straps**  
1409-1.5b

Bump caps or hats shall never be used as a substitute for safety helmets where there is danger from falling objects, flying particles or electric shock.

**bump caps**  
1409-1.5c

Hair enclosures (a hat, cap or net) shall be worn where there is danger of hair entanglement in moving parts of machinery or equipment or where there is exposure to means of ignition. It shall be designed to enclose all loose hair and be adjustable to accommodate all head sizes.

**hair enclosures**  
1409-1.5d

Material used for a hair enclosure shall be durable, fast-dyed, nonirritating to the skin and capable of withstanding frequent cleaning. Hair enclosures shall not be reissued from one employee to another, unless thoroughly sanitized.

Helmets for the protection of employees against impact and penetration of falling and flying objects shall meet the specifications contained in American National Standards Institute, 281.1, dated 1969.

**helmets**  
1409-1.5e

Employees exposed to continuous noise levels of ninety (90) or more decibels (dBA) slow response shall be provided with ear protection.

**hearing protection**  
1409-1.6

If ear plugs that require fitting are provided, they shall be fitted to the individual employee by a competent person.

**ear plugs**  
1409-1.6a

Plain cotton is not an acceptable device.

**cotton not acceptable**  
1409-1.6b

Lifelines, safety belts and lanyards shall be used when engaged in securing or shifting thrust-outs, inspecting or working on overhead machines that support scaffolds or on other high rigging, on steeply pitched roofs and by all employees exposed to hazards of falling when the operation being performed is more than 15 feet above ground or above a floor or platform.

**lifelines, safety belts,  
lanyards**  
1409-1.7

Lifelines and safety belts shall be securely fastened to the structure and shall sustain a static load of no less than 5,400 pounds.

**employer  
responsibility**  
1409-1.7a

It shall be the responsibility of the employer to provide appropriate lifelines, safety belts and lanyards and to keep them in good repair.

**employee  
responsibility**  
1409-1.7b

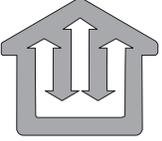
It shall be the responsibility of the employee to wear such equipment when engaged in the activities identified in 1409-1.7 above.

**employee  
safeguarding**  
1409-1.7c

Lifelines, safety belts and lanyards shall be used only for employee safeguarding. Any lifeline, safety belt or lanyard actually subjected to in-service loading, as distinguished from static load testing, shall be removed from service and shall not be used again for employee safeguarding.

**hardware**  
1409-1.7d

All safety belt and lanyard hardware shall be drop forged or pressed steel, cadmium plated. Surface shall be smooth and free from sharp edges.

	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>BASIC SAFETY STANDARDS</b>
		Subject	<b>Working Lead Safe</b>

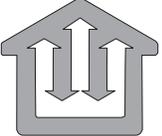
*WORKING LEAD SAFE 1410*

Lead-based paint (LBP) was used on the majority of houses built before 1978. It is probable that LBP is present on houses weatherized by the HWAP that were built before 1978.

**probability**  
1410-1.1

If paint is disturbed (cut, scraped, sawn, drilled, etc.) during the weatherization work, that work shall be done in a lead safe manner.



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>APPENDICES AND REFERENCES</b>
	Subject	<b>Materials Standards Appendix A</b>

*STANDARDS FOR WEATHERIZATION MATERIALS 1501*

Weatherization materials installed under the HWAP shall conform to these specifications and standards and to those standards in Appendix A of 10 CFR Part 440.

**materials shall conform**  
1501-1

*HEATING SYSTEM REPAIRS/TUNE-UPS/REPLACEMENT/MODIFICATIONS 1501-2*

Repairs/Tune-ups to heating systems must be performed using:

**repairs/tune-ups**  
1501-2.1

The manufacturer’s instructions, if provided; or

**manufacturer's instructions**  
1501-2.1a

The appropriate NFPA manual if no manufacturer instructions are provided:

**NFPA Manual**  
1501-2.1b

1. Natural Gas and Propane - NFPA 54
2. Fuel Oil and Kerosene - NFPA 31
3. Chimneys, Fireplaces, Vents - all fuel types - NFPA 211, Solid Fuel Burning Appliances - NFPA 211
4. Electric - NFPA 70; or

Local Codes

**local codes**  
1501-2.1c

*HEATING UNIT REPLACEMENTS 1501-3*

Replacement units shall be purchased for installation in a location for which they are designated according to Unit Type Designations as listed in the most current edition of the Gas Appliance Manufacturers’ Association “Consumer’s Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment”.

**replacement heating units**  
1501-3.1

Indoor rated units are models installed indoors and which use indoor air for all combustion and ventilation air.

**indoor rated units**  
1501-3.1a

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**non-weatherized**  
1501-3.1b

Non-weatherized - Isolated Combustion System models are installed indoors with all combustion and ventilation air admitted through grills or ducts from outdoors.

**outdoor units**  
1501-3.1c

Outdoor units are models intended for installation out-of-doors. Fuel gas replacement furnaces to be purchased for installation shall be of ANSI Category II or III.

### *SITE-BUILT/MULTI-FAMILY UNITS 1501-4*

The following standards shall apply to all heating unit replacements for site-built and multifamily dwelling units

**less than 225,000 Btu/hr** 1501-4.1

For natural gas, propane and oil-fired central furnaces rated at less than 225,000 Btu/hr.

1501-4.1a

All units shall have a GAMA certified minimum AFUE rating of 78%.

1501-4.1b

All units shall include electronic ignition.

1501-4.1c

All units shall be either power combustion or power vent (induced draft).

1501-4.1d

All fuel-gas fired units shall meet ANSI Z21.13, except direct vent central furnaces which shall meet ANSI Z21.64.

1501-4.1e

All oil-fired central furnaces shall meet UL 727.

**electric forced air furnaces**  
1501-4.2

For electric forced-air furnaces all units shall meet UL-1096.

**boilers/less than 300,000Btu/hr**  
1501-4.3

For natural gas, propane and oil-fired boilers rated at less than 300,000 Btu/hr.

1501-4.3a

All units shall have a GAMA certified minimum AFUE rating of 78%.

1501-4.3b

All units shall include electronic ignition.

1501-4.3c

All units shall be either power combustion or power vent (induced draft).

1501-4.3d

All fuel gas units shall meet ANSI Z21.13.

## APPENDICES AND REFERENCES—Materials Standards Appendix A OWPS 1501

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All oil-fired units shall meet UL 726.	1501-4.3e
For natural gas, propane and oil-fired boilers rated at greater than 300,000 Btu/hr.	<b>boilers/greater than 300,000Btu/hr</b> 1501-4.4
RESERVED.	1501-4.4a
For electric boilers:	<b>electric boilers</b> 1501-4.5
RESERVED.	1501-4.5a
For natural gas or propane vented floor furnaces:	<b>vented floor furnaces</b> 1501-4.6
All units shall have a minimum GAMA certified AFUE rating of 56%.	1501-4.6a
All units shall meet ANSI Z21.48.	1501-4.6b
For oil-fired floor furnaces all units shall meet UL 729.	<b>oil-fired floor furnaces</b> 1501-4.7
For natural gas or propane vented room heaters:	<b>vented room heaters</b> 1501-4.8
All units shall have a minimum GAMA certified AFUE rating of 58%.	1501-4.8a
All vented room heaters shall be equipped with a spill switch to shut down the unit in the event of flue gas spillage.	1501-4.8b
All units shall meet ANSI Z21.11.1.	1501-4.8c
For oil-fired vented room heaters all units shall meet UL 896.	<b>oil-fired vented room heaters</b> 1501-4.9
For natural gas or propane vented wall furnaces:	<b>vented wall furnaces</b> 1501-4.10
All units shall have a minimum GAMA certified AFUE rating of 63%.	1501-4.10a

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1501-4.10b All units shall meet ANSI Z21.49, except that direct vent wall furnaces shall meet Z21.44.

1501-4.10c Wall furnaces placed in an exterior wall cavity shall be of the sealed-combustion (direct vent) type.

**oil-fired vented wall furnaces**  
1501-4.11 For fuel oil vented wall furnaces all units shall meet UL 730.

**electric direct air**  
1501-4.12 For electric direct air heaters all units shall meet UL 1025.

**electric baseboard**  
1501-4.13 For electric baseboard heating equipment all units shall meet UL 1042.

**solid fuel room heaters**  
1501-4.14 For solid fuel type room heaters all units shall meet UL 1482.

### *MOBILE HOMES 1501-5*

The following standards apply to all replacement units for mobile homes.

**forced air**  
1501-5.1 For natural gas and propane forced air furnaces:

1501-5.1a All units shall have a minimum GAMA certified AFUE rating of 78%.

1501-5.1b All units shall meet the following ANSI, UL, or other listed standards as applicable:

For central furnaces (except direct vent and separated combustion system central furnaces), ANSI Z21.47.

For direct vent central furnaces, ANSI Z21.64.

For other heating appliances, UL 307(B).

**oil-fired forced air**  
1501-5.2 For liquid fuel-burning (fuel oil) forced air furnaces:

1501-5.2a All units shall have a minimum GAMA certified AFUE of 80%.

All units shall meet the following ANSI, UL, or other listed standards as applicable: 1501-5.2b

UL 307A

For electric central air heating equipment all units shall meet the following ANSI, UL, or other listed standards as applicable: **electric central air**  
1501-5.3

UL 1096

For electric baseboard heating equipment all units shall meet the following ANSI, UL, or other listed standards as applicable: **baseboard heating**  
1501-5.4

UL 1042

For electric air heaters all units shall meet the following ANSI, UL, or other listed standards as applicable: **electric air heaters**  
1501-5.5

UL 1025

For solid-fuel type room heaters all units shall meet the following ANSI, UL, or other listed standards as applicable: **solid-fuel room heaters**  
1501-5.6

UL 1482

For fireplace stoves all units shall meet the following ANSI, UL, or other listed standards as applicable: **fireplace stoves**  
1501-5.7

UL 737

#### *VENTING SYSTEMS 1501-6*

Venting Systems Components shall meet the materials standards set forth in the NFPA code for the specific heating appliance being replaced. **venting systems**  
1501-6.1

Power vents must meet ANSI Z-21.47. **power vents**  
1506-6.2

#### *SUPPLY AND RETURN SYSTEMS 1501-7*

Supply and return system components for central warm air furnaces shall meet the materials standards specified in NFPA 90B. **supply and return systems**  
1501-7

*HEATING UNIT EFFICIENCY MODIFICATIONS  
1501-8*

<b>gas power draft burners</b> 1501-8.1	Gas Power Draft Burners
<b>replacement</b> 1501-8.1.a	Replacement - conformance to ANSI Z 223.1, Natural Fuel Gas Code; ANSI 283.1 "Gas Installations".
<b>conversion</b> 1501-8.1.b	Conversion (for gas or oil-fired systems) - conformance to ANSI Z21.8a; ANSI Z 21.17; Installation, ANSI Z 223.1; AGA Laboratories Certification Seal.
<b>oil flame retention burners</b> 1501-8.2	Oil Flame Retention Burners - conformance to NFPA31, Oil Equipment; ANSI Z 96.2, (UL-296); ANSI Z 91.2.
<b>modulating aquastat</b> 1501-.8.3	Modulating Aquastat - conformance with ANSI/ASME CDS.1; applicable sections of ANSI Z 223.1 and NFPA 31.
<b>gas vent dampers</b> 1501-8.4	Gas Fueled Heating System Vent Dampers - conformance to:
1501-8.4a	Applicable sections, National Fuel Gas Code including Appendices H, I, J, K.
<b>electrical</b> 1501-8.4b	Electrically Operated - ANSI Z 21.66 and Addenda A and B.
<b>mechanical</b> 1501-8.4c	Mechanically Actuated - ANSI Z 21.67 and Appendices A and B.
<b>thermal</b> 1501-8.4d	Thermally Activated - ANSI Z 21.68 and Appendices A and B.
<b>oil vent dampers</b> 1501-8.5	Oil Fueled Heating System Vent Dampers - conformance with applicable sections of NFPA 31 for installation and UL 17.
<b>clock thermostats</b> 1501-8.6	Clock Thermostats - conformance to NEMA DC 3 or NEMA DC 15 and performance test requirements.
<b>gas iid</b> 1501-8.7	Gas Intermittent Ignition Devices - Z 21.71.
<b>downsizing gas units</b> 1501-8.8	Downsizing gas units - conformance with local utility company procedures if applicable and appendices C and F of NFPA 54.

Downsizing oil units - conformance to NFPA 31.

**downsizing oil units**  
1501-8.9

*WATER FLOW CONTROLLERS 1501-9*

Low-flow shower heads - “commercial availability” aerated and with a maximum flow of 2.5 gallons per minute.

**low-flow shower heads**  
1501-9.1

*THERMAL INSULATION MATERIALS 1501-10*

Mineral fibrous materials, such as glass, rock, or slag wool.

**fibrous minerals**  
1501-10.1

Blanket/batt - conformance to ASTM C665.

**blanket/batt**  
1501-10.1a

Thermal insulation used to insulate warm air heating system duct work, domestic hot water heaters, and foundation perimeters - conformance to ASTM C971, flame spread classification not exceeding 25/50 and a minimum R-value of 6.

**ducts/ water heaters/  
perimeters**  
1501-10.1b

Board - conformance to ASTM C726.

**board**  
501-10.1c

Loose-fill - conformance to ASTM C764.

**loose fill**  
1501-10.1d

Mineral cellular materials such as perlite and vermiculite.

**mineral cellular  
materials**  
1501-10.2

Perlite loose-fill - conformance to ASTM C549.

**perlite loose fill**  
1501-10.2a

Vermiculite loose fill - conformance to ASTM C516.

**vermiculite**  
1501-10.2b

Cellular glass block - conformance to ASTM C552.

**glass block**  
1501-10.2c

Perlite board - conformance to ASTM C728.

**perlite board**  
1501-10.2d

Organic cellular materials such as wood, paper or synthetic fibers.

**cellulose**  
1501-10.3

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<b>cellulose, loose-fill</b> 1501-10.3a	Cellulose, loose-fill - conformance to ASTM C739 (or latest amended version) and Interim Safety Standard 16 CFR Part 1209.
<b>cellulose board</b> 1501-10.3b	Cellulose fiberboard - conformance to ASTM C208.
<b>polystyrene or polyurethane</b> 1501-10.4	Organic cellular materials such as polystyrene or polyurethane.
<b>polystyrene block</b> 1501-10.4a	Preformed block-type polystyrene - conformance to ASTM C578.
<b>polyurethane board</b> 1501-10.4b	Rigid preformed polyurethane board - conformance to ASTM C591.
<b>felt faced board</b> 1501-10.4c	Polyurethane or polyisocyanurate board faced with felts on both sides - conformance to F.S. HH-1.
<b>aluminum faced board</b> 1501-10.4d	Polyurethane or polyisocyanurate board with aluminum foil on both sides - conformance to F.S. HH-1.
<b>composite board</b> 1501-10.5	Composite Boards
1501-10.5a	Mineral fiber and rigid cellular polyurethane composite board - conformance to ASTM C726.
1501-10.5b	Perlite and rigid cellular polyurethane composite board - conformance to ASTM C984.
1501-10.5c	Gypsum board and polyurethane or polyisocyanurate composite board - conformance to F.S. HH-1.
	<i>VAPOR BARRIERS 1501-11</i>
<b>vapor barriers</b> 1501-11	Vapor barriers used in conjunction with attic, sidewall, floor and perimeter insulation shall be selected according to the provisions cited in ASTM C755. Permeance not greater than 1 perm when determined according to the desiccant method described in ASTM E96.

***RADIANT BARRIERS 1501-12***

Radiant barriers used to wrap domestic water heater tanks under conditions allowed by DOE shall have a Reflectivity Rating of .9 or greater (Emissivity Rating of .1 or less), an ASTM E84 Flame Spread Rating of 25 or less, and a Smoke Developed Index of 450 or less.

**radiant barriers**  
1501-12

***VENTILATION DEVICES 1501-13***

Attic ventilation - “commercial availability”.

**attic**  
1501-13.1

Basement/crawl space ventilation - “commercial availability” and closeable.

**basement/crawl space**  
1501-13.2

Mechanical ventilation devices to expel excess moisture/pollutants shall:

**mechanical**  
1501-13.3

Carry an independent testing laboratory seal.

**approvals**  
1501-13.3a

Have a rated capacity against a static pressure of at least 0.1" W.C.

**capacity**  
1501-13.3b

Provide a positive closure of the air path when the fan is not in operation.

**damper**  
1501-13.3c

Provide the option to be installed in conjunction with a humidistat control or a timed automatic control switch.

**controls**  
1501-13.3d

Operate with a CFM capacity to certified sone rating ratio of no lower than 50 CFM per sone.

**sone rating**  
1501-13.3e

Be sized in accordance with H.V.I. sizing methods.

**sizing**  
1501-13.3f

***AIR LEAKAGE SEALING MATERIALS 1501-14***

Materials used to seal air leakage sites must be as nearly impermeable to air movement as possible and form a continuous, nonporous surface over the opening being sealed.

**air sealing materials**  
1501-14

Caulks and sealants must meet either the intermediate or the high performance category. Material standards shall be:

**caulks/sealants**  
1501-14.1

Latex - conformance to ASTM C834.

1501-14.1a

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1501-14.1b	Acrylic (solvent type) - conformance to F.S. TT-S-00230C.
1501-14.1c	Butyl Rubber - conformance to F.S. TT-S-001657.
1501-14.1d	Chlorosulfonated Polyethylene - conformance to F.S. TT-S-00230C.
1501-14.1e	Polysulfide, Polyurethane, and Silicone - conformance to ASTM C920.
1501-14.1f	Acrylic/Latex/Silicone Hybrids - conformance to ASTM C834.
1501-14.1g	Polymeric Isocyanate with Polyol Resin - “commercial availability”.
1501-14.1h	Acoustical Sealants - “commercial availability”.
<b>packing materials</b> 1501-14.2	Packing materials used to fill gaps too large for caulks or sealants to seal properly must be flexible closed cell or otherwise nonporous materials that will not absorb moisture and will remain flexible at low temperatures.
<b>preformed gaskets</b> 1501-14.2a	Preformed Gasket and Sealing Materials - conformance to ASTM C509-.
<b>weatherstripping</b> 1501-14.3	Weatherstripping material - “commercial availability”, excluding felt and flexible foam weatherstripping. Flexible foam adhesive-backed weatherstripping may only be used to seal ceiling-mounted attic accesses and should be mechanically fastened. Weatherstripping around doors and windows, including window channel, door sweeps and thresholds must be able to be mechanically fastened in place.
<b>glazing</b> 1501-14.4	Glazing material - “commercial availability”. Safety glazing material shall conform to 16 CFR Part 1201 and have a minimum thickness of 1/16 inch.
<b>glazing - metal sashes</b> 1501-14.5	Glazing sealant compounds for metal sashes - conformance to ASTM C669.
<b>glazing - wood sashes</b> 1501-14.6	Glazing sealant compounds for wood sashes - conformance to F.S. TT-P-00791 B.
<b>general air barriers</b> 1501-14.7	General Air Impermeable Barrier materials - “commercial availability”. These materials shall be selected as appropriate to their use as described in these standards. The following air barrier materials shall be used for the following conditions:

Polyethylene Sheet Plastic shall have a minimum thickness of 6 mil. and be used as an interior air barrier material when moisture must be kept out of the conditioned space.

**polyethylene**  
1501-14.7a

Spun olefin membrane air infiltration barrier shall be used when moisture must escape from the conditioned space.

**spun olefin**  
1501-14.7b

Wood or Wood Composite Products shall be used where flame retardant abilities are not a factor. When exposed to moisture or weather, all raw exposed wood must be an exterior grade material and primed on all sides.

**wood/wood composites**  
1501-14.7c

Drywall shall be used in interior applications where excessive moisture is not a problem and where flame retardant abilities are a factor.

**drywall**  
1501-14.7d

Metal Flashing shall be used when high temperature or high moisture is a factor.

**metal flashing**  
1501-14.7e

Specialty Air Barrier material - “commercial availability”. Specialty materials include such items as electrical outlet gaskets and plugs, window pulley gaskets and interior wall patching materials.

**special air barriers**  
1501-14.8

Plastic films used to cover prime windows shall be clear vinyl, reusable, have a minimum thickness of 4 mils and seal tightly into a frame which is secured to the casing.

**plastic films**  
1501-14.9

#### *REPLACEMENT PRIME WINDOWS 1501-15*

Replacement prime windows should be thermally improved and the material standards shall meet the following standards.

**prime windows**  
1501-15

Aluminum Frame - conformance to ANSI/AAMA 101.

**aluminum frame**  
1501-15.1

Steel Frame - conformance to Steel Window Institute recommended specifications for steel windows.

**steel frame**  
1501-15.2

Wood Frame - conformance to ANSI/NWMA I.S. 2.

**wood frame**  
1501-15.3

Rigid Vinyl Frame - conformance to ASTM D4099.

**rigid vinyl frame**  
1501-15.4

**manufactured units**  
1501-15.5 For Manufactured dwelling units - conformance to HUD Manufactured Home Construction and Safety Standards, 24 CFR Part 3280, section 3280.403(b); or 3280.404 for egress (fire escape) windows.

*REPLACEMENT PRIME DOORS 1501-16*

**hinged steel**  
1501-16.1 Hinged Steel - conformance to SDI 100.

**hinged wood**  
1501-16.2 Hinged Wood - Flush Doors - conformance to exterior door provisions of ANSI/NWWDA I.S. 1.

**wood**  
1501-16.3 Pine, Fir, Hemlock, Spruce Doors - conformance to ANSI/NWWDA I.S. 6.

**manufactured units**  
1501-16.4 For manufactured dwelling units - conformance to HUD Manufactured Home Construction and Safety Standards, 24 CFR Part 3280, section 340.405(d).

*SECONDARY WINDOWS 1501-17*

**aluminum frame**  
1501-17.1 Aluminum frame - conformance to ANSI/AMMA 1002.10.

**wood frame**  
1501-17.2 Wood frame - conformance to Section 3 of ANSI/NWWDA I.S. 2.

**rigid vinyl frame**  
1501-17.3 Rigid vinyl frame - conformance to ASTM D4099.

**removable glazing**  
1501-17.4 Removable, non self-storing - acrylic glazing thickness 1/8 inch and rigid tight sealing frame.

*REPLACEMENT GAS LINES FOR STOVE 1501-18*

**gas flex line**  
1501-18.1 Flexible gas lines for stoves shall meet ANSI-Z21.24

*REPLACEMENT WATER HEATERS 1501-19*

**site-built DHW**  
1501-19.1 For site-built units, all replacement DHW units must be UL listed.

**mobile home DHW**  
1501-19-2 For mobile homes all replacement DHW units must be UL listed and must meet the following standard:

HUD Construction and Safety Standards, section 3280.707(d)(1) or (2).

If the DHW unit is to be installed in an area that is isolated from living area, and accessed from the exterior, it can be an atmospheric unit.

**isolated from living area**  
1501-19.3

If the DHW unit is to be installed in an area that is not isolated from living area, and which has either an interior or exterior access, it must be a sealed combustion unit.

**not isolated from living area**  
1501-19.4

### *CARBON MONOXIDE ALARMS 1501-20*

All carbon monoxide alarms shall:

**carbon monoxide alarms**  
1501-20.1

UL 2034-98

**approvals**  
1501-20.1a

Incorporate semiconductor technology.

**sensor type**  
1501-20.1b

Be tamper resistant.

**security**  
1501-20.1c

NOT have a field sensitivity adjustment which is accessible without removing covering.

**adjustment**  
1501-20.1d

Activate the alarm to indicate a gas concentration in excess of 30 ppm carbon monoxide for thirty days or 70 ppm carbon monoxide for 1 hour.

**thresholds**  
1501-20.1e

Not activate in the presence of a CO concentration of less than 70 ppm for less than 60 minutes or 30 ppm for less than 30 days.

**false alarms**  
1501-20.1f

Have a reset button with maximum 6 minute mute (hush).

**reset**  
1501-20.1g

Operate with 24V or 120 V AC power source.

**power**  
1501-20.1h

Have a minimum five year warranty.

**warranty**  
1501-20.1i

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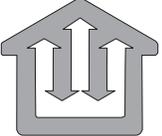
## OWPS 1501 APPENDICES AND REFERENCES—Materials Standards Appendix A

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<b>all raceways</b> 1501-20.2	All types of raceways shall comply with applicable provisions of Article 352 of the NEC.
<b>metallic raceways</b> 1501-20.3	Metallic raceways shall be UL listed for 120 volt applications.
<b>nonmetallic raceways</b> 1501-20.4	Nonmetallic raceways shall be flame resistant per UL 94-VO.
<b>fixture/outlet boxes</b> 1501-20.5	Fixture boxes and outlet boxes shall be UL listed.

### *SMOKE DETECTORS 1501-21*

<b>smoke detectors</b> 1501-21.1	All smoke detectors shall be:
<b>approvals</b> 1501-21.1a	UL listed.
<b>power source</b> 1501-21.1b	Battery operated unless of the hard-wired type, which is connected to the dwelling's electrical system, is required by local code.
<b>all raceways</b> 1501-21.2	All types of raceways shall comply with applicable provisions of Article 352 of the NEC.
<b>metallic raceways</b> 1501-21.3	Metallic raceways shall be UL listed for 120 volt applications.
<b>nonmetallic raceways</b> 1501-21.4	Nonmetallic raceways shall be flame resistant per UL 94-VO.
<b>fixture/outlet boxes</b> 1501-21.5	Fixture boxes and outlet boxes shall be UL listed.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>APPENDICES AND REFERENCES</b>
	Subject	<b>Certificate of Insulation</b>

*CERTIFICATE OF INSULATION 1502-1*

The Certificate of Insulation shall contain the following information:

**content**  
1502-1.1

- a. Address of the building.
- b. Date of completion of installation.
- c. Name and address of contractor.
- d. Insulation type(s).
- e. Insulation manufacturer.
- f. Location and dimension (in square feet) of each space which was insulated.
- g. The amount of insulation which was installed in each of the locations identified in 1502-1.1.f, given in the units in which the material is most commonly available (i.e. the number of batts, bags, etc.).
- h. The R-value installed in each of the locations identified in f.
- i. A statement, signed by an authorized individual, certifying that the installation was carried out in conformance to the applicable standard practices, codes and regulations.

**required information**  
1502-1.1.a - i.

The "Certificate of Insulation" shall be distributed and posted as follows:

**distribution and posting requirements**  
1502-1.2

- a. One copy shall be permanently affixed on or adjacent to the consumer's electric service panel.
- b. One copy shall be submitted to the homeowner or building occupant.

- c. One copy shall be retained for a period of five years by the agency responsible for the installation in the client files.

**manufacturer fact  
sheet**  
1502-1.3

A Manufacturer Fact Sheet is to be distributed to the ultimate consumer. This Fact Sheet shall clearly and conspicuously contain the information required under Chapter 119:4-3-14 of the Ohio Administrative Rules.

***NOTE:** In order to sell insulation in the State of Ohio, your manufacturer is required by Ohio State Law to provide a sufficient quantity of these fact sheets to be distributed by the installer to the ultimate consumer.*

(Sample)

PART I - GENERAL

Date of Completion \_\_\_\_\_

Address of Residence: \_\_\_\_\_

Name and Address of Contractor  
\_\_\_\_\_

PART II - AREAS INSULATED

Walls ( _____ sq. ft.)	
Type of Insulation: <b>Cellulose</b>	
Manufacturer: _____	
R-value Installed	Amount Installed sq. ft.
_____	_____
Weight of Bags	Number of Bags
_____	_____
Walls ( _____ sq. ft.)	
Type of Insulation: <b>Fiberglass</b>	
Manufacturer: _____	
R-value Installed	Amount Installed sq. ft.
_____	_____
Number of Rolls	Number of sq. ft./roll
_____	_____

Ceilings ( _____ sq. ft.)	
Type of Insulation: <b>Cellulose</b>	
Manufacturer: _____	
R-value Installed	Amount Installed sq. ft.
_____	_____
Weight of Bags	Number of Bags
_____	_____
Ceilings ( _____ sq. ft.)	
Type of Insulation: <b>Fiberglass</b>	
Manufacturer: _____	
R-value Installed	Amount Installed sq. ft.
_____	_____
Number of Rolls	Number of sq. ft./roll
_____	_____

Floors ( _____ sq. ft.)	
Type of Insulation: _____	
Manufacturer: _____	
R-value Installed	Amount Installed sq. ft.
_____	_____
Other (location) _____ ( _____ sq. ft.)	
Type of Insulation: _____	
Manufacturer: _____	
R-value Installed	Amount Installed sq. ft.)
_____	( _____
R-value Installed	Amount Installed sq. ft.)
_____	( _____



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>APPENDICES AND REFERENCES</b>
	Subject	<b>Sample Safety Policy</b>

*SAMPLE SAFETY POLICY 1503*

Statement of Safety Policy

The safety and health of every employee of the energy conservation program is of primary importance. Work related injuries and illnesses must be prevented. In order to assure a safe work environment, the following policy has been adopted:

The (provider name) will comply with state and federal safety codes and regulations.

Safety and health rules and regulations will be formulated and all employees shall be required to comply with them as a condition of employment.

All employees will be expected to comply with this program and to aid in making the work environment safe for themselves and their co-workers.

Suitable personal protective equipment will be issued to individual employees within program guidelines. The equipment will be issued in a sanitary condition.

Each supervisor will be responsible for safety in the area under his/her control. Each supervisor will be given the training, assistance, authority and support needed to fulfill this responsibility.

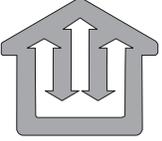
Every accident will be investigated promptly and thoroughly, with the aim of preventing a similar accident in the future.

Regularly scheduled safety inspections will be made to discover and eliminate unsafe conditions and practices that could cause accidents and injuries.

A safety committee will be formed with employee representation. Committee membership will be on a rotating basis so that as many employees as possible will be involved.

The provider will encourage the participation of all employees in a safety suggestion program. All suggestions will be forwarded to the safety committee for consideration.



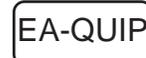
	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>APPENDICES AND REFERENCES</b>
		Subject	<b>Symbols, Abbreviations and Definitions</b>

## *SYMBOLS*

Consumer Energy Education - This symbol identifies points in the weatherization process to provide information to the customer regarding the impacts of their behavior on the energy use in the home.



EA-QUIP - This symbol identifies situations where calculations for the Energy Audit using the Queens Information Package are necessary to determine the cost effectiveness of a given retrofit.



Exclamation Point - This symbol indicates a hazard or critical area to examine for situations which could affect the safety or health of the customer or weatherization employee.



MHEA - This symbol identifies situations where calculations for the Mobile Home Energy Audit are necessary to determine the cost effectiveness of a given retrofit.



NEAT - This symbol identifies situations where NEAT calculations are necessary to determine the cost-effectiveness of a given retrofit.



STOP - This symbol indicates when weatherization work cannot start or continue until a particular problem or situation is corrected.



EBM - Electric Baseload Measurements - This symbol identifies sections that are specific to electric baseload measures and to the Electric Partnership Program. Replacement freezers and waterbed covers are not allowable HWAP expenditures.



*ABBREVIATIONS AND DEFINITIONS***- A -****- A -****Abatement**

Abatement - A measure or set of measures designed to permanently eliminate a hazard (i.e. lead based paint). Abatement strategies include removal of the hazardous materials, replacement of building components containing the hazardous material, enclosure or encapsulation. All of these strategies require proper preparation, cleanup, waste disposal post abatement clearance testing, and if applicable, record keeping and monitoring.

**Absorption**

Absorption - Absorption is the process by which a substance can be readily taken into the body through the skin or membranes. The best defense is to have a protective barrier between the substance and the skin.

**ACH50**

Air Changes per Hour at 50 Pascals (ACH50) - The number of times that the complete volume of a home is exchanged for outside air in one hour when a blower door depressurizes or pressurizes the home to 50 Pa.

**ACHnat**

Air Changes per Hour natural (ACHnat) - The number of times the indoor air is exchanged with the outdoor air in one hour under natural driving forces. It can be estimated with blower door use.

**air exchange**

Air exchange - The process where indoor air is replaced with the outdoor air through air leakage and ventilation. One CFM out equals one CFM in.

**air free CO**

Air Free CO - A method used to be able to compare CO readings with varying amounts of dilution air mixed in.

**air handler**

Air handler - A steel cabinet containing a blower with cooling and/or heating coils connected to ducts, which circulates indoor air across the exchangers and into the living space.

**air infiltration barrier**

Air infiltration barrier - A spun polymer sheet (for example, house wrap) that stops almost all the air traveling through a building cavity, while allowing moisture to pass through it.

**AFUE**

AFUE - Annual Fuel Utilization Efficiency - A laboratory derived efficiency for heating appliances which accounts for chimney losses, jacket losses, and cycling losses, but not distribution losses or fan/pump energy.

AAMA - Architectural Aluminum Manufacturers' Association **AAMA**

Asbestos - A fibrous mineral with fireproof and insulation characteristics which may be shaped into a variety of building materials. Small, sharp asbestos fibers may cause damage to lungs if they are inhaled. **asbestos**

Ambient air - Air in the living space. **ambient air**

ANSI - American National Standards Institute, Inc. **ANSI**

ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. **ASHRAE**

ASME - American Society of Mechanical Engineers **ASME**

ASTM - American Society for Testing and Materials **ASTM**

Ampere - A unit of measurement that tells how much electricity flows through a conductor. It is like cubic feet per second to measure the flow of water. For example, a 1,200 watt, 120 volt hair dryer pulls 10 amperes of electric current (watts divided by volts). **ampere**

Aquastat - A heating control that switches the burner or the circulator pump in a hydronic heating system. **aquastat**

Atmospheric appliances - A heating device that takes its combustion air from the surrounding room air. Also know as open-combustion heater. **atmospheric appliances**

**- B -**

**- B -**

Backdrafting - Continuous spillage of combustion gases from a vented combustion appliance into the living space. **backdrafting**

Backdraft damper - A damper, installed near a fan, that allows air to flow in only one direction and prevents reverse flow when the fan is off. **backdraft damper**

Backer rod - Polyethylene foam rope used as a backer for caulking. **backer rod**

Baffle - A plate or strip designed to retard or redirect the flow of flue gases. **baffle**

<b>balance point</b>	Balance point - The outdoor temperature at which no heating is needed to maintain inside temperatures.
<b>ballast</b>	Ballast - A coil of wire or electronic device that provides a high starting voltage for a lamp and limits the current from flowing through it.
<b>balloon framing</b>	Balloon framing - A method of construction in which the vertical framing members (studs) are continuous pieces running the entire height of the wall.
<b>bandjoist</b>	Bandjoist - See Rim joist.
<b>barometric vent damper</b>	Barometric vent damper - a device installed in the heating unit vent system to control draft. Usually used on oil-fueled units.
<b>base temperature</b>	Base temperature - The outdoor temperature below which heating or above which cooling systems are used.
<b>batt</b>	Batt - A blanket of preformed insulation, generally 14.5" or 22.5" wide and varying in thickness from 3.5" to 9".
<b>belly return</b>	Belly return - A configuration found in some mobile homes that uses the belly cavity as the return side of the distribution system.
<b>BCR</b>	Benefit-to-Cost Ratio (BCR) - See Savings-to-Investment Ratio (SIR).
<b>bimetal element</b>	Bimetal element - A metal spring, lever, or disc made of two dissimilar metals that expand and contract at different rates as the temperature around them changes. This movement operates a switch in the control circuit of a heating or cooling device.
<b>blocking</b>	Blocking - A building element or material used to prevent movement into or through building cavities.
<b>blow-down</b>	Blow-down - Removing water from a boiler to remove sediment and suspended particulates.
<b>blower</b>	Blower - The "squirrel-cage" fan in a furnace or air handler.
<b>blower door</b>	Blower door - A calibrated device to measure the air tightness of a building by pressurizing or depressurizing the building and measuring the flow through the fan.

Blown insulation - A loose-fill insulation that is blown into attics and building cavities using an insulation blowing machine. **blown insulation**

Boot - A duct section that connects between a duct and a register, floor, or wall cavity or between round and square ducts. **boot**

Branch circuit - An electrical circuit used to power outlets and lights within a home. **branch circuit**

Brightness - The luminous intensity of any surface in a given direction per unit of projected area of the surface as viewed in that direction. **brightness**

British Thermal Unit (Btu) - The quantity of heat required at sea level to raise the temperature of one pound of water one degree Fahrenheit. **Btu**

Btuh - British thermal units per hour. **Btuh**

Building cavities - The spaces inside walls, floors, and ceilings or between the interior and exterior sheeting. **building cavities**

Building science - An involved perspective on buildings, using contemporary technology to analyze and solve problems dealing with design, construction, maintenance, safety, and energy efficiency of the buildings. **building science**

BWR - Building Weatherization Report. **BWR**

Burner - A device that facilitates the burning of a fossil fuel like gas or oil. **burner**

Bypass - An air leakage site that allows air to leak out of a building passing around the air barrier and insulation. **bypass**

**- C -**

**- C -**

Carbon dioxide (CO<sub>2</sub>) - A heavy, colorless, nonflammable gas formed by the oxidation of carbon, by combustion, and in respiration of plants and animals. **Carbon Dioxide**  
**CO<sub>2</sub>**

Carbon monoxide (CO) - An odorless, colorless, tasteless, and poisonous gas produced by incomplete combustion. **Carbon Monoxide**  
**CO**

<b>caulking</b>	Caulking - A mastic compound for filling joints and cracks.
<b>cellulose insulation</b>	Cellulose insulation - Insulation, packaged in bags for blowing, made from newspaper or wood waste and treated with a fire retardant.
<b>certified</b>	Certified - Having successfully completed required training courses at the Ohio Weatherization Training Center or equivalent training facility.
<b>chimney</b>	Chimney - A building component designed for the sole purpose of assuring combustion by-products are exhausted to the exterior of the building.
<b>circuit breaker</b>	Circuit breaker - A device that disconnects an electrical circuit from electricity under a specified or abnormal condition of current flow.
<b>CFR</b>	CFR - Code of Federal Regulations.
<b>COP</b>	Coefficient of Performance (COP) - A heat pump or air conditioner's output in wathours of heat moved divided by wathours of electrical input.
<b>coil</b>	Coil - A snakelike piece of copper tubing surrounded by rows of aluminum fins which clamp tightly to the tubing to aid in heat transfer.
<b>CRI</b>	Color rendering index (CRI) - A measurement of a light source's ability to render colors the same as sunlight. CRI has a scale of 0 to 100.
<b>color temperature</b>	Color temperature - A measurement of the warmness or coolness of a light source in the Kelvin temperature scale.
<b>combustible</b>	Combustible - Susceptible to combustion, inflammable, any substance that will burn.
<b>combustible gas leak detector</b>	Combustible Gas Leak Detector - A device for determining the presence and general location of combustible gases in the air.
<b>combustion</b>	Combustion - The act or process of burning. Oxygen, fuel and a spark must be present for combustion to occur.
<b>combustion air</b>	Combustion air - Air required to chemically combine with a fuel during combustion to produce heat and flue gases, mainly carbon dioxide and water vapor.

Combustion analyzer - A device used to measure steady-state efficiency of combustion heating units.	<b>combustion analyzer</b>
Combustion appliance - Any appliance in which combustion occurs.	<b>combustion appliance</b>
Combustion Appliance Zone (CAZ) - The closed space or area which holds one or more combustion appliances.	<b>CAZ</b>
Combustion chamber - The area inside a heating unit where the flame burns.	<b>combustion chamber</b>
Compact fluorescent light (CFL) - A small fluorescent light engineered to fit conventional incandescent fixtures.	<b>compact fluorescent light</b>
Compressor - A motorized pump that compresses the gaseous refrigerant and sends it to the condenser where heat is released.	<b>compressor</b>
Condense - To change from a gaseous or vaporous state to a liquid or solid state by cooling or compression.	<b>condense</b>
Condenser - The coil in an air conditioning system where the refrigerant condenses and releases heat, which is carried away by air moving across the coil.	<b>condenser</b>
Condensate - The liquid formed when a vapor is condensed.	<b>condensate</b>
Condensate receiver - A tank for catching returning condensate water from a steam heating system.	<b>condensate receiver</b>
Conditioned - Intentionally heated or cooled areas of a building are conditioned.	<b>conditioned</b>
Conductance - The quantity of heat, in Btu, that will flow through one square foot of material in one hour, when there is a one degree Fahrenheit temperature difference between both surfaces. Conductance values are given for a specific thickness of material, not per inch thickness.	<b>conductance</b>
Conduction - The transfer of heat energy through a material (solid, liquid or gas) by the motion of adjacent atoms and molecules without gross displacement of the particles.	<b>conduction</b>
Conductivity - The quantity of heat that will flow through one square foot of homogeneous material, one inch thick, in one hour, when there is a temperature difference of one degree Fahrenheit between its surfaces.	<b>conductivity</b>

<b>confined space</b>	Confined space - A space with a volume of less than 50 cubic feet per 1,000 Btu per hour of the total input rating of all combustion appliances installed in that space.
<b>CEE</b>	CEE - Consumer Energy Education.
<b>contractor</b>	Contractor - Any for-profit, not-for-profit, or government entity that provides services to the program under contract, not as a result of a grant of funds.
<b>control circuit</b>	Control circuit - A circuit whose work is switching a power circuit or opening an automatic valve.
<b>convection</b>	Convection - The transmission of heat by the actual movement of a fluid because of differences in temperature, density, etc.
<b>CDD</b>	Cooling Degree Day.
<b>cooling load</b>	Cooling load - The maximum rate of heat removal required of an air conditioner when the outdoor temperature and humidity are at the highest expected level.
<b>cost-effective</b>	Cost-effective - Having an acceptable payback, return-on-investment, or savings-to-investment ratio.
<b>critical framing juncture</b>	Critical Framing Juncture - An intersection of framing members and envelope components that require special attention during prep and installation of insulation.
<b>cross section</b>	Cross section - A view of a building component drawn or imagined by cutting through the component.
<b>Ccm</b>	Ccm - Cubic feet per centimeter. Used to measure fluid flow.
<b>CFM</b>	CFM - Cubic Feet per Minute - A measurement of air movement in cubic feet past a certain point or through a certain structure per minute.
<b>CFM50</b>	CFM50 - The number of cubic feet per minute of air flowing through the fan housing of a blower door when the house pressure is 50 Pa (0.2 inches of water). This figure is the most common and accurate way of comparing the airtightness of buildings that are tested using a blower door.

CFMnat - The number of cubic feet of air flowing through a house from indoors to outdoors during typical, natural conditions. This figure can be roughly estimated using a blower door using the LBL (Lawrence Berkeley Labs) infiltration model.

**CFMnat**

**- D -**

**- D -**

Degree-days (DD) - A measure of the temperature element of climate produced by summing the temperature differences between the inside (65°F) and the daily average outside temperature for a one year period.

**DD**

Demand - The peak need for electrical energy. Some utilities levy a monthly charge for demand.

**demand**

Density - The weight of a material divided by its volume, usually measured in pounds per cubic foot.

**density**

DOE - The United States Department of Energy.

**DOE**

Depressurize - To lower the pressure in an enclosed area with respect to a reference pressure.

**depressurize**

Design temperature - A high or low temperature used for designing heating and cooling systems when calculating the building load.

**design temperature**

Dew point - The warmest temperature of an object in an environment where water vapor would condense from the surrounding air onto that object.

**dew point**

Dilution air - Air that enters through the dilution device-an opening where the chimney joins to an atmospheric-draft combustion appliance.

**dilution air**

Dilution device - A draft diverter or barometric draft control on an atmospheric-draft combustion appliance.

**dilution device**

Direct Vent Appliance - Appliances that are constructed and installed so that all combustion air is taken directly from and the flue gases are vented directly to the outside.

**direct vent appliance**

Distribution system - A system of pipes or ducts used to distribute energy.

**distribution system**

<b>DHW</b>	DHW - Domestic Hot Water
<b>dormer</b>	Dormer - A framed structure projecting above a sloping roof surface, and normally containing a vertical window.
<b>draft diverter</b>	Draft diverter - A device built into an appliance or made a part of the vent connector for an appliance that is designed to: 1) provide for the ready escape of the flue gasses from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood, 2) prevent a backdraft from entering the appliance, and 3) neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.
<b>drywall</b>	Drywall - Gypsum interior wallboard used to produce a smooth and level interior wall surface and to resist fire. Also called gypsum wall board and sheetrock.
<b>dry bulb temperature</b>	Dry bulb temperature - Normal ambient air temperature measured by a thermometer.
<b>duct blower</b>	Duct blower - A blower-door-like device used for testing duct leakiness and air flow.
<b>duct zone</b>	Duct zone - A building space or cavity which contains heating or cooling ducts.
<b>- E -</b>	
<b>eave</b>	Eave - The part of a roof that projects beyond its supporting walls. See also soffit.
<b>efficiency</b>	Efficiency - The ratio of output divided by input.
<b>efficacy</b>	Efficacy - The number of lumens produced by a watt used for lighting a lamp. Used to describe lighting efficiency.
<b>electric service</b>	Electric service - The electric meter and main switch, usually located outside the building.
<b>emittance</b>	Emittance - The rate that a material emits radiant energy from its surface. Also called emissivity.
<b>encapsulation</b>	Encapsulation - Any covering or coating that acts as a barrier between the hazard (i.e. lead-based paint) and the environment, the durability of which relies on adhesion and the integrity of existing bonds between any existing layers (i.e. paint) and the substrate.

Enclosure - The use of rigid, durable construction materials that are mechanically fastened to the substrate to act as a barrier between the hazardous material (i.e. lead-based paint) and the environment.	<b>enclosure</b>
Energy - A quantity of heat or work.	<b>energy</b>
Energy Audit - The process of identifying energy conservation opportunities in buildings.	<b>energy audit</b>
EQ-QUIP - This symbol identifies situations where calculations for the Energy Audit using the Queens Information Package are necessary to determine the cost effectiveness of a given retrofit.	<b>EA-QUIP</b>
Energy consumption - The conversion or transformation of potential energy into kinetic energy for heat, light, electricity, etc.	<b>energy consumption</b>
Energy efficiency - Term describing how efficiently a building component uses energy.	<b>energy efficiency</b>
EEM - Energy efficiency measure.	<b>EEM</b>
Energy efficiency ratio (EER) - A measurement of energy efficiency for room air conditioners. The EER is computed by dividing cooling capacity, measured in British Thermal Units per hour (Btuh), by the watts of power. (See also Seasonal Energy Efficiency Rating-SEER)	<b>EER</b>
Envelope - The building shell. The exterior walls, floor, and roof assembly of a building.	<b>envelope</b>
Environmentally-sensitive - A person who is highly sensitive to pollutants, often because of overexposure, is said to be environmentally sensitive.	<b>environmentally-sensitive</b>
Evaporation - The process of being changed into a vapor or gas, at a temperature below the boiling point. Evaporation is a cooling process.	<b>evaporation</b>
Evaporative cooler - A device for cooling homes in dry climates that cools the incoming air through the evaporation of water.	<b>evaporative cooler</b>
Evaporator - The heat transfer coil of an air conditioner or heat pump that cools the surrounding air as the refrigerant inside the coil evaporates and absorbs heat.	<b>evaporator</b>

<b>exacerbate</b>	Exacerbate - To aggravate or make worse.
<b>exfiltration</b>	Exfiltration - Air flowing out of a building from its conditioned space through the holes in the shell.
<b>- F -</b>	<b>- F -</b>
<b>°F</b>	Fahrenheit - A temperature scale in which water boils at 212° and freezes at 32°.
<b>fan control</b>	Fan control - A bimetal thermostat that turns the furnace blower on and off as it senses the presence of heat.
<b>FS</b>	F.S. - Federal Specifications
<b>feeder wires</b>	Feeder wires - The wires connecting the electric meter and main switch with the main panel box indoors.
<b>fenestration</b>	Fenestration - Window and door openings in a building's wall.
<b>fiberglass</b>	Fiberglass - A fibrous material made by spinning molten glass.
<b>fill tube</b>	Fill tube - A plastic or metal tube used for its stiffness to blow insulation inside a building cavity and allows the insulation to be delivered at the extreme end of the cavity.
<b>FHDA</b>	FHDA - Fir and Hemlock Door Association
<b>fire stop</b>	Fire stop - Framing member, usually installed horizontally between studs, designed to stop the spread of fire within a wall cavity.
<b>firring</b>	Firring - Thin wood strips fastened to a wall or ceiling surface as a nailing base for finish materials.
<b>flame safety control</b>	Flame safety control - A control for avoiding fuel delivery in the event of no ignition.
<b>flammable/ inflammable</b>	Flammable/Inflammable - Combustible; readily set on fire.
<b>flashing</b>	Flashing - Waterproof material used to prevent leakage at intersections between the roof surface at walls or penetrations.

Floor joists - The framing members that support the floor. **floor joists**

Flue - a vent for combustion gases. **flue**

Foamboard - Plastic foam insulation manufactured most commonly in 4' x 8' sheets in thicknesses of 1/2" to 3". **foamboard**

Footcandle - A measure of light striking a surface. **footcandle**

Footing - The part of a foundation system that actually transfers the weight of the building to the ground. **footing**

Frost line - The maximum depth of the soil where water will freeze during the coldest weather. **frost line**

**- G -**

**- G -**

Gable - The triangular section of an end wall formed by the pitch of the roof. **gable**

Gable roof - A roof shape that has a ridge at the center and slopes in two directions. **gable roof**

GAMA - Gas Appliance Manufacturers' Association **GAMA**

Gasket - Elastic strip that seals a joint between two materials. **gasket**

Ground Fault Circuit Interrupter (GFI or GFCI) - An electrical connection device which breaks a circuit if a short occurs. These are required for all exterior use of electrical equipment or when an electrical outlet is located near a water source. **GFI/GFCI**

Glazing - Glass installation. Pertaining to glass assemblies or windows. **glazing**

Glazing compound - A flexible, putty-like material used to seal glass in its frame. **glazing compound**

Grantee - A non-profit service provider that has been awarded a grant of funds to operate the Home Weatherization Assistance Program. **grantee**

Gypsum board - A common interior sheeting material for walls and ceilings made of gypsum rock powder packaged between two sheets of heavy building paper. Also called sheetrock, gyprock, or gypboard. **gypsum**

- H -

- H -

<b>hazardous condition</b>	Hazardous condition - A situation which is causing a danger to the client/crew/contractor that either exists prior to, is created by, or is exacerbated by, weatherization. For example, a dwelling could have a moisture problem that is allowing biological hazards (molds, viruses, bacteria, etc.) to flourish. Another example would be allowing fiberglass to enter the living space due to improperly fastened or sealed ductwork.
<b>hazardous material</b>	Hazardous material - A particular substance that is considered to be a danger to the client/crew/contractor.
<b>HHS</b>	HHS - United States Department of Health and Human Services
<b>heat anticipator</b>	Heat anticipator - A very small electric heater in a thermostat that causes the thermostat to turn off before room temperature reaches the thermostat setting, so that the house does not overheat from heat remaining in the furnace and distribution system after the burner shuts off.
<b>heat capacity</b>	Heat capacity - The quantity of heat required to produce a unit of temperature change.
<b>heat exchanger</b>	Heat exchanger - The area in a heating unit that separates the combustion process from the distribution fluid with the sole purpose of transferring heat from the combustion process to the distribution fluid.
<b>heat loss</b>	Heat loss - The amount of heat escaping through the building shell during some period of time like a month or year.
<b>heat pump</b>	Heat pump - A type of heating unit, usually electric, which uses a refrigerant fluid to produce heat.
<b>heat rise</b>	Heat rise - The number of degrees of temperature increase that air is heated as it is blown over the heat exchanger. Heat rise equals supply temperature minus return temperature.
<b>HDD</b>	Heating degree day (HDD)- Each degree that the average daily temperature is below the base temperature (usually 65°F) constitutes one heating degree day.

Heating load - The maximum amount of heat needed by a building during the very coldest weather to maintain the designed inside temperature. **heating load**

Heating seasonal performance factor (HSPF) - Rating for heat pumps describing how many Btus they transfer per kilowatt-hour of electricity consumed. **HSPF**

HVAC - Heating, Ventilating, Air-Conditioning **HVAC**

High limit - A bimetal thermostat that turns the heating element of a furnace off if it senses a dangerously high temperature. **high limit**

Hip Roof - A roof that slants in four directions from a central peak. **hip roof**

Home energy index - The number of Btus of energy used by a home divided by its area in square feet, then divided by the number of heating degree days during the time period. **home energy index**

HVI - Home Ventilating Institute **HVI**

HWAP - Home Weatherization Assistance Program **HWAP**

House pressure - The difference in pressure between the inside and outside of the house. **house pressure**

HUD - United States Department of Housing and Urban Development **HUD**

Humidistat - An automatic control that switches a fan, humidifier, or dehumidifier on and off based on the relative humidity at the control. **humidistat**

Humidity ratio - The absolute amount of air's humidity measured in pounds of water vapor per pound of dry air. **humidity ratio**

Hydronic - A heating system using hot water or steam as the heat-transfer fluid. A hot-water heating system (common usage). **hydronic**

**- I -**

**- I -**

Illumination - The light level measured on a horizontal plane in footcandles. **illumination**

<b>incandescent light</b>	Incandescent light - The common light bulb found in residential lamps and light fixtures and sold in stores everywhere that is known for its inefficiency.
<b>IAQ</b>	IAQ - Indoor Air Quality
<b>infiltration</b>	Infiltration - The uncontrolled movement of non-conditioned air into a conditioned air space.
<b>infrared</b>	Infrared - Pertaining to heat rays emitted by the sun or warm objects on earth.
<b>ingestion</b>	Ingestion - Ingestion is the process by which a substance enters the body by swallowing through the mouth. The best defense is to wash your hands before eating or putting your fingers in your mouth, keeping hazardous materials out of reach from small children, and guarding against splashing of hazardous materials into your mouth.
<b>inhalation</b>	Inhalation - Inhalation is the process by which a substance is breathed into the body in the form of a gas, vapor, fume, mist, or dust. The best defense is to use a proper filter to remove these contaminants before they enter the body or to not create dust if possible.
<b>input rating</b>	Input rating - The designed capacity of an appliance usually specified in Btus or units of energy.
<b>insulating glass</b>	Insulating glass - Two or more glass panes spaced apart and sealed in a factory giving a higher R-value.
<b>insulation</b>	Insulation - A material used to retard heat transfer.
<b>IID</b>	Intermittent ignition device (IID)- A device that lights the pilot light on a gas appliance when the control system calls for heat, thus saving the energy wasted by a standing pilot.
<b>internal gains</b>	Internal gains - The heat generated by bathing, cooking, and operating appliances that must be removed during the summer to promote comfort or will reduce the heating demand in the winter.
<b>interstitial</b>	Interstitial - Space between framing and other building components.

- J -

Joist - A horizontal wood framing member that supports a floor or ceiling.

**joist**

Joule - A unit of energy. One thousand joules equals 1 Btu.

**joule**

- J -

- K -

Kilowatt - One thousand watts. A unit of measurement of the amount of electricity needed to operate given equipment.

**kilowatt (kW)**

Kilowatt-hour - The most commonly used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour.

**kilowatt hour (kWh)**

Kinetic energy - Consisting of or depending on motion; distinguished from potential energy.

**kinetic energy**

- L -

Lamp - A light bulb.

**lamp**

Latent heat - The amount of heat required to change the state of a substance from a solid to a liquid or from a liquid to a gas without changing the temperature of the substance.

**latent heat**

Lath - A thin strip of wood or base of metal or gypsum board serving as a support for plaster.

**lath**

Light quality - Good light quality is characterized by absence of glare and low brightness contrast.

**light quality**

Low-water cutoff - A float-operated control for turning the burner off if a steam boiler is low on water.

**low-water cutoff**

Lumen - A unit of light output from a lamp.

**lumen**

Low-E - Short for low emissivity, which means the characteristic of a metallic glass coating to resist the flow of radiant heat.

**low-e**

- M -

Main panel box - The service box containing a main switch, and the fuses or circuit breakers located inside the home.

**main panel box**

- M -

<b>major gas leak</b>	Major gas leak - A gas leak that is detectable by the human nose.
<b>make-up air</b>	Make-up air - Air supplied to a space to replace exhausted air.
<b>manifold</b>	Manifold - A tube with one inlet and multiple outlets or multiple inlets and one outlet.
<b>manometer</b>	Manometer - A pressure differential gauge used for measuring gas and air pressures.
<b>MHEA</b>	MHEA - Manufactured Housing Energy Audit, developed by DOE for HWAP. Used to audit mobile homes.
<b>masonry</b>	Masonry - Construction of stone, brick, or concrete block.
<b>mastic</b>	Mastic - A thick creamy substance used to seal seams and cracks in building materials and especially useful on ductwork.
<b>MSDS</b>	MSDS - Materials Safety Data Sheet
<b>metabolic process</b>	Metabolic process - Chemical and physiological activities in the human body.
<b>minor gas leak</b>	Minor gas leak - A gas leak that is detectable only with the use of sensitive gas detection equipment.
<b>mitigate</b>	Mitigate - To make less severe. To mollify.
<b>mobile home</b>	Mobile Home. See manufactured home.
<b>manufactured home</b>	Manufactured Home A manufactured home is built on a steel undercarriage with a necessary wheel assembly, to be transported to a permanent or semi-permanent site. The wheel assembly can be removed when the house is placed on a permanent foundation, but the steel undercarriage remains intact as a necessary structural component.
<b>modular home</b>	Modular Home A modular home is made of large prefabricated units that are assembled at the final site. Although a modular home can be transported on a steel undercarriage, the undercarriage is not a permanent and necessary structural component and is usually removed when the home is placed on a permanent foundation.

Mortar - A mixture of sand, water, and cement used to bond bricks, stones, or blocks together. **mortar**

**- N -**

**- N -**

NBS - The National Bureau of Standards, Department of Commerce renamed the National Institute of Standards and Technology (NIST). **NBS**

NEMA - National Electrical Manufacturers' Association **NEMA**

NEAT - National Energy Audit, developed by DOE for HWAP. Used to audit single-family and low-rise multi-family buildings. **NEAT**

NFPA - National Fire Protection Association **NFPA**  
NWMA - National Woodwork Manufacturers Association **NWMA**

Net Free Vent Area (NFVA) - The area of a vent after that area has been adjusted for the restrictions caused by insect screen, louvers and weather coverings. The free area is always less than the actual area. **NFVA**

Natural ventilation - Ventilation using only natural air movement, without fans or other mechanical devices. **natural ventilation**

Non-conditioned space - An area within the building envelope that is not intentionally heated and tends to be the same temperature as outside. **non-conditioned area**

Nozzle - An orifice designed to change a liquid like oil into a mist to improve the combustion process. **nozzle**

**- O -**

**- O -**

OEE - Ohio Department of Development's Office of Energy Efficiency. **OEE**

ODOD - Ohio Department of Development. **ODOD**

Ohm - A unit of measure of electrical resistance. One volt can produce a current of one ampere through a resistance on one ohm. **ohm**

<b>orifice</b>	Orifice - A hole in a gas pipe where gas exits the pipe to be mixed with air in a burner before combustion in a heating device. The size of the orifice will help determine the flow rate.
<b>output capacity</b>	Output capacity - The conversion rate of useful heat or work that a device produces after waste involved in the energy transfer is accounted for.
<b>O<sub>2</sub></b>	O <sub>2</sub> - Oxygen
<b>ODS</b>	Oxygen Depletion Sensor (ODS) - A safety device for unvented combustion heaters that shuts off gas when oxygen is depleted.
<b>- P -</b>	
<b>ppm</b>	Parts per million (ppm) - The unit commonly used to represent the degree of pollutant concentration where the concentrations are small.
<b>Pa</b>	Pascal (Pa) - A metric unit of measurement of air pressure. 2.5Pa = 0.01 inches of water column.
<b>payback period</b>	Payback period - The number of years that an investment in energy conservation will take to repay its cost in energy savings.
<b>PMI</b>	PMI - Per manufacturer's instructions.
<b>perimeter pull</b>	Perimeter Pull - A technique used in attics previously insulated with batt insulation. The batts are cut back 2 feet from the eaves and the area is insulated with blown insulation to ensure coverage over the outer wall top plate and to prevent wind washing of the insulation under the existing batts.
<b>perlite</b>	Perlite - A heat-expanded mineral used for insulation.
<b>perm</b>	Perm - A measurement of how much water vapor a material will let pass through it per unit of time.
<b>pitot tube</b>	Pitot Tube - A device for measuring fluid velocity: an instrument placed in a moving fluid and used along with a manometer to measure fluid velocity.

Plaster - A plastic mixture of sand, lime, and portland cement spread over wood or metal lathe to form the interior surfaces of walls and ceilings.	<b>plaster</b>
Plate - A piece framing member installed horizontally to which the vertical studs in a wall frame are attached.	<b>plate</b>
Plenum - The section of ductwork that connects the air handler to the main supply duct.	<b>plenum</b>
Plywood - Laminated wood sheeting with layers cross grained to each other.	<b>plywood</b>
PAC - Policy Advisory Committee is a group of advisors that oversee the operation of the HWAP.	<b>PAC</b>
Polyethylene - A plastic made by the polymerization of ethylene, used in making translucent, lightweight, and tough plastics, films, insulations, vapor retarders, air barriers, etc.	<b>polyethylene</b>
Polyisocyanurate - A plastic foam insulation sold in sheets, similar in composition to polyurethane.	<b>polyisocyanurate</b>
Polystyrene insulation - A rigid plastic foam insulation, usually white, blue, pink or green in color.	<b>polystyrene insulation</b>
Polyurethane - A versatile plastic foam insulation, usually yellow in color.	<b>polyurethane</b>
Potential energy - Energy in a stored or packaged form.	<b>potential energy</b>
Pressure - A force that encourages movement by virtue of a difference in some condition between two areas. High pressure moves to low pressure.	<b>pressure</b>
Pressure diagnostics - The practice of measuring pressures and flows in buildings to control air leakage, and also to ensure adequate heating and cooling air flows and ventilation.	<b>pressure diagnostics</b>
Pressure pan - A device used to block a duct register, while measuring the static pressure behind it.	<b>pressure pan</b>
Pressure Relief Valve - A safety component required on a HWT, designed to relieve excess pressure buildup in the tank.	<b>pressure relief valve</b>

**pressuretrol** Pressuretrol - A control that turns a steam boiler's burner on and off as steam pressure changes.

**prime window** Prime window - The main window installed on the outside wall. Not to be confused with a storm window.

**provider** Provider - Either a grantee or contractor.

**- R -**

**- R -**

**R-value** R-value - A measurement of thermal resistance.

**radiant barrier** Radiant barrier - A foil sheet or coating designed to reflect radiant heat flow. Radiant barriers are not insulating materials.

**radiant temperature** Radiant temperature - The average temperature of objects in a home like walls, ceiling, floor, furniture, and other objects.

**radiation** Radiation - Heat energy that is transferred by electromagnetic or infrared light from one object to another. Radiant heat flow can travel through a vacuum.

**radon** Radon - A radioactive gas that decomposes into radioactive particles.

**rafter** Rafter - A beam that gives form and support to a roof.

**rated ventilation** Rated ventilation - A ventilation system that has been designed and installed under the guidelines established by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) or guidance in the WPS.

**reflectance** Reflectance - The ratio of lumenation or radiant heat reflected from a given surface to the total light falling on it. Also called reflectivity.

**refrigerant** Refrigerant - Any of various liquids that vaporize at a low temperature, used in mechanical refrigeration.

**register** Register - A grill covering a duct outlet used to diffuse the air flow and sometimes control the flow.

Relative humidity - The percent of moisture present in the air compared to the maximum amount possible at that given temperature. Air that is saturated has 100% relative humidity.	<b>relative humidity</b>
Relay - An automatic, electrically-operated switch.	<b>relay</b>
Removal - A complete withdrawal of the hazardous material from the dwelling.	<b>removal (hazard)</b>
Reset controller - Adjusts fluid temperature or pressure in a central heating system according to outdoor air temperature.	<b>reset controller</b>
RCS - Residential Conservation Service Program	<b>RCS</b>
Resistance - The property of a material resisting the flow of electrical energy or heat energy.	<b>resistance</b>
Retrofit - An energy conservation measure that is applied to an existing building. Also means the action of improving the thermal performance or maintenance of a building.	<b>retrofit</b>
Return air - Air circulating back to the furnace or central air conditioning unit from the house, to be heated or cooled and supplied back to the living area.	<b>return air</b>
Rim joist - The outermost joist around the perimeter of the floor framing.	<b>rim joist</b>
Room air conditioner - A unitary air conditioner installed through a wall or window, which cools the room by removing heat from the room and releasing it outdoors.	<b>room air conditioner</b>
<b>- S -</b>	
Sash - A movable or stationary part of a window that frames a piece of glass.	<b>sash</b>
Saturation - Describing air at 100% relative humidity or dry steam.	<b>saturation</b>
Savings-to-Investment Ratio (SIR)- Measures how many times an energy retrofit pays for itself during its lifetime and includes discounting the investment value and escalations in fuel costs.	<b>SIR</b>

<b>sealed combustion appliance</b>	Sealed-combustion appliance - An appliance that draws combustion air from outdoors and has a sealed exhaust system.
<b>SEER</b>	Seasonal energy efficiency ratio (SEER) - A measurement of energy efficiency for central air conditioners. The SEER is computed by dividing cooling capacity, measured in Btuh, by the watts. (See also Energy Efficiency Rating.)
<b>sensible heat</b>	Sensible heat - The heat required to change the temperature of a material without changing its form.
<b>sequencer</b>	Sequencer - A bimetal switch that turns on the elements of an electric furnace in sequence.
<b>service wires</b>	Service wires - The wires coming from the utility transformer to the service equipment of the building.
<b>sheathing</b>	Sheathing - A structural sheeting, attached on top of the framing, underneath siding and roofing of a building. Any building material used for covering a building surface.
<b>sheetrock</b>	Sheetrock - See drywall.
<b>shell</b>	Shell - The building's exterior envelope—walls, floor, and roof of a building.
<b>shingle</b>	Shingle - A modular roofing component installed in overlapping rows.
<b>short circuit</b>	Short circuit - A dangerous malfunction in an electrical circuit, where electricity is flowing through conductors and into the ground without going through an electric load, like a light or motor.
<b>sill</b>	Sill - The bottom of a window or door frame.
<b>sill box</b>	Sill box - The area bounded by the rim joist, floor joists, sill plate, and floor.
<b>sling psychrometer</b>	Sling psychrometer - A device holding two thermometers, one wet and one dry, that is slung through the air to measure relative humidity.
<b>slope</b>	Slope - The roof section of a kneewall attic with the roof and ceiling surfaces attached to the rafters.

Soffit - The underside of a roof overhang or a small lowered ceiling, as above cabinets or a bathtub.	<b>soffit</b>
Solar gain - Heat from the sun that is absorbed by a building and contributes to the need for cooling in the summer and less heating in the winter.	<b>solar gain</b>
Solenoid - A magnetic device that moves a switch or valve stem.	<b>solenoid</b>
Space heating - Heating the living spaces of the home with a room heater or central heating system.	<b>space heating</b>
Spillage - Temporary flow of combustion gases from a dilution device.	<b>spillage</b>
Stack effect - The tendency for warm buoyant air to rise and leak out of the top of the house and be replaced by colder outside air entering from the bottom of the house.	<b>stack effect</b>
Standing losses - Losses from a hot water storage tank through its shell.	<b>standing losses</b>
Steady-state efficiency (SSE) - The efficiency of a heating appliance, after an initial start-up period, that measures how much heat crosses the heat exchanger. The steady-state efficiency is measured by a combustion analyzer.	<b>SSE</b>
Steam trap - An automatic valve that closes to trap steam in a radiator until it condenses.	<b>steam trap</b>
Steam vent - A bimetal-operated air vent that allows air to leave steam piping and radiators, but closes when exposed to steam itself.	<b>steam vent</b>
SDI - Steel Door Institute	<b>SDI</b>
Stud - A vertical framing member used to build a wall.	<b>stud</b>
Subfloor - The sheathing over the floor joists and under the flooring.	<b>subfloor</b>
Supply air - Air that has been heated or cooled and is then moved through the ducts and out the supply registers of a home.	<b>supply air</b>

**suspended ceiling**                      Suspended ceiling - Modular ceiling panels supported by a hanging frame.

**- T -**

**- T -**

**therm**                                      Therm - A unit of energy equalling 100,000 Btus or 29.3 kilowatt-hours.

**thermal break**                      Thermal break - A piece of relatively low conducting material between two high conducting materials installed to reduce heat flow through the assembly.

**thermal bridging**                      Thermal bridging - Rapid heat conduction resulting from direct contact between very thermally conductive materials like metal and glass.

**thermal bypass**                      Thermal bypass - An indirect penetration that tends to reduce the effectiveness of insulation by allowing conditioned air to move out of a structure, or allowing unconditioned air to move in, depending on the pressures exerted on it.

**thermal conductance**                      Thermal conductance - A material's ability to transmit heat; the inverse of the R-value.

**thermal resistance**                      Thermal resistance - Same as R-value, expressing ability to retard heat flow.

**thermocouple**                      Thermocouple - A bimetal-junction electric generator used to keep the safety valve of an automatic gas valve open.

**thermostat**                              Thermostat - A device used to control a heating or cooling system to maintain a set temperature.

**transformer**                              Transformer - A double coil of wire that reduces or increases voltage from a primary circuit to a secondary circuit.

**transition duct**                      Transition duct - Transition ducts are used to connect the dryer to the exhaust duct and shall be listed for that application or installed in accordance with the clothes dryer manufacturer's installation instructions.

**truss**                                      Truss - A braced framework usually in the shape of a triangle to form and support a roof.

- U -

U-value - The total heat transmission in Btus per square feet per hour with a 1°F temperature difference between the inside and the outside; the thermal conductance of a material.

Ultraviolet radiation - Light radiation having wavelengths beyond the violet end of the visible spectrum; high frequency light waves.

Underlayment - Sheeting installed to provide a smooth, sound base for a finish material.

UL - Underwriter's Laboratory  
 Unintentionally conditioned space - Areas in a building that are not intentionally heated but are heated indirectly by internal heat gain from the heating unit, duct or heat distribution losses, or other unintended heat loss.

- U -

**U-value**

**ultraviolet radiation**

**underlayment**

**UL**  
**unintentionally conditioned space**

- V -

Vapor barrier - A material that retards the passage of water vapor.

Vapor diffusion - The flow of water vapor through a solid material.

Vapor diffusion retarder - A vapor barrier.

Vaporize - Change from a liquid to a gas.

Vent damper - An automatic damper powered by heat or electricity that closes the chimney while a heating device is off.

Ventilation - The movement of air through an area for the purpose of removing moisture, air pollution, or unwanted heat.

Venting - The removal of combustion gases by a chimney.

Vermiculite - A heat-expanded mineral used for insulation.

- V -

**vapor barrier**

**vapor diffusion**

**vapor diffusion retarder**

**vaporize**

**vent damper**

**ventilation**

**venting**

**vermiculite**

**volt** Volt - A unit of electromotive force. It is the amount of force required to drive a steady current of one ampere through a resistance of one ohm. Electrical systems of most homes have 120 volts.

- **W** -

- **W** -

**wc"** WC" - Water Column, Inches of, a measure of pressure in fluids.

**watt** Watt (W) - A unit measure of electric power at a point in time, as capacity or demand. One watt of power maintained over time is equal to one joule per second.

**watt-hour** Watt-hour - One watt of power extended for one hour. One thousandth of a kilowatt hour

**weatherization** Weatherization - The process of reducing energy consumption and increasing comfort in buildings by improving energy efficiency of the building and maintaining health and safety.

**WPS** WPS - Weatherization Program Standards. Inspection, installation and materials standards developed for use in the Ohio Home Weatherization Assistance Program.

**weatherstripping** Weatherstripping - Flexible gaskets, often mounted in rigid metal strips, for limiting air leakage.

**weep holes** Weep holes - Holes drilled for the purpose of allowing water to drain out of an area in a building component where it may accumulate.

**wet-bulb temperature** Wet-bulb temperature - The temperature of a dampened thermometer of a sling psychrometer used to determine relative humidity.

**window films** Window films - Plastic films, coated with a metalized reflective surface, that are adhered to window glass to reflect heat rays from the sun.

**window frame** Window frame - The sides, top, and sill of the window which forms a box around window sashes and other components.

WRT - “With reference to” used to show that the air pressures between two areas are being compared.

**WRT**

Worst-case depressurization test - A safety test, performed by specific procedures, designed to assess the probability of chimney backdrafting.

**worst-case draft**



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>APPENDICES AND REFERENCES</b>
	Subject	<b>Carbon Monoxide and Smoke Detectors</b>

*CARBON MONOXIDE ALARMS 1505-1*

Alarms shall be installed:

- a. PMI;
- b. a minimum of 5 feet above the floor;
- c. a minimum of 1 foot below the ceiling; and
- d. to a circuit that is energized (hot) at all times.

**installation**  
1505-1.1

Reference Section 1501-20 for material specifications for alarms.

Alarms shall NOT be installed:

- a. in a home where there is an existing CO alarm
- b. in an area with room temperature outside of the range specified by the manufacturer, within 5 feet of a combustion appliance nor on the opposite wall from the appliance;
- c. within 5 feet of a combustion appliance flue, vent, chimney;
- d. within 5 feet of direct path of supply or exhaust fan;
- e. within 5 feet of a storage area for vapor producing household chemicals and gases;
- f. within 12 inches of exterior doors and windows;
- g. within a furnace closet/room;
- h. with an electrical connection to a switched circuit; or
- i. with a connection to a GFCI receptacle, downline from (in series with) a GFCI receptacle, or in a receptacle controlled by a GFCI breaker.

**alarm cautions**  
1505-1.2

**when to install**  
1505-1.3

A carbon monoxide alarm shall be installed (Refer to Section 1501-20 for material specifications of alarm):

- a. in all homes that have an unvented space heater in operation; or
- b. in all homes that have a return system of a forced air furnace (gas, oil, or electric) drawing it's air from a space containing a wood stove, fireplace, or other space heating or water heating combustion appliance.

**consumer education**  
1505-1.4

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The consumer shall be provided with verbal and written information regarding:

- a. the effects and symptoms of carbon monoxide poisoning;
- b. alarm maintenance;
- c. alarm testing;
- d. how to respond to an activated alarm; and
- e. the manufacturer's manuals and instructions.

*SMOKE DETECTOR ALARM STANDARDS 1505-2*

**installation**  
1505-2.1

Alarms shall be installed:

- a. PMI;
- b. within 4 to 12 inches from the ceiling, when the detector is a wall mounted unit;
- c. at least 4 inches from the nearest wall, when the detector is a ceiling mounted unit;
- d. to a circuit that is energized (hot) at all times, when applicable; and
- e. all cords to outlets must be enclosed by an non-metallic conduit.

Alarms shall NOT be installed:

- a. in a home with an existing smoke detector alarm;
- b. too near a window, exterior door, or forced-air register;
- c. with an electrical connection to a switched circuit;  
or
- d. with a connection to a GFCI receptacle, downline from (in series with) a GFCI receptacle, or in a receptacle controlled by a GFCI breaker.

**alarm cautions**  
1505-2.2

A smoke detector shall be installed:

- a. in all homes that have a space heater (vented or unvented) in operation; or
- b. in all homes that have a wood stove or operational fireplace.

**when to install**  
1505-2.3

Consumer Education

The consumer shall be provided with verbal and written information regarding:

- a. alarm maintenance, including the need to replace the battery;
- b. alarm testing;
- c. how to respond to an activated alarm; and
- d. the manufacturer's manuals and instructions.

**consumer education**  
1505-2.4

CEE





State of Ohio  
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Section **DIAGNOSTIC TESTING  
METHODS**

Subject **Blower Door Test**

*BLOWER DOOR TEST PREPARATION 1506-1.1*

Prepare the house for a blower door test by performing the following steps:

**house preparation**  
1506-1.1a

Deactivate all vented combustion-type appliances prior to depressurizing the structure by turning the thermostat down or the appliance off.

**depressurization  
(normal)**  
1506-1.1b

Prepare to perform a one-point pressurization test on structures with an operating drip pot, fuel oil-fired, wood or coal combustion unit (see 1506-1.3 for specific procedures).

**pressurization  
(special case)**  
1506-1.1c

Prevent the ashes of wood/coal burning units from entering the living space by closing/sealing doors and dampers or by cleaning out or covering the ashes.

**ashes, wood and coal**  
1506-1.1d

Inspect the house for loose or missing hatchways, panelling, ceiling tiles, or glazing panes. Secure any items that may become dislocated during the test and seal any missing hatchways.

**loose items**  
1506-1.1e

Close all prime windows, self-storing storm windows (if possible), exterior doors and latch them as they normally would be found during the winter.

**windows**  
1506-1.1f

Open all livable areas to the interior of the structure, even if the occupants close them off during the winter.

**livable areas open**  
1506-1.1g

Close basement doors during test unless one of the following conditions is present:

**basement doors**  
1506-1.1h

1. The basement is used as a living area.
2. The client leaves the basement door open during the winter or there is no basement door.
3. The air returns do not connect directly to the furnace.

---

<b>basement doors (con't)</b> 1506-1.1h	4. The basement is to be considered to be inside the Building Envelope.
<b>favorable location</b> 1506-1.1i	Set up the blower door unit in a favorable location in an area free from obstructions and wind interference.
	<i>BLOWER DOOR TEST, DEPRESSURIZATION (NORMAL)</i> <i>1506-1.2</i>
<b>depressurization/ pressurization</b> 1506-1.2a	Perform a 1 point blower door test at 50 pa or the highest achievable house pressure if unable to reach 50 pa. Use the depressurization mode, unless a solid fuel unit or drip-pot, oil burning space heater is in operation. (See 1506-1.1c).
<b>setup location</b> 1506-1.2b	Set the blower door up in a door with the least number of obstacles within 3 feet of the blower door fan. If the doorway leads to an enclosed area, make sure the space is open to the outside. Do not set up in a door facing the wind if an acceptable alternative exists.
<b>frame and panel setup</b> 1506-1.2c	Install the frame and panel securely into the door frame, making sure that there are no gaps between any of the components or between the components and the door frame.
<b>fan setup</b> 1506-1.2d	Set the fan into the panel/frame assembly, making sure that the panel opening fits snugly around the fan. Install the fan so that the flow ring assembly (or low flow plate) is facing toward the inside of the house. Set up the fan in a level or nearly level position.
<b>gauge position</b> 1506-1.2e	Set up the gauges in a vertical position if using the magnahelic gauges.
<b>variable speed controller</b> 1506-1.2f	Make sure the variable speed control is off. Plug the fan electric cord into an electrical outlet.
<b>zero the gauges</b> 1506-1.2g	Insert the tube from the house pressure gauge into the hole in the door panel. Make sure that the end of the hose is not in front of the fan outlet or positioned so that it is exposed to windy conditions. Leave the fan pressure gauge tube end inside the house (not connected to the fan). Zero the pressure gauges. <b>Ensure that the fabric cover or all the rings are on the fan.</b>

Install the open end of the fan pressure gauge tube onto the blower door fan pressure tap.

**gauge to tap connection**  
1506-1.2h

Perform a 1 point test by depressurizing to 50 pa house pressure or the highest house pressure if unable to reach 50 pa. Use the flow rings or low flow plate if the fan pressure is less than 25 pa. If wind seems to be affecting test results, take several 1 point tests and average the results.

**flow rings**  
1506-1.2i

Calculate the CFM50 of the dwelling by using the blower door computer or consulting the appropriate table.

**calculate CFM50**  
1506-1.2j

Consult the blower door owner's manual or training manual for details.

**further instructions**  
1506-1.2k

*BLOWER DOOR TEST, PRESSURIZATION 1506-1.3*

Use the pressurization blower door test method only if a solid fuel heating unit or a drip-pot, oil burning space heater is in operation,

**pressurization determination**  
1506-1.3a

Install the door panel and hang the gauge assembly as it normally would be installed.

**door panel/gauges**  
1506-1.3b

Attach a tube to the LOWER tap of the HOUSE pressure gauge and run the other end of the tube through the hole in the upper part of the door panel making sure it is away from the fan outlet.

**tubes/pressure taps**  
1506-1.3c

Leave the FAN pressure tube "Tee" attached to the gauges and fan as it normally would be.

**fan pressure tube**  
1506-1.3d

Attach an extra "Tee" to the UPPER taps of the FAN pressure gauge and run the other end of the tube to the outside of the house, somewhere away from any fan turbulence.

**fan pressure—extra "Tee"**  
1506-1.3e

Install the fan BACKWARDS. In other words, the face where the flow rings/low flow plate attaches is facing the outside. The fan tube and the extra tube will run outside between the fan housing and the elastic collar. The fan speed control must remain on the inside of the door panel.

**install fan**  
1506-1.3f

Level and stabilize the fan as necessary.

**stabilize fan**  
1506-1.3g

**fan switch**

1506-1.3h

Do not change the fan switch from its normal (forward) position.

**b. d. test, calculate  
CFM50**

1506-1.3i

Take a one-point test at 50 pa house pressure. If a 50 pa house pressure difference is not achievable, take a one-point test at the highest achievable house pressure. Use the computer to complete the CFM50 calculation, and other important numbers.



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Section **DIAGNOSTIC TESTING  
METHODS**

Subject **Gas Cook Stove Test**

*SCOPE OF TESTING 1506-2.1*

All cook stoves that are connected to the domestic gas supply line are to be tested.

**stoves to be tested**  
1506-2.1a

*PREPARATION FOR TESTING 1506-2.2*

Zero a digital combustion analyzer or digital carbon monoxide detector in the out-of-doors, ambient air.

**zero CO testing  
equipment**  
1506-2.2a

Ensure that all existing pilot lights are lit.

**pilot lights**  
1506-2.2b

Test the gas cook stove in the "as is" condition, except remove any aluminum foil (do not clean or adjust it) prior to beginning any testing.

**remove foil, test "as is"**  
1506-2.2c

Turn on the exhaust hood or an exhaust fan prior to beginning testing.

**operate exhaust fan**  
1506-2.2d

*STOVE TOP BURNER TESTING PROCEDURES 1506-2.3*

Individually test each stove top gas burner, using a digital combustion analyzer or digital CO meter. Turn on only one burner at a time.

**test burners  
individually**  
1506-2.3a

Turn the burner on high and hold the analyzer probe 6 to 8 inches above the flame. After two minutes, record the CO reading for that burner.

**time and  
distance from flame**  
1506-2.3b

Test all stove top burners. Any burner with a CO reading above 25 ppm must be cleaned, tuned or adjusted prior to beginning weatherization work.

**CO action level**  
1506-2.3c

*OVEN TESTING PROCEDURES 1506-2.4*

**locate vent, remove or  
perforate foil**  
1506-2.4a

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Locate the oven exhaust vent (normally an opening centered at the back of the stove top. Ovens with glass doors may also have a vent in the door). Look into the oven to see if the bottom of the oven is covered with aluminum foil. Caution the customer not to place foil on the bottom of the oven.

With the exhaust fan still operating, turn the oven to the broil setting. Keep the oven door closed.

**oven CO test,  
ambient air**  
1506-2.4b

Monitor the ambient air CO level with the combustion analyzer or CO meter during the entire test. If ambient air CO levels exceed 20 ppm during this period turn off the oven, cease oven testing, and have the oven cleaned and tuned. Do not begin weatherization work until the oven has been cleaned, tuned or adjusted, and retested.

**oven CO test,  
exhaust vent**  
1506-2.4c

Place the analyzer probe in the oven vent and turn on the oven. Allow it to run for 10 minutes or until the stack temperature stabilizes. If the CO level in the exhaust vent is above 100 ppm, the oven must be cleaned, tuned or adjusted. The CO level must be below 100 ppm before weatherization work can begin.

**gas flex lines**  
1506-2.5

Inspect gas flex lines to insure that:

**brass connectors**  
1506-2.5a

no brass range connectors are present;

**2 - piece connectors**  
1506-2.5b

no soldered 2 - piece range connectors are present; and

**date ring**  
1506-2.5c

no pre - 1973 date rings are present. In some cases, the date will be found on the flare nuts rather than a date ring.



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Section	<b>DIAGNOSTIC TESTING METHODS</b>
Subject	<b>Zone Pressure Measurement Tests</b>

## ZONE PRESSURE MEASUREMENT TEST 1506-3.1

Zone pressures can determine if there are leaks (thermal bypasses) between a house and a zone connected to the house (e.g. attic). The Add-a-Hole and Vent Opening methods can be used to estimate the size of the hole between the zone and the house. Further calculations can turn the hole size into a CFM50 estimate. For example, estimating the amount of bypass leakage may be used to help decide if it is cost-effective to seal the leaks in an attic that is already insulated. It will generally not be cost-effective to address leakage that is less than a 20 sq. in (150 - 200 CFM50) hole.

**purpose**  
1506-3.1a

Zone pressures only determine the relative size of the leaks between that zone and the inside compared to that zone and the outside. To know whether the leakage rate is significant, determine the approximate leakiness of one side of the pressure boundary or use one of the measurement methods (e.g., add a hole).

**limitations**  
1506-3.1b

Zones that are located outside the thermal boundary of the house should have house-to-zone pressure differences of 50 Pa with the house to outside difference at 50 Pa. Readings lower than 50 Pa from house-to-zone indicate that there are air pathways between the house and the zone.

**exterior zones**  
1506-3.1c

Zones located within the thermal boundary should have house-to-zone pressure differences of 0 Pa. A reading greater than zero indicates there are air pathways between the zone and outside.

**interior zones**  
1506-3.1d

Pressure diagnostics is possible in a very leaky house, where a reading of 50 Pa from house-to-outside pressure differential can not be obtained. It requires the use of the computer program in the blower door computer. Refer to the blower door manual for the use of this program.

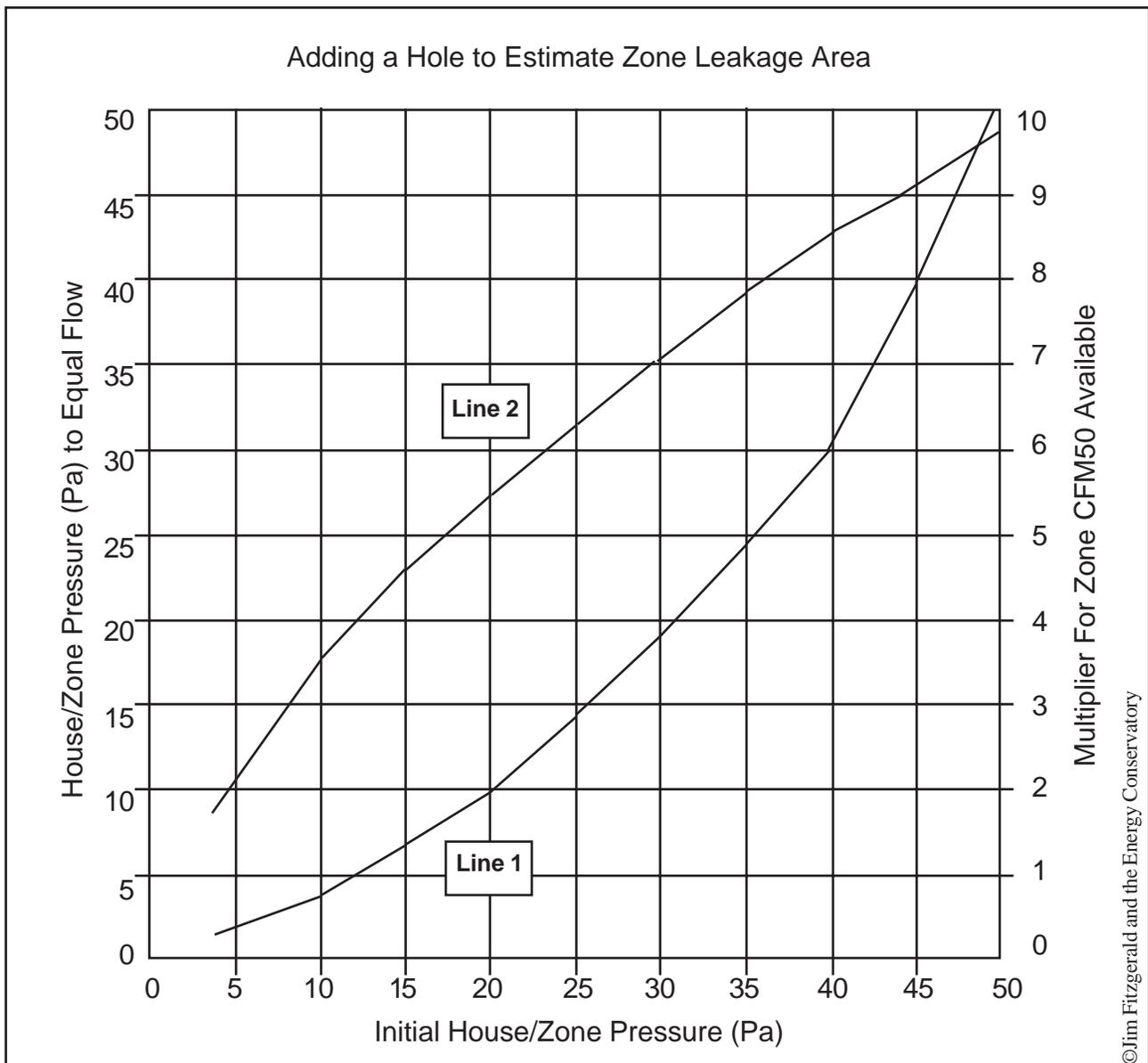
**leaky houses**  
1506-3.1e

Overall building tightness should not be overlooked while air sealing based on pressure differential readings. Potential reductions available from effective air sealing can be predicted using the advanced testing procedures and the blower door diagnostic computer program.

**building tightness  
considerations**  
1506-3.1f

*BASIC ZONE TESTING 1506-3.2*

<b>set up blower door</b> 1506-3.2a	Set up the blower door using established procedures and precautions. Run a hose to the exterior of the house making sure it will not be affected by the blower door exhaust air flow.
<b>run hoses</b> 1506-3.2a.i	Run hoses to the zones to be tested making sure the end of the hose is beyond any existing insulation, flooring or false ceilings, and will not be subjected to air flow through surrounding leakage areas when the blower door is operating.
<b>depressurize house</b> 1506-3.2a.ii	Using a separate pressure gauge set up to record house WRT outside, depressurize the house to -50 Pa. It is important to check throughout the testing procedure to assure the house to outside pressure differential remains at -50 Pa.
<b>take reading</b> 1506-3.2a.iii	Take a pressure reading from the house to the zone and record the reading.
<b>seal leakage sites</b> 1506-3.2b	Seal leaks between the zone and the house. If a large intentional penetration exists, temporarily block it while performing the testing and sealing of the zone. The goal is to achieve a pressure difference of 50 Pa. If the pressure difference of 50 Pa is not achieved, reenter the attic and find the leaks by using a smoke bottle with a blower door running. Seal the remaining leaks.
<b>take reading</b> 1506-3.2c	If an opening exists between the zone and the house, a quick test can be performed to give a visual indication of the remaining hole size. Measure the house to zone pressure with the house-to-outside pressure set to -50 Pa.
<b>determine target pressure</b> 1506-3.2d	Using figure 1506-3.2d, locate the measured pressure on the bottom line of the graph (Initial House/Zone Pressure). Read up vertically to the intersection of Line 1. Read horizontally to the left side of the graph (House/Zone Pressure to Equal Flow). The number indicated will be the new target house to zone pressure.



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It will not be cost effective to address leakage that is less than 20 in<sup>2</sup>. Open the hole a small amount and adjust the blower door until the house-to-outside pressure is at -50 Pa. Measure the house to zone pressure. If the house-to-zone pressure is not at the target difference, repeat changing the hole size and readjusting the blower door until the target house-to-zone differential is achieved. Once the target differential is obtained, look at the size of the hole that was created. This hole approximately equals the size of the existing hole between the house and the zone.

open hole  
1506-3.2e

*FINDING LEAKAGE BY TESTING INTERIOR WALLS*  
*1506-3.3***zone testing**  
1506-3.3

Set up the blower door using established procedures and precautions. Run a hose to the exterior of the house making sure it will not be affected by the blower door exhaust air flow.

**set up blower door**  
1506-3.3a

Depressurize the house to -50Pa. Obtain permission to drill small holes into the interior partition walls if the wall surface is repairable with a latex spackling compound or paintable caulk. Avoid wall papered and wood panelled walls.

**set up and access walls** 1506-3.3a.i

Run a hose to the attic making sure the end of the hose is beyond any existing insulation, flooring, false ceilings, and will not be subjected to air flow through surrounding leakage areas when the blower door is running.

**run hoses**  
1506-3.3a.ii

Using a separate pressure gauge set up to record house WRT outside, depressurize the house to -50 Pa. It is important to check throughout the testing procedure to assure the house to outside pressure difference remains at -50 Pa.

**depressurize house**  
1506-3.3a.iii

If a wall/attic zone connection is being investigated, ensure that doors to conditioned or unintentionally conditioned basements remain open during the testing.

**open basement door**  
1506-3.3a.iv

Take a pressure reading from the house to the attic and record the reading.

**take reading**  
1506-3.3a.v

If the reading is less than 50 Pa, proceed with primary attic bypass sealing looking for chimney and plumbing chases, open-top partitions, dropped ceilings, and other visible openings. It can be helpful to use a smoke bottle to look for leaks with the blower door running.

**seal leakage sites**  
1506-3.3b**retest**  
1506-3.3c

Retest the attic. If the attic is still not at 50 Pa WRT the house, further air sealing is needed.

**check interior walls**  
1506-3.3d

Obtain permission to drill small holes into the interior partition walls if the wall surface is repairable with a latex spackling compound or paintable caulk. Avoid wall papered or wood panelled walls. Depressurize the house to -50 Pa. Drill small holes into the interior partition walls and take pressure readings.

A reading greater than zero indicates that a wall is connected to the outside. However, readings greater than 15Pa indicate that the wall has significant leaks to the zone (i.e. attic) or the outside (i.e. exterior wall cavities). **It is not cost-effective to address leakage for any wall with a reading of less than 15 Pa WRT the attic.**

**check interior walls (con't)**  
1506-3.3d

With the blower door running, reenter the attic and use a smoke bottle to find the remaining leaks connected to the tested walls. Seal the leaks. This may require dense packing interior wall cavities. Retest the interior walls as necessary.

**seal leakage sites**  
1506-3.3e

Retest the attic. If the attic is still not at 50 Pa and all interior walls are less than 15 Pa house to wall cavity, then further testing will be required to determine the size of the holes.

**retest**  
1506-3.3f

*DETERMINING THE AMOUNT OF LEAKAGE - ADD-A-HOLE METHOD* 1506-3.4

**"add-a-hole" method**  
1506-3.4

If there is an opening between the zone and the living area, the size of the leak can be estimated by opening the hatch/door gradually to achieve the pressure difference indicated in 1506-3.2d.

**purpose**  
1506-3.4a

Identify the unheated zones that could contain the most significant air leakage pathways. This may include attics, crawlspaces, cellars, attached garages, etc.

**identify zones**  
1506-3.4b

Access the zone and insert a vinyl tube or a probe connected to that tube.

**run hoses**  
1506-3.4c

Provide a means for checking the house-to-outside pressure difference in the same location that you will be measuring the house-to-zone pressure difference. It will be necessary to be able to control the blower door fan speed from that same area.

**provide reference check**  
1506-3.4d

Depressurize the house to -50 Pascal pressure difference and record the house-to-zone pressure difference (see Figure 1506-3.2d). Find the House/Zone Pressure reading along the bottom line of the graph, follow the vertical line to where it intersects LINE 1 and locate where that horizontal line intersects the left hand column (House/Zone Pressure to Equal Flow).

**determine target pressure**  
1506-3.4e

<b>open hole</b> 1506-3.4f	Open the hatch or door into the zone until you have dropped the house-to-zone pressure to the level indicated on the left hand column of Figure 1506-3.2d. The house-to-outside pressure will need to be maintained at 50 Pa. When the pressure drop is stable, measure the amount of opening around the hatch/door. Close the hatch/door and turn off the blower door.
<b>estimate leakage rate</b> 1506-3.4g	<p>Convert the hatch/door measurements to square inches. Consult Figure 1506-3.2d to determine the CFM50 per sq.in. conversion factor for the initial house-to-zone pressure difference by following the initial house/zone pressure reading up the vertical line to where it intersects LINE 2.</p> <p>The horizontal line that intersects the right hand column (Multiplier for Zone CFM50 Available) is the number of CFMs per square inch of opening. Multiply the square inch opening by that conversion factor to find the CFM50 leakage estimate from that zone.</p>
<b>test other zones</b> 1506-3.4h	Proceed to the other zones and repeat this procedure. As the zone pressures are measured, inspect the areas for indications of the primary air leakage pathways.
	<i>DETERMINING THE AMOUNT OF LEAKAGE - ESTIMATE VENT OPENING METHOD 1506-3.5</i>
<b>NFVA method</b> 1506-3.5	If there is no interior attic access or it cannot be opened while a blower door is operating, the following method can be used to roughly estimate the size of the leaks across the house-to-zone boundary.
<b>take reading</b> 1506-3.5a	Note the pressure drop across the attic ceiling. Using Figure 1506-3.5a (Zone pressures and Leakage Rate), find the most appropriate house-to-zone pressure level.
<b>estimate attic ventilation</b> 1506-3.5b	Estimate the amount of ventilation opening (in NFVA) between the attic and the outside. It may be necessary to estimate the openings, especially when there is a continuous perforated soffit. Be very conservative with estimates.
<b>estimate leakage rate</b> 1506-3.5c	Calculate the amount of leakage across the house-to-zone boundary by multiplying the ventilation area by the appropriate house-to-zone multiplier (fraction). This will provide an estimate of how large a hole, in square inches, there is between the house and zone.

**Zone Pressure and Leakage Rates**

Attic to Outside

House to Attic

Zone Pressures		Relative Size of Leaks	
House-Zone	Zone-Outside	House-Zone	Zone-Outside
12	38	2	1
25	25	1	1
37	13	.5	1
41	9	.33	1
45	5	.25	1
48	2	.13	1
49	1	.08	1

Note: Zone pressures only tell us the relative size of the leaks between that zone and the inside compared to that zone and the outside. To know whether the leakage rate is significant, determine how leaky one side is, or else use one of the measurement methods (e.g. open a door).

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**USING PRESSURE TO DETERMINE ZONE INTERCONNECTIONS 1506-3.6**

This test is used to determine if two separate zones are connected. The two zones may be an attic and basement, or a kneewall attic and upper attic.

**zone interconnection test**  
1506-3.6

Set up the blower door using established procedures and precautions. Run a hose to the exterior of the house making sure it will not be affected by the blower door exhaust air flow.

**set up blower door**  
1506-3.6a

Run hoses to the zones to be tested making sure the end of the hose is beyond any existing insulation, flooring, false ceilings, and will not be subjected to air flow through surrounding leakage areas when the blower door is running.

**run hoses**  
1506-3.6a.i

Close access doors to the two zones being checked.

**close access doors**  
1506-3.6a.ii

Using a separate pressure gauge set up to record house WRT outside, depressurize the house to -50 Pa. It is important to check throughout the testing procedure to assure the house to outside pressure differential remains at -50 Pa.

**depressurize house**  
1506-3.6a.iii

**take reading**  
1506-3.6a.iv

Record the pressure differential between the house and one of the zones.

**open one access door**  
1506-3.6a.v

Open the door to the other zone and adjust the blower door so the house-to-outside pressure is back to -50 Pa if needed.

**take reading**  
1506-3.6a.vi

Recheck the pressure differential between the house and the first zone. If the pressure differential dropped more than 2 Pa, there is a direct connection between the two zones.



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Section	<b>DIAGNOSTIC TESTING METHODS</b>
Subject	<b>Worst Case Draft Test</b>

*PURPOSE 1506-4.1*

The purpose of backdraft testing is to insure the proper venting of all combustion devices in the home.

**purpose**  
1506-4.1

*PROCEDURE 1506-4.2*

The procedure for backdraft testing must measure the difference in pressure between outside and inside the house at the combustion device and measure the draft at all combustion appliances. If multiple devices are located in different areas of the house, a test must be performed for each area. A pressure reading of -5 Pa or above in houses with non-sealed combustion appliances, woodstoves or fireplaces, a pressure reading of -10 Pa or above with all draft induced appliances and mobile home furnaces, or an insufficient draft measurement in the flue of any combustion appliance requires corrective action. Negative pressures caused by furnace distribution fans shall be eliminated no matter what the pressure is. There are two methods applicable to testing the direction of air flow. The first is the cautious use of a smoke generator. The second is the use of a pressure differential gauge. The decision on which method to use is up to the auditor/inspector.

**procedure**  
1506-4.2

*EXCEPTIONS 1506-4.3*

Backdraft testing must be done on all units weatherized with the following exceptions:

**exceptions**  
1506-4.3

The house is all electric with no combustion appliances, woodstoves or fireplaces, or the house has combustion appliances that are all sealed combustion.

**no combustion  
appliances**  
1506-4.3a

A house without a furnace (forced-air distribution system) and no exhaust equipment. Exhaust equipment includes vented dryers, vented bath and kitchen fans, vented central vacuums, fireplace or woodstove, etc.

**no furnace/no exhaust  
equipment**  
1506-4.3b

**apartment/no  
combustion appliance**  
1506-4.3c

Apartments with no combustion appliances.

*WHEN TO TEST 1506-4.4*

**when to test**  
1506-4.4

Backdraft testing must be done after all other work is completed, or at the end of each work day when work has affected the holes in the house or ducts or the exhaust potential, i.e. venting a dryer or exhaust fan.

*CONFIGURATION 1506-4.5*

**configuration**  
1506-4.5

Determine the configuration of the house (interior doors open or closed) and which exhaust devices should be activated on a site-by-site basis. In every case, the draft test should be done with the house in its worst case situation.

**worst case**  
1506-4.5a

Worst case is defined as the configuration of the house that results in the greatest negative pressure being developed in the area of the vented combustion appliances or fireplace (CAZ).

**considerations**  
1506-4.5b

Consideration must be given to the following:

- i. The types and locations of the heating systems.
- ii. The location and strength of all exhausting equipment (bath fans, dryers, kitchen exhaust devices, etc.).
- iii. The location of wood stoves, fireplaces and water heaters.
- iv. The volume of the area where the combustion devices are located.
- v. The location of the forced-air system returns.

*CERTIFICATION 1506-4.6*

**certified tester**  
1506-4.6

Backdraft testing must be performed by certified provider personnel or a contractor who has been certified.

*EXHAUST FANS ONLY 1506-4.7*

**winter mode**  
1506-4.7

Place the home in the winter operating mode with all windows and doors closed. If the blower door is set up, make sure the cover is on or the fan is closed off. Deactivate all combustion appliances. Open all interior doors.

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Zero the pressure gauge to 30 Pa if using a magnahelic gauge.	<b>zero gauge</b> 1506-4.7a
Run a hose from the exterior (outside) to the reference tap (bottom tap) on the pressure differential gauge.	<b>exterior hose</b> 1506-4.7b
Run a hose from the combustion appliance zone(s) to the input tap (top tap) on the pressure differential gauge. Multiple CAZ may require running more than one hose.	<b>CAZ hose</b> 1506-4.7c
Record the pressure(s) from the CAZ(s) WRT the outside. This is the baseline pressure.	<b>measure baseline</b> 1506-4.7d
Activate all exhaust equipment in the house (this does not include the furnace or DHW).	<b>start exhaust equipment</b> 1506-4.7e
Close down each interior door and cautiously using smoke, determine the required door position. If the smoke is pulled into the room, leave the door open [the room is negative WRT the main body]. If the smoke is blown out of the room, close the door [the room is more positive WRT the main body].	<b>determine interior door position</b> 1506-4.7f
Close down each CAZ door. Cautiously using smoke, determine the required position. If the smoke is pulled into the CAZ, close the door [the CAZ is more negative WRT the main body]. If the smoke is blown out of the CAZ, leave the door open [the CAZ is more positive WRT the main body].	<b>determine CAZ door(s) position(s)</b> 1506-4.7g
Measure and record the CAZ pressures with reference to outside. Repeat for each CAZ.	<b>record CAZ pressure</b> 1506-4.7h
<i>Exhaust Fans and Airhandler Fans On</i>	
Open all doors and leave all exhaust fans on. Start blower motor (air handler).	<b>start furnace blower</b> 1506-4.7i
<b>Caution: If the only way to activate the blower is to fire the furnace, extreme caution must be used due to the potential of combustion backdrafting or flame rollout. Test for ambient CO levels in the combustion appliance zone during the test. If ambient levels exceed 20 PPM, abort the test.</b>	

<b>determine interior door position(s)</b> 1506-4.7j	Close down each interior door and cautiously using smoke, determine the required door position. If the smoke is pulled into the room, leave the door open [the room is negative WRT the main body]. If the smoke is blown out of the room, close the door [the room is more positive WRT the main body].
<b>determine CAZ door position</b> 1506-4.7k	Close down each CAZ door. Cautiously using smoke, determine the required position. If the smoke is pulled into the CAZ, close the door [the CAZ is more negative WRT the main body]. If the smoke is blown out of the CAZ, leave the door open [the CAZ is more positive WRT the main body].
<b>measure CAZ pressures</b> 1506-4.7l	Measure the CAZ pressures with reference to outside. Repeat for each CAZ.
<b>subtract baseline</b> 1506-4.7m	Subtract the baseline CAZ measurements from the recorded CAZ pressures. The result is the actual pressure differential.
<b>review test results</b> 1506-4.7n	Review the results of the testing and determine the configuration of the building that results in the greatest negative pressure being developed in the combustion appliance zone
<b>recreate configuration</b> 1506-4.7o	Recreate the configuration that results in the greatest negative pressure in the combustion appliance zone. <b>Caution: If depressurization in the zone exceeds -5 Pa with atmospheric combustion appliances or -10 Pa with induced draft appliances or mobile home furnace, it would be prudent to monitor ambient CO levels while performing draft tests. If ambient levels exceed 20 PPM, abort the test.</b>
<b>measure draft</b> 1506-4.7p	Fire the combustion appliance with the lowest Btu output first if multiple appliances are located in the zone. Measure the draft at the appliance. Acceptable draft must be established at two (2) minutes. Shut down the appliance. Fire all remaining appliances, one at a time in order of output, testing each one for draft.  If the appliances vent into the same chimney or vent connector, test each one individually. If the appliances vent into different chimneys or vents, test with each successive unit running. All appliances must achieve acceptable draft at two (2) minutes of firing.

Turn off all exhaust equipment and/or furnace blower and return combustion appliances to their normal settings.

**normal settings**  
1506-4.7q

*MULTIPLE CAZ, ONE WITH FIREPLACE 1506-4.8*

*All exhaust fans on.*

Place the home in the winter operating mode, all windows and doors closed. If the blower door is set up, make sure the cover is on or the fan is closed off. Deactivate all combustion appliances. Open all interior doors.

**winter mode**  
1506-4.8

Zero the pressure gauge to 30 Pa if using a magnahelic gauge.

**zero gauge**  
1506-4.8a

Run a hose from the exterior (outside) to the reference tap (bottom) on the pressure differential gauge.

**exterior hose**  
1506-4.8b

Run a hose from the combustion appliance zone to the input tap (top) on the pressure differential gauge.

**CAZ hose**  
1506-4.8c

Record the pressure reading WRT the outside for each CAZ. This is the baseline pressure.

**record baseline pressure**  
1506-4.8d

Activate all exhaust equipment in the house (this does not include the furnace or DHW).

**start exhaust equipment**  
1506-4.8e

Close down each interior door and cautiously using smoke, determine the required door position. If the smoke is pulled into the room, leave the door open [the room is negative WRT the main body]. If the smoke is blown out of the room, close the door [the room is more positive WRT the main body].

**determine interior door position(s)**  
1506-4.8f

Close down each CAZ door. Cautiously using smoke, determine the required position. If the smoke is pulled into the CAZ, close the door [the CAZ is more negative WRT the main body]. If the smoke is blown out of the CAZ, leave the door open [the CAZ is more positive WRT the main body].

**determine CAZ door positions**  
1506-4.8g

Measure and record the CAZ pressures with reference to outside. Repeat for each CAZ.

**measure and record pressures**  
1506-4.8h

*All Exhaust Fans and Blower Door (Fireplace) On*

Activate all exhausting equipment in the house.

**activate exhaust fans**  
1506-4.8i

<b>simulate fireplace</b> 1506-4.8j	To simulate an active fireplace that draws combustion air from the dwelling, configure the blower door to exhaust 300 CFM.
<b>determine interior door position(s)</b> 1506-4.8k	Close down each interior door and cautiously using smoke, determine the required door position. If the smoke is pulled into the room, leave the door open [the room is negative WRT the main body]. If the smoke is blown out of the room, close the door [the room is more positive WRT the main body].
<b>determine CAZ door position</b> 1506-4.8l	Close down each CAZ door. Cautiously using smoke, determine the required position. If the smoke is pulled into the CAZ, close the door [the CAZ is more negative WRT the main body]. If the smoke is blown out of the CAZ, leave the door open [the CAZ is more positive WRT the main body].
<b>measure and record pressures</b> 1506-4.8m	Measure and record the CAZ pressures with reference to outside. Repeat for each CAZ.  <i>All Exhaust Fans, Blower Door (fireplace), and Airhandler Fans On.</i>
<b>activate air handler fan</b> 1506-4.8n	With exhaust fans and blower door on, start the air handler fan. <b>Caution: If the only way to activate the blower is to fire the furnace, extreme caution must be used due to the potential of combustion backdrafting or flame rollout. It would be prudent to test for ambient CO levels in the combustion appliance zone during the test. If ambient levels exceed 20 PPM, abort the test.</b>
<b>determine interior door position(s)</b> 1506-4.8o	Close down each interior door and cautiously using smoke, determine the required door position. If the smoke is pulled into the room, leave the door open [the room is negative WRT the main body]. If the smoke is blown out of the room, close the door [the room is more positive WRT the main body].
<b>determine CAZ door position</b> 1506-4.8p	Close down each CAZ door. Cautiously using smoke, determine the required position. If the smoke is pulled into the CAZ, close the door [the CAZ is more negative WRT the main body]. If the smoke is blown out of the CAZ, leave the door open [the CAZ is more positive WRT the main body].
<b>measure and record pressures</b> 1506-4.8q	Measure and record the CAZ pressures with reference to outside. Repeat for each CAZ.

Subtract the baseline CAZ measurements from the recorded CAZ pressures. The result is the actual pressure differential.

**subtract baseline**  
1506-4.8r

Review the results of the testing and determine the configuration of the building that results in the greatest negative pressure being developed in the combustion appliance zones.

**review results**  
1506-4.8s

Recreate the configuration that results in the greatest negative pressure in the combustion appliance zones.

**recreate configuration**  
1506-4.8t

**Caution: If depressurization in the zone exceeds -5 Pa with atmospheric combustion appliances or -10 Pa with induced draft appliances or mobile home furnace, it would be prudent to monitor ambient CO levels while performing draft tests. If ambient levels exceed 20 PPM, abort the test.**

Fire the combustion appliance with the lowest Btu output first if multiple appliances are located in the zone. Measure the draft at the appliance. Acceptable draft must be established within two (2) minutes. Fire all remaining appliances, one at a time in order of output, testing each one for draft. If the appliances vent into the same chimney or vent connector, test each one individually. If the appliances vent into different chimneys or vents, test with each successive unit running. All appliances must achieve acceptable draft within two (2) minutes of firing.

**measure draft**  
1506-4.8u

In the case of a fireplace, only pressure readings can be used to determine if the depressurization potential can cause problems. Action is required if the CAZ containing the fireplace is depressurized to -5Pa or greater.

**measure pressure**  
1506-4.8v

Turn off all exhaust fans and return combustion appliances to normal settings.

**normal settings**  
1506-4.8w





State of Ohio  
Weatherization Program  
Standards

Section	<b>DIAGNOSTIC TESTING METHODS</b>
Subject	<b>Distribution System Testing</b>

*DUCT TESTING PROCEDURES 1506-5*

Interview the occupants to determine whether there are areas that are over- or under-heated.	<b>interview occupants</b> 1506-5.1
Inspect duct system to determine location of ducts. It is important to determine if the duct system has runs outside of the heated envelope, uses building cavities as ducts, or has ducts running within the interstitial building cavities.	<b>inspect ducts</b> 1506-5.2
Identify all registers that terminate duct runs that run outside the envelope, are made of building cavities, or are located in interstitial cavities.	<b>identify registers</b> 1506-5.3
Determine if the duct zone is conditioned, unintentionally conditioned, or non-conditioned. Based on this determination, proceed as follows:	<b>basement</b> 1506-5.4
Temporarily seal registers in the duct zone. If there is a basement which is conditioned space, leave the basement door open, otherwise close the basement door.	<b>conditioned</b> 1506-5.4a
Temporarily seal registers in duct zone. If it is determined that the basement doesn't need to be heated then indicate on the work order to have them sealed permanently.	<b>unintentionally conditioned</b> 1506-5.4b
Temporarily seal registers in the duct zone and indicate on the work order to have them sealed permanently.	<b>non-conditioned</b> 1506-5.4c
Set up the blower door using established blower door test procedures and precautions (see 1506-1).	<b>set-up blower door</b> 1506-5.5
Depressurize the house to -50 Pa. Measure the pressure differential between the zone of the ducts and the main body of the house. If the pressure differential is less negative than -5.0 Pa., then the pressure differential must be magnified. A window or door of the zone in which the ducts are located, but which leads to the outside, should be opened to cause a larger pressure differential.	<b>depressurize house</b> 1506-5.5a

<b>cover registers</b> 1506-5.5b	One at a time, cover each register connected to the ducts identified above with a pressure pan, masking tape, or tape and paper. Use the easiest method based on the size, shape, and location of the register.
<b>measure pressure</b> 1506-5.5c	Measure the pressure difference across the register. Remove tape, paper, or pressure pan and move on to the next register.
<b>determine sealing sites</b> 1506-5.5d	A reading of 1 Pa or higher indicates a visual inspection of the boot, boot and floor intersection, and the duct will be needed to determine where the sealing will take place.
<b>turn off blower door</b> 1506-5.5e	When all registers have been tested, turn off the blower door and cap it.
<b>locate/seal leaks</b> 1506-5.5f	Turn on the air handler and using a smoke bottle, locate and seal all leaks. All return leaks in combustion appliance zone(s) and unconditioned spaces must be sealed. All supply leaks to unconditioned spaces must be sealed.
<b>turn off air handler</b> 1506-5.5g	Turn off the air handler.
<b>repeat</b> 1506-5.5h	Repeat the duct pressure test with the house to outside pressure at -25 Pa. The process must be repeated until all pressure readings at the registers are less than 1 Pa.
<b>Mobile Home Distribution System Leakage Test</b> 1506-5.6	Use the blower door based subtraction method to measure mobile home duct system leakage after the established blower door set-up procedure and precautions have been completed (see 1506-1).
<b>subtraction test limitations</b> 1506-5.6a	For the subtraction test to be accurate, there must be a pressure differential between the living area and the cavity where the mobile home ductwork is located. If there is little or no pressure difference between these two areas, there will be very little difference between the Taped Duct CFM50 and the Initial Duct CFM50. The most important tools in determining leakage in mobile home distribution systems are flashlights, drop lights, and mirrors. Check the ends of the distribution systems, the boot/floor connection, the boot/main duct connection, along with the connection between the furnace and the main duct.

Insert a tube, or probe attached to a tube, into the cavity between the mobile home floor and the belly board and measure the pressure difference of the living space WRT the cavity containing the duct system. The pressure difference must be greater than 5 Pa.

**measure the pressure  
across the floor**  
1506-5.6b

Perform an initial blower door test and record the result as the Initial CFM50. Then, seal all ducts at the supply registers and at the return air grill completely using tape, plastic film, sheets of paper or other temporary air-impermeable material. Assure that no air is moving through any openings from the return grill or supply registers. Examine the system to assure that all auxiliary or add-on air conditioner or heat pump grills are also sealed. Perform a blower door test and record as the Taped Duct CFM50.

**taped duct test**  
1506-5.6c

Subtract the Taped Duct CFM50 reading from the Initial CFM50 reading to determine the amount of air leakage through the distribution system.





State of Ohio  
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Section	<b>DIAGNOSTIC TESTING METHODS</b>
Subject	<b>Procedures for Measuring Electricity</b>

*PROCEDURES FOR MEASURING ELECTRICITY/  
PROCEDURES FOR DETERMINING COST-  
EFFECTIVENESS 1506-6*

Use a commercially available kilowatt-hour meter to measure electricity use of refrigerators, well water pumps, etc. Record the date and time period for the meter reading period. Account for seasonal operating characteristics of appliances. For instance, many waterbed heaters are not on in the summer time, so usage would be underestimated.

**testing equipment**  
1506-6.1



Use the following method to calculate savings based on metering of energy consumption.

**metered savings  
calculations**  
1506-6.2



Determine the pre-retrofit energy consumption.

**pre-retrofit  
consumption**  
1506-6.2a



- i. Determine existing wattage by taking meter reading ( $W_{pre}$ ).
- ii. Determine the hours of use ( $H_{pre}$ ).
- iii. Determine the number of days of use per year ( $Y_{pre}$ ).
- iv. Multiply  $W_{pre} \times H_{pre} \times Y_{pre}$  and divide by 1,000 to calculate pre-retrofit kWh use ( $kWh_{pre}$ ).

Determine the post-retrofit energy consumption.

**post-retrofit  
consumption**  
1506-6.2.b



- i. Determine the new wattage ( $W_{post}$ ).
- ii. Determine the hours of use ( $H_{post}$ ).
- iii. Determine the number of days of use per year ( $Y_{post}$ ).
- iv. Multiply  $W_{post} \times H_{post} \times Y_{post}$  and divide by 1,000 to calculate pre-retrofit kWh use ( $kWh_{post}$ ).

Or use the information on the DOE energy guide label to determine consumption for replacement appliances ( $kWh_{post}$ ).

Determine annual energy savings from the measure ( $S_a$ ).

**annual savings**  
1506-6.2.c



- i.  $S_a = kWh_{post} - kWh_{pre}$ .

**NEAT input**  
1506-6.2d



Convert annual energy savings to Mbtu for input into NEAT (Mbtu).



- i.  $Mbtu = (S_a \times 3412 \text{ btu/kWh})/1,000,000$ .
- ii. Input Mbtu into the NEAT audit, along with the fuel type saved and the life of the measure. Include the measure in the SIR calculations on the last NEAT input screen.

**non-metered savings calculation**  
1506-6.3



Use the following method to calculate electricity savings if a kilowatt-hour meter is not used:

**pre-retrofit consumption**  
1506-6.3a



Determine the pre-retrofit energy consumption.

- i. Determine existing wattage ( $W_{pre}$ ).
- ii. Determine the hours of use ( $H_{pre}$ ).
- iii. Determine the number of days of use per year ( $Y_{pre}$ ).
- iv. Multiply  $W_{pre} \times H_{pre} \times Y_{pre}$  and divide by 1,000 to calculate pre-retrofit kWh use ( $kWh_{pre}$ ).

**post-retrofit consumption**  
1506-6.3b



Determine the post-retrofit energy consumption.

- i. Determine the new wattage ( $W_{post}$ ).
- ii. Determine the hours of use ( $H_{post}$ ).
- iii. Determine the number of days of use per year ( $Y_{post}$ ).
- iv. Multiply  $W_{post} \times H_{post} \times Y_{post}$  and divide by 1,000 to calculate pre-retrofit kWh use ( $kWh_{post}$ ).

**annual savings**  
1506-6.3c



Determine annual energy savings from the measure ( $S_a$ ).

- i.  $S_a = kWh_{post} - kWh_{pre}$ .

**NEAT input**  
1506-6.3d



Convert annual energy savings to Mbtu for input into NEAT (Mbtu).



- i.  $Mbtu = (S_a \times 3412 \text{ btu/kWh})/1,000,000$ .
- ii. Input Mbtu into the NEAT audit, along with the fuel type saved and the life of the measure. Include the measure in the SIR calculations on the last NEAT input screen.

The provider/grantee/contractor must collect the following data for the analysis:

- cost of electricity in dollars and cents per kWh
- 2 hour metered electric usage of old appliance
- DOE Energy Guide listing of annual usage of the proposed new appliance
- Cost of the proposed new appliance

**mandatory data for appliance replacement**

1506-6.4a



Select the table from Appendix A for the DOE Energy Guide annual kWh usage of the new appliance. For those appliances with annual usage between the listed annual usages, select the table of the next highest annual usage.

**using the table**

1506-6.4b



Select the kWh/day number that matches the metered usage of the old unit. For those readings that fall between the listed readings, select the next lowest reading from the table.

Follow that row across to the column closest to the electric rate (energy cost in cents per kWh) of the utility serving the house.

The dollars listed in the table represent the threshold cost of a replacement unit with an SIR of 1. All replacements that cost *less* than the cost listed in the table have an SIR greater than 1 and may be replaced. All replacements that cost *more* than the cost listed in the table have an SIR less than 1 and may not be replaced.

Collect the following information:

- cost of electricity in dollars and cents per kWh
- hours of use for each existing lamp
- proposed wattage of each new lamp
- cost of each new lamp

**mandatory data for lighting replacement**

1506-6.5a



Select the table for the wattage of the old lamp. For those lamps with wattage between the listed wattages, select the table of the next lowest usage.

**using the table**

1506-6.5b



Select the wattage that matches the proposed replacement (CFL Watts). For those readings that fall between the listed wattages, select the next highest reading from the table.

Select the row corresponding to the daily usage (Hours on per day) for the lamp.

Follow that row across to the column closest to the electric rate (energy cost in cents per kWh) of the utility serving the house.

The dollars listed in the table represent the threshold cost of a replacement unit with an SIR of 1. All replacements that cost *less* than the cost listed in the table have an SIR greater than 1 and may be replaced. All replacements that cost *more* than the cost listed in the table have an SIR less than 1 and may not be replaced.

## Refrigerator/Freezer Replacement Discounted Lifetime Savings

### 800 Kwh Annual Usage Replacement Unit

	Kwh/Day Kwh/Year	3 1095	3.5 1277.5	4 1460	4.5 1642.5	5 1825	5.5 2007.5	6 2190	6.5 2372.5	7 2555
<b>F</b>	<b>\$0.065</b>	\$145.72	\$235.87	\$326.02	\$416.17	\$506.32	\$596.47	\$686.63	\$776.78	\$866.93
	<b>\$0.070</b>	\$156.93	\$254.02	\$351.10	\$448.19	\$545.27	\$642.36	\$739.44	\$836.53	\$933.61
	<b>\$0.075</b>	\$168.14	\$272.16	\$376.18	\$480.20	\$584.22	\$688.24	\$792.26	\$896.28	\$1,000.30
<b>C</b>	<b>\$0.080</b>	\$179.35	\$290.31	\$401.26	\$512.21	\$623.17	\$734.12	\$845.08	\$956.03	\$1,066.99
	<b>\$0.085</b>	\$190.56	\$308.45	\$426.34	\$544.23	\$662.12	\$780.01	\$897.89	\$1,015.78	\$1,133.67
	<b>\$0.090</b>	\$201.77	\$326.59	\$451.42	\$576.24	\$701.06	\$825.89	\$950.71	\$1,075.54	\$1,200.36
<b>i</b>	<b>\$0.095</b>	\$212.98	\$344.74	\$476.50	\$608.25	\$740.01	\$871.77	\$1,003.53	\$1,135.29	\$1,267.05
	<b>\$0.100</b>	\$224.19	\$362.88	\$501.57	\$640.27	\$778.96	\$917.65	\$1,056.35	\$1,195.04	\$1,333.73
<b>C</b>	<b>\$0.105</b>	\$235.40	\$381.03	\$526.65	\$672.28	\$817.91	\$963.54	\$1,109.16	\$1,254.79	\$1,400.42
	<b>\$0.110</b>	\$246.61	\$399.17	\$551.73	\$704.29	\$856.86	\$1,009.42	\$1,161.98	\$1,314.54	\$1,467.11
	<b>\$0.115</b>	\$257.82	\$417.31	\$576.81	\$736.31	\$895.80	\$1,055.30	\$1,214.80	\$1,374.30	\$1,533.79
<b>p</b>	<b>\$0.120</b>	\$269.03	\$435.46	\$601.89	\$768.32	\$934.75	\$1,101.18	\$1,267.62	\$1,434.05	\$1,600.48
	<b>\$0.125</b>	\$280.24	\$453.60	\$626.97	\$800.33	\$973.70	\$1,147.07	\$1,320.43	\$1,493.80	\$1,667.17
	<b>\$0.130</b>	\$291.45	\$471.75	\$652.05	\$832.35	\$1,012.65	\$1,192.95	\$1,373.25	\$1,553.55	\$1,733.85
<b>K</b>	<b>\$0.135</b>	\$302.65	\$489.89	\$677.13	\$864.36	\$1,051.60	\$1,238.83	\$1,426.07	\$1,613.30	\$1,800.54
	<b>\$0.140</b>	\$313.86	\$508.03	\$702.20	\$896.37	\$1,090.54	\$1,284.72	\$1,478.89	\$1,673.06	\$1,867.23

750 Kwh Annual Usage Replacement Unit

	Kwh/Day	3	3.5	4	4.5	5	5.5	6	6.5	7
	Kwh/Year	1095	1277.5	1460	1642.5	1825	2007.5	2190	2372.5	2555
<b>F</b> <b>u</b> <b>e</b> <b>l</b>	<b>\$0.065</b>	\$170.42	\$260.57	\$350.72	\$440.87	\$531.02	\$621.17	\$711.32	\$801.47	\$891.62
	<b>\$0.070</b>	\$183.53	\$280.62	\$377.70	\$474.79	\$571.87	\$668.96	\$766.04	\$863.13	\$960.21
	<b>\$0.075</b>	\$196.64	\$300.66	\$404.68	\$508.70	\$612.72	\$716.74	\$820.76	\$924.78	\$1,028.80
<b>C</b> <b>o</b> <b>s</b> <b>t</b>	<b>\$0.080</b>	\$209.75	\$320.70	\$431.66	\$542.61	\$653.57	\$764.52	\$875.48	\$986.43	\$1,097.38
	<b>\$0.085</b>	\$222.86	\$340.75	\$458.64	\$576.53	\$694.41	\$812.30	\$930.19	\$1,048.08	\$1,165.97
	<b>\$0.090</b>	\$235.97	\$360.79	\$485.62	\$610.44	\$735.26	\$860.09	\$984.91	\$1,109.73	\$1,234.56
<b>i</b> <b>n</b>	<b>\$0.095</b>	\$249.08	\$380.84	\$512.59	\$644.35	\$776.11	\$907.87	\$1,039.63	\$1,171.39	\$1,303.14
	<b>\$0.100</b>	\$262.19	\$400.88	\$539.57	\$678.27	\$816.96	\$955.65	\$1,094.34	\$1,233.04	\$1,371.73
<b>C</b> <b>e</b> <b>n</b> <b>t</b> <b>s</b>	<b>\$0.105</b>	\$275.30	\$420.92	\$566.55	\$712.18	\$857.81	\$1,003.43	\$1,149.06	\$1,294.69	\$1,440.32
	<b>\$0.110</b>	\$288.41	\$440.97	\$593.53	\$746.09	\$898.65	\$1,051.22	\$1,203.78	\$1,356.34	\$1,508.90
	<b>\$0.115</b>	\$301.51	\$461.01	\$620.51	\$780.01	\$939.50	\$1,099.00	\$1,258.50	\$1,417.99	\$1,577.49
<b>p</b> <b>e</b> <b>r</b>	<b>\$0.120</b>	\$314.62	\$481.06	\$647.49	\$813.92	\$980.35	\$1,146.78	\$1,313.21	\$1,479.65	\$1,646.08
	<b>\$0.125</b>	\$327.73	\$501.10	\$674.47	\$847.83	\$1,021.20	\$1,194.56	\$1,367.93	\$1,541.30	\$1,714.66
<b>K</b> <b>w</b> <b>h</b>	<b>\$0.130</b>	\$340.84	\$521.14	\$701.44	\$881.75	\$1,062.05	\$1,242.35	\$1,422.65	\$1,602.95	\$1,783.25
	<b>\$0.135</b>	\$353.95	\$541.19	\$728.42	\$915.66	\$1,102.89	\$1,290.13	\$1,477.37	\$1,664.60	\$1,851.84

700 Kwh Annual Usage Replacement Unit

	Kwh/Day	3	3.5	4	4.5	5	5.5	6	6.5	7
	Kwh/Year	1095	1277.5	1460	1642.5	1825	2007.5	2190	2372.5	2555
<b>F</b>	<b>\$0.065</b>	\$195.12	\$285.27	\$375.42	\$465.57	\$555.72	\$645.87	\$736.02	\$826.17	\$916.32
	<b>\$0.070</b>	\$210.13	\$307.21	\$404.30	\$501.38	\$598.47	\$695.55	\$792.64	\$889.72	\$986.81
	<b>\$0.075</b>	\$225.14	\$329.16	\$433.18	\$537.20	\$641.22	\$745.24	\$849.26	\$953.28	\$1,057.30
<b>C</b>	<b>\$0.080</b>	\$240.15	\$351.10	\$462.06	\$573.01	\$683.97	\$794.92	\$905.87	\$1,016.83	\$1,127.78
	<b>\$0.085</b>	\$255.16	\$373.05	\$490.94	\$608.82	\$726.71	\$844.60	\$962.49	\$1,080.38	\$1,198.27
	<b>\$0.090</b>	\$270.17	\$394.99	\$519.81	\$644.64	\$769.46	\$894.28	\$1,019.11	\$1,143.93	\$1,268.76
<b>i</b>	<b>\$0.095</b>	\$285.18	\$416.93	\$548.69	\$680.45	\$812.21	\$943.97	\$1,075.73	\$1,207.48	\$1,339.24
	<b>\$0.100</b>	\$300.18	\$438.88	\$577.57	\$716.26	\$854.96	\$993.65	\$1,132.34	\$1,271.04	\$1,409.73
	<b>\$0.105</b>	\$315.19	\$460.82	\$606.45	\$752.08	\$897.70	\$1,043.33	\$1,188.96	\$1,334.59	\$1,480.22
<b>C</b>	<b>\$0.110</b>	\$330.20	\$482.77	\$635.33	\$787.89	\$940.45	\$1,093.01	\$1,245.58	\$1,398.14	\$1,550.70
	<b>\$0.115</b>	\$345.21	\$504.71	\$664.21	\$823.70	\$983.20	\$1,142.70	\$1,302.19	\$1,461.69	\$1,621.19
	<b>\$0.120</b>	\$360.22	\$526.65	\$693.08	\$859.52	\$1,025.95	\$1,192.38	\$1,358.81	\$1,525.24	\$1,691.67
<b>p</b>	<b>\$0.125</b>	\$375.23	\$548.60	\$721.96	\$895.33	\$1,068.70	\$1,242.06	\$1,415.43	\$1,588.79	\$1,762.16
	<b>\$0.130</b>	\$390.24	\$570.54	\$750.84	\$931.14	\$1,111.44	\$1,291.74	\$1,472.05	\$1,652.35	\$1,832.65
	<b>\$0.135</b>	\$405.25	\$592.49	\$779.72	\$966.96	\$1,154.19	\$1,341.43	\$1,528.66	\$1,715.90	\$1,903.13
<b>K</b>	<b>\$0.140</b>	\$420.26	\$614.43	\$808.60	\$1,002.77	\$1,196.94	\$1,391.11	\$1,585.28	\$1,779.45	\$1,973.62

**650 Kwh Annual Usage Replacement Unit**

	<b>Kwh/Day</b>	3	3.5	4	4.5	5	5.5	6	6.5	7
	<b>Kwh/Year</b>	1095	1277.5	1460	1642.5	1825	2007.5	2190	2372.5	2555
<b>F</b>	<b>\$0.065</b>	\$219.82	\$309.97	\$400.12	\$490.27	\$580.42	\$670.57	\$760.72	\$850.87	\$941.02
	<b>\$0.070</b>	\$236.73	\$333.81	\$430.90	\$527.98	\$625.07	\$722.15	\$819.24	\$916.32	\$1,013.41
	<b>\$0.075</b>	\$253.64	\$357.66	\$461.68	\$565.70	\$669.72	\$773.74	\$877.76	\$981.78	\$1,085.80
<b>C</b>	<b>\$0.080</b>	\$270.55	\$381.50	\$492.46	\$603.41	\$714.36	\$825.32	\$936.27	\$1,047.23	\$1,158.18
	<b>\$0.085</b>	\$287.46	\$405.34	\$523.23	\$641.12	\$759.01	\$876.90	\$994.79	\$1,112.68	\$1,230.57
	<b>\$0.090</b>	\$304.36	\$429.19	\$554.01	\$678.84	\$803.66	\$928.48	\$1,053.31	\$1,178.13	\$1,302.95
<b>i</b>	<b>\$0.095</b>	\$321.27	\$453.03	\$584.79	\$716.55	\$848.31	\$980.07	\$1,111.82	\$1,243.58	\$1,375.34
	<b>\$0.100</b>	\$338.18	\$476.88	\$615.57	\$754.26	\$892.95	\$1,031.65	\$1,170.34	\$1,309.03	\$1,447.73
	<b>\$0.105</b>	\$355.09	\$500.72	\$646.35	\$791.97	\$937.60	\$1,083.23	\$1,228.86	\$1,374.49	\$1,520.11
<b>e</b>	<b>\$0.110</b>	\$372.00	\$524.56	\$677.13	\$829.69	\$982.25	\$1,134.81	\$1,287.37	\$1,439.94	\$1,592.50
	<b>\$0.115</b>	\$388.91	\$548.41	\$707.90	\$867.40	\$1,026.90	\$1,186.39	\$1,345.89	\$1,505.39	\$1,664.89
	<b>\$0.120</b>	\$405.82	\$572.25	\$738.68	\$905.11	\$1,071.55	\$1,237.98	\$1,404.41	\$1,570.84	\$1,737.27
<b>r</b>	<b>\$0.125</b>	\$422.73	\$596.09	\$769.46	\$942.83	\$1,116.19	\$1,289.56	\$1,462.93	\$1,636.29	\$1,809.66
	<b>\$0.130</b>	\$439.64	\$619.94	\$800.24	\$980.54	\$1,160.84	\$1,341.14	\$1,521.44	\$1,701.74	\$1,882.04
	<b>\$0.135</b>	\$456.55	\$643.78	\$831.02	\$1,018.25	\$1,205.49	\$1,392.72	\$1,579.96	\$1,767.20	\$1,954.43
<b>h</b>	<b>\$0.140</b>	\$473.46	\$667.63	\$861.80	\$1,055.97	\$1,250.14	\$1,444.31	\$1,638.48	\$1,832.65	\$2,026.82

600 Kwh Annual Usage Replacement Unit

	Kwh/Day	3	3.5	4	4.5	5	5.5	6	6.5	7
	Kwh/Year	1095	1277.5	1460	1642.5	1825	2007.5	2190	2372.5	2555
<b>F</b>	<b>\$0.065</b>	\$244.52	\$334.67	\$424.82	\$514.97	\$605.12	\$695.27	\$785.42	\$875.57	\$965.72
	<b>\$0.070</b>	\$263.33	\$360.41	\$457.50	\$554.58	\$651.67	\$748.75	\$845.84	\$942.92	\$1,040.01
	<b>\$0.075</b>	\$282.14	\$386.16	\$490.18	\$594.19	\$698.21	\$802.23	\$906.25	\$1,010.27	\$1,114.29
<b>C</b>	<b>\$0.080</b>	\$300.94	\$411.90	\$522.85	\$633.81	\$744.76	\$855.72	\$966.67	\$1,077.63	\$1,188.58
	<b>\$0.085</b>	\$319.75	\$437.64	\$555.53	\$673.42	\$791.31	\$909.20	\$1,027.09	\$1,144.98	\$1,262.87
	<b>\$0.090</b>	\$338.56	\$463.39	\$588.21	\$713.03	\$837.86	\$962.68	\$1,087.50	\$1,212.33	\$1,337.15
<b>i</b>	<b>\$0.095</b>	\$357.37	\$489.13	\$620.89	\$752.65	\$884.41	\$1,016.16	\$1,147.92	\$1,279.68	\$1,411.44
	<b>\$0.100</b>	\$376.18	\$514.87	\$653.57	\$792.26	\$930.95	\$1,069.65	\$1,208.34	\$1,347.03	\$1,485.72
	<b>\$0.105</b>	\$394.99	\$540.62	\$686.25	\$831.87	\$977.50	\$1,123.13	\$1,268.76	\$1,414.38	\$1,560.01
<b>n</b>	<b>\$0.110</b>	\$413.80	\$566.36	\$718.92	\$871.49	\$1,024.05	\$1,176.61	\$1,329.17	\$1,481.74	\$1,634.30
	<b>\$0.115</b>	\$432.61	\$592.11	\$751.60	\$911.10	\$1,070.60	\$1,230.09	\$1,389.59	\$1,549.09	\$1,708.58
	<b>\$0.120</b>	\$451.42	\$617.85	\$784.28	\$950.71	\$1,117.14	\$1,283.58	\$1,450.01	\$1,616.44	\$1,782.87
<b>p</b>	<b>\$0.125</b>	\$470.23	\$643.59	\$816.96	\$990.32	\$1,163.69	\$1,337.06	\$1,510.42	\$1,683.79	\$1,857.16
	<b>\$0.130</b>	\$489.04	\$669.34	\$849.64	\$1,029.94	\$1,210.24	\$1,390.54	\$1,570.84	\$1,751.14	\$1,931.44
	<b>\$0.135</b>	\$507.84	\$695.08	\$882.32	\$1,069.55	\$1,256.79	\$1,444.02	\$1,631.26	\$1,818.49	\$2,005.73
<b>h</b>	<b>\$0.140</b>	\$526.65	\$720.82	\$914.99	\$1,109.16	\$1,303.33	\$1,497.50	\$1,691.67	\$1,885.84	\$2,080.01

550 Kwh Annual Usage Replacement Unit

	Kwh/Day	3	3.5	4	4.5	5	5.5	6	6.5	7
	Kwh/Year	1095	1277.5	1460	1642.5	1825	2007.5	2190	2372.5	2555
<b>F</b>	<b>\$0.065</b>	\$269.22	\$359.37	\$449.52	\$539.67	\$629.82	\$719.97	\$810.12	\$900.27	\$990.42
	<b>\$0.070</b>	\$289.93	\$387.01	\$484.10	\$581.18	\$678.27	\$775.35	\$872.44	\$969.52	\$1,066.61
	<b>\$0.075</b>	\$310.63	\$414.65	\$518.67	\$622.69	\$726.71	\$830.73	\$934.75	\$1,038.77	\$1,142.79
<b>C</b>	<b>\$0.080</b>	\$331.34	\$442.30	\$553.25	\$664.21	\$775.16	\$886.12	\$997.07	\$1,108.02	\$1,218.98
	<b>\$0.085</b>	\$352.05	\$469.94	\$587.83	\$705.72	\$823.61	\$941.50	\$1,059.39	\$1,177.28	\$1,295.16
	<b>\$0.090</b>	\$372.76	\$497.58	\$622.41	\$747.23	\$872.06	\$996.88	\$1,121.70	\$1,246.53	\$1,371.35
<b>i</b>	<b>\$0.095</b>	\$393.47	\$525.23	\$656.99	\$788.75	\$920.50	\$1,052.26	\$1,184.02	\$1,315.78	\$1,447.54
	<b>\$0.100</b>	\$414.18	\$552.87	\$691.57	\$830.26	\$968.95	\$1,107.64	\$1,246.34	\$1,385.03	\$1,523.72
	<b>\$0.105</b>	\$434.89	\$580.52	\$726.14	\$871.77	\$1,017.40	\$1,163.03	\$1,308.65	\$1,454.28	\$1,599.91
<b>C</b>	<b>\$0.110</b>	\$455.60	\$608.16	\$760.72	\$913.28	\$1,065.85	\$1,218.41	\$1,370.97	\$1,523.53	\$1,676.10
	<b>\$0.115</b>	\$476.31	\$635.80	\$795.30	\$954.80	\$1,114.29	\$1,273.79	\$1,433.29	\$1,592.78	\$1,752.28
	<b>\$0.120</b>	\$497.01	\$663.45	\$829.88	\$996.31	\$1,162.74	\$1,329.17	\$1,495.60	\$1,662.04	\$1,828.47
<b>p</b>	<b>\$0.125</b>	\$517.72	\$691.09	\$864.46	\$1,037.82	\$1,211.19	\$1,384.55	\$1,557.92	\$1,731.29	\$1,904.65
	<b>\$0.130</b>	\$538.43	\$718.73	\$899.03	\$1,079.34	\$1,259.64	\$1,439.94	\$1,620.24	\$1,800.54	\$1,980.84
	<b>\$0.135</b>	\$559.14	\$746.38	\$933.61	\$1,120.85	\$1,308.08	\$1,495.32	\$1,682.55	\$1,869.79	\$2,057.03
<b>K</b>	<b>\$0.140</b>	\$579.85	\$774.02	\$968.19	\$1,162.36	\$1,356.53	\$1,550.70	\$1,744.87	\$1,939.04	\$2,133.21

500 Kwh Annual Usage Replacement Unit

	Kwh/Day Kwh/Year	3	3.5	4	4.5	5	5.5	6	6.5	7
<b>F</b>	<b>\$0.065</b>	\$293.92	\$384.07	\$474.22	\$564.37	\$654.52	\$744.67	\$834.82	\$924.97	\$1,015.12
	<b>\$0.070</b>	\$316.52	\$413.61	\$510.69	\$607.78	\$704.86	\$801.95	\$899.03	\$996.12	\$1,093.20
	<b>\$0.075</b>	\$339.13	\$443.15	\$547.17	\$651.19	\$755.21	\$859.23	\$963.25	\$1,067.27	\$1,171.29
<b>C</b>	<b>\$0.080</b>	\$361.74	\$472.70	\$583.65	\$694.60	\$805.56	\$916.51	\$1,027.47	\$1,138.42	\$1,249.38
	<b>\$0.085</b>	\$384.35	\$502.24	\$620.13	\$738.02	\$855.91	\$973.80	\$1,091.68	\$1,209.57	\$1,327.46
	<b>\$0.090</b>	\$406.96	\$531.78	\$656.61	\$781.43	\$906.25	\$1,031.08	\$1,155.90	\$1,280.73	\$1,405.55
<b>i</b>	<b>\$0.095</b>	\$429.57	\$561.33	\$693.08	\$824.84	\$956.60	\$1,088.36	\$1,220.12	\$1,351.88	\$1,483.63
	<b>\$0.100</b>	\$452.18	\$590.87	\$729.56	\$868.26	\$1,006.95	\$1,145.64	\$1,284.34	\$1,423.03	\$1,561.72
	<b>\$0.105</b>	\$474.79	\$620.41	\$766.04	\$911.67	\$1,057.30	\$1,202.92	\$1,348.55	\$1,494.18	\$1,639.81
<b>n</b>	<b>\$0.110</b>	\$497.39	\$649.96	\$802.52	\$955.08	\$1,107.64	\$1,260.21	\$1,412.77	\$1,565.33	\$1,717.89
	<b>\$0.115</b>	\$520.00	\$679.50	\$839.00	\$998.49	\$1,157.99	\$1,317.49	\$1,476.99	\$1,636.48	\$1,795.98
	<b>\$0.120</b>	\$542.61	\$709.04	\$875.48	\$1,041.91	\$1,208.34	\$1,374.77	\$1,541.20	\$1,707.63	\$1,874.07
<b>p</b>	<b>\$0.125</b>	\$565.22	\$738.59	\$911.95	\$1,085.32	\$1,258.69	\$1,432.05	\$1,605.42	\$1,778.79	\$1,952.15
	<b>\$0.130</b>	\$587.83	\$768.13	\$948.43	\$1,128.73	\$1,309.03	\$1,489.33	\$1,669.64	\$1,849.94	\$2,030.24
	<b>\$0.135</b>	\$610.44	\$797.67	\$984.91	\$1,172.15	\$1,359.38	\$1,546.62	\$1,733.85	\$1,921.09	\$2,108.32
<b>h</b>	<b>\$0.140</b>	\$633.05	\$827.22	\$1,021.39	\$1,215.56	\$1,409.73	\$1,603.90	\$1,798.07	\$1,992.24	\$2,186.41

450 Kwh Annual Usage Replacement Unit

	Kwh/Day	3	3.5	4	4.5	5	5.5	6	6.5	7
	Kwh/Year	1095	1277.5	1460	1642.5	1825	2007.5	2190	2372.5	2555
<b>F</b> <b>u</b> <b>e</b> <b>l</b>	<b>\$0.065</b>	\$318.61	\$408.76	\$498.91	\$589.07	\$679.22	\$769.37	\$859.52	\$949.67	\$1,039.82
	<b>\$0.070</b>	\$343.12	\$440.21	\$537.29	\$634.38	\$731.46	\$828.55	\$925.63	\$1,022.72	\$1,119.80
	<b>\$0.075</b>	\$367.63	\$471.65	\$575.67	\$679.69	\$783.71	\$887.73	\$991.75	\$1,095.77	\$1,199.79
<b>C</b> <b>o</b> <b>s</b> <b>t</b>	<b>\$0.080</b>	\$392.14	\$503.09	\$614.05	\$725.00	\$835.96	\$946.91	\$1,057.87	\$1,168.82	\$1,279.78
	<b>\$0.085</b>	\$416.65	\$534.54	\$652.43	\$770.32	\$888.21	\$1,006.09	\$1,123.98	\$1,241.87	\$1,359.76
	<b>\$0.090</b>	\$441.16	\$565.98	\$690.81	\$815.63	\$940.45	\$1,065.28	\$1,190.10	\$1,314.92	\$1,439.75
<b>i</b> <b>n</b>	<b>\$0.095</b>	\$465.67	\$597.42	\$729.18	\$860.94	\$992.70	\$1,124.46	\$1,256.22	\$1,387.97	\$1,519.73
	<b>\$0.100</b>	\$490.18	\$628.87	\$767.56	\$906.25	\$1,044.95	\$1,183.64	\$1,322.33	\$1,461.03	\$1,599.72
<b>C</b> <b>e</b> <b>n</b> <b>t</b> <b>s</b>	<b>\$0.105</b>	\$514.68	\$660.31	\$805.94	\$951.57	\$1,097.19	\$1,242.82	\$1,388.45	\$1,534.08	\$1,679.71
	<b>\$0.110</b>	\$539.19	\$691.76	\$844.32	\$996.88	\$1,149.44	\$1,302.00	\$1,454.57	\$1,607.13	\$1,759.69
	<b>\$0.115</b>	\$563.70	\$723.20	\$882.70	\$1,042.19	\$1,201.69	\$1,361.19	\$1,520.68	\$1,680.18	\$1,839.68
<b>p</b> <b>e</b> <b>r</b>	<b>\$0.120</b>	\$588.21	\$754.64	\$921.07	\$1,087.50	\$1,253.94	\$1,420.37	\$1,586.80	\$1,753.23	\$1,919.66
	<b>\$0.125</b>	\$612.72	\$786.09	\$959.45	\$1,132.82	\$1,306.18	\$1,479.55	\$1,652.92	\$1,826.28	\$1,999.65
	<b>\$0.130</b>	\$637.23	\$817.53	\$997.83	\$1,178.13	\$1,358.43	\$1,538.73	\$1,719.03	\$1,899.33	\$2,079.63
<b>K</b> <b>w</b> <b>h</b>	<b>\$0.135</b>	\$661.74	\$848.97	\$1,036.21	\$1,223.44	\$1,410.68	\$1,597.91	\$1,785.15	\$1,972.39	\$2,159.62
	<b>\$0.140</b>	\$686.25	\$880.42	\$1,074.59	\$1,268.76	\$1,462.93	\$1,657.10	\$1,851.27	\$2,045.44	\$2,239.61

400 Kwh Annual Usage Replacement Unit

	Kwh/Day Kwh/Year	3 1095	3.5 1277.5	4 1460	4.5 1642.5	5 1825	5.5 2007.5	6 2190	6.5 2372.5	7 2555
<b>F</b> <b>u</b> <b>e</b> <b>l</b>	<b>\$0.065</b>	\$343.31	\$433.46	\$523.61	\$613.76	\$703.91	\$794.06	\$884.22	\$974.37	\$1,064.52
	<b>\$0.070</b>	\$369.72	\$466.81	\$563.89	\$660.98	\$758.06	\$855.15	\$952.23	\$1,049.32	\$1,146.40
	<b>\$0.075</b>	\$396.13	\$500.15	\$604.17	\$708.19	\$812.21	\$916.23	\$1,020.25	\$1,124.27	\$1,228.29
<b>C</b> <b>o</b> <b>s</b> <b>t</b>	<b>\$0.080</b>	\$422.54	\$533.49	\$644.45	\$755.40	\$866.36	\$977.31	\$1,088.26	\$1,199.22	\$1,310.17
	<b>\$0.085</b>	\$448.95	\$566.84	\$684.73	\$802.61	\$920.50	\$1,038.39	\$1,156.28	\$1,274.17	\$1,392.06
	<b>\$0.090</b>	\$475.36	\$600.18	\$725.00	\$849.83	\$974.65	\$1,099.47	\$1,224.30	\$1,349.12	\$1,473.95
<b>i</b> <b>n</b>	<b>\$0.095</b>	\$501.76	\$633.52	\$765.28	\$897.04	\$1,028.80	\$1,160.56	\$1,292.31	\$1,424.07	\$1,555.83
	<b>\$0.100</b>	\$528.17	\$666.87	\$805.56	\$944.25	\$1,082.95	\$1,221.64	\$1,360.33	\$1,499.02	\$1,637.72
<b>C</b> <b>e</b> <b>n</b> <b>t</b> <b>s</b>	<b>\$0.105</b>	\$554.58	\$700.21	\$845.84	\$991.46	\$1,137.09	\$1,282.72	\$1,428.35	\$1,573.98	\$1,719.60
	<b>\$0.110</b>	\$580.99	\$733.55	\$886.12	\$1,038.68	\$1,191.24	\$1,343.80	\$1,496.36	\$1,648.93	\$1,801.49
	<b>\$0.115</b>	\$607.40	\$766.90	\$926.39	\$1,085.89	\$1,245.39	\$1,404.88	\$1,564.38	\$1,723.88	\$1,883.37
<b>p</b> <b>e</b> <b>r</b>	<b>\$0.120</b>	\$633.81	\$800.24	\$966.67	\$1,133.10	\$1,299.53	\$1,465.97	\$1,632.40	\$1,798.83	\$1,965.26
	<b>\$0.125</b>	\$660.22	\$833.58	\$1,006.95	\$1,180.32	\$1,353.68	\$1,527.05	\$1,700.41	\$1,873.78	\$2,047.15
	<b>\$0.130</b>	\$686.63	\$866.93	\$1,047.23	\$1,227.53	\$1,407.83	\$1,588.13	\$1,768.43	\$1,948.73	\$2,129.03
<b>K</b> <b>w</b> <b>h</b>	<b>\$0.135</b>	\$713.03	\$900.27	\$1,087.50	\$1,274.74	\$1,461.98	\$1,649.21	\$1,836.45	\$2,023.68	\$2,210.92
	<b>\$0.140</b>	\$739.44	\$933.61	\$1,127.78	\$1,321.95	\$1,516.12	\$1,710.29	\$1,904.46	\$2,098.63	\$2,292.80



## Compact Fluorescent Bulb Replacement

### Replacement of 50 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
15	F	\$0.060	\$6.90	\$10.35	\$13.81	\$17.26	\$20.71	\$24.16
	u	\$0.065	\$7.48	\$11.22	\$14.96	\$18.70	\$22.43	\$26.17
	e	\$0.070	\$8.05	\$12.08	\$16.11	\$20.13	\$24.16	\$28.19
	l	\$0.075	\$8.63	\$12.94	\$17.26	\$21.57	\$25.89	\$30.20
	C	\$0.080	\$9.20	\$13.81	\$18.41	\$23.01	\$27.61	\$32.21
	o	\$0.085	\$9.78	\$14.67	\$19.56	\$24.45	\$29.34	\$34.23
	s	\$0.090	\$10.35	\$15.53	\$20.71	\$25.89	\$31.06	\$36.24
	t	\$0.095	\$10.93	\$16.39	\$21.86	\$27.32	\$32.79	\$38.25
	i	\$0.100	\$11.50	\$17.26	\$23.01	\$28.76	\$34.51	\$40.27
	n	\$0.105	\$12.08	\$18.12	\$24.16	\$30.20	\$36.24	\$42.28
	C	\$0.110	\$12.66	\$18.98	\$25.31	\$31.64	\$37.97	\$44.29
	e	\$0.115	\$13.23	\$19.85	\$26.46	\$33.08	\$39.69	\$46.31
	n	\$0.120	\$13.81	\$20.71	\$27.61	\$34.51	\$41.42	\$48.32
	t	\$0.125	\$14.38	\$21.57	\$28.76	\$35.95	\$43.14	\$50.33
s	\$0.130	\$14.96	\$22.43	\$29.91	\$37.39	\$44.87	\$52.35	
p	\$0.135	\$15.53	\$23.30	\$31.06	\$38.83	\$46.59	\$54.36	
e	\$0.140	\$16.11	\$24.16	\$32.21	\$40.27	\$48.32	\$56.37	
r								
K								
w								
h								

Replacement of 50 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
18	F	\$0.060	\$6.31	\$9.47	\$12.62	\$15.78	\$18.93	\$22.09
		\$0.065	\$6.84	\$10.26	\$13.67	\$17.09	\$20.51	\$23.93
	u	\$0.070	\$7.36	\$11.04	\$14.73	\$18.41	\$22.09	\$25.77
		\$0.075	\$7.89	\$11.83	\$15.78	\$19.72	\$23.67	\$27.61
	e	\$0.080	\$8.41	\$12.62	\$16.83	\$21.04	\$25.24	\$29.45
		\$0.085	\$8.94	\$13.41	\$17.88	\$22.35	\$26.82	\$31.29
	l	\$0.090	\$9.47	\$14.20	\$18.93	\$23.67	\$28.40	\$33.13
		\$0.095	\$9.99	\$14.99	\$19.99	\$24.98	\$29.98	\$34.97
	C	\$0.100	\$10.52	\$15.78	\$21.04	\$26.30	\$31.56	\$36.81
		\$0.105	\$11.04	\$16.57	\$22.09	\$27.61	\$33.13	\$38.66
	o	\$0.110	\$11.57	\$17.36	\$23.14	\$28.93	\$34.71	\$40.50
		\$0.115	\$12.10	\$18.14	\$24.19	\$30.24	\$36.29	\$42.34
	s	\$0.120	\$12.62	\$18.93	\$25.24	\$31.56	\$37.87	\$44.18
		\$0.125	\$13.15	\$19.72	\$26.30	\$32.87	\$39.44	\$46.02
t	\$0.130	\$13.67	\$20.51	\$27.35	\$34.19	\$41.02	\$47.86	
	\$0.135	\$14.20	\$21.30	\$28.40	\$35.50	\$42.60	\$49.70	
i	\$0.140	\$14.73	\$22.09	\$29.45	\$36.81	\$44.18	\$51.54	
n								
C								
e								
n								
t								
s								
P								
e								
r								
K								
w								
h								

Replacement of 50 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7
20 F u e l  C o s t  i n  C e n t s  P e r  K w h	\$0.060	\$5.92	\$8.88	\$11.83	\$14.79	\$17.75	\$20.71
	\$0.065	\$6.41	\$9.61	\$12.82	\$16.02	\$19.23	\$22.43
	\$0.070	\$6.90	\$10.35	\$13.81	\$17.26	\$20.71	\$24.16
	\$0.075	\$7.40	\$11.09	\$14.79	\$18.49	\$22.19	\$25.89
	\$0.080	\$7.89	\$11.83	\$15.78	\$19.72	\$23.67	\$27.61
	\$0.085	\$8.38	\$12.57	\$16.76	\$20.95	\$25.15	\$29.34
	\$0.090	\$8.88	\$13.31	\$17.75	\$22.19	\$26.63	\$31.06
	\$0.095	\$9.37	\$14.05	\$18.74	\$23.42	\$28.10	\$32.79
	\$0.100	\$9.86	\$14.79	\$19.72	\$24.65	\$29.58	\$34.51
	\$0.105	\$10.35	\$15.53	\$20.71	\$25.89	\$31.06	\$36.24
	\$0.110	\$10.85	\$16.27	\$21.69	\$27.12	\$32.54	\$37.97
	\$0.115	\$11.34	\$17.01	\$22.68	\$28.35	\$34.02	\$39.69
	\$0.120	\$11.83	\$17.75	\$23.67	\$29.58	\$35.50	\$41.42
	\$0.125	\$12.33	\$18.49	\$24.65	\$30.82	\$36.98	\$43.14
\$0.130	\$12.82	\$19.23	\$25.64	\$32.05	\$38.46	\$44.87	
\$0.135	\$13.31	\$19.97	\$26.63	\$33.28	\$39.94	\$46.59	
\$0.140	\$13.81	\$20.71	\$27.61	\$34.51	\$41.42	\$48.32	

Replacement of 50 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
23	F	\$0.060	\$5.33	\$7.99	\$10.65	\$13.31	\$15.98	\$18.64
	u	\$0.065	\$5.77	\$8.65	\$11.54	\$14.42	\$17.31	\$20.19
	e	\$0.070	\$6.21	\$9.32	\$12.43	\$15.53	\$18.64	\$21.74
	l	\$0.075	\$6.66	\$9.98	\$13.31	\$16.64	\$19.97	\$23.30
	C	\$0.080	\$7.10	\$10.65	\$14.20	\$17.75	\$21.30	\$24.85
	o	\$0.085	\$7.54	\$11.32	\$15.09	\$18.86	\$22.63	\$26.40
	s	\$0.090	\$7.99	\$11.98	\$15.98	\$19.97	\$23.96	\$27.96
	t	\$0.095	\$8.43	\$12.65	\$16.86	\$21.08	\$25.29	\$29.51
	i	\$0.100	\$8.88	\$13.31	\$17.75	\$22.19	\$26.63	\$31.06
	n	\$0.105	\$9.32	\$13.98	\$18.64	\$23.30	\$27.96	\$32.62
	C	\$0.110	\$9.76	\$14.64	\$19.53	\$24.41	\$29.29	\$34.17
	e	\$0.115	\$10.21	\$15.31	\$20.41	\$25.52	\$30.62	\$35.72
	n	\$0.120	\$10.65	\$15.98	\$21.30	\$26.63	\$31.95	\$37.28
	t	\$0.125	\$11.09	\$16.64	\$22.19	\$27.73	\$33.28	\$38.83
s	\$0.130	\$11.54	\$17.31	\$23.08	\$28.84	\$34.61	\$40.38	
p	\$0.135	\$11.98	\$17.97	\$23.96	\$29.95	\$35.94	\$41.93	
e	\$0.140	\$12.43	\$18.64	\$24.85	\$31.06	\$37.28	\$43.49	
r								
K								
w								
h								

Replacement of 50 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
27	F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$4.54	\$6.80	\$9.07	\$11.34	\$13.61	\$15.88
		\$0.065	\$4.91	\$7.37	\$9.83	\$12.29	\$14.74	\$17.20
		\$0.070	\$5.29	\$7.94	\$10.58	\$13.23	\$15.88	\$18.52
		\$0.075	\$5.67	\$8.51	\$11.34	\$14.18	\$17.01	\$19.85
		\$0.080	\$6.05	\$9.07	\$12.10	\$15.12	\$18.14	\$21.17
		\$0.085	\$6.43	\$9.64	\$12.85	\$16.07	\$19.28	\$22.49
		\$0.090	\$6.80	\$10.21	\$13.61	\$17.01	\$20.41	\$23.81
		\$0.095	\$7.18	\$10.77	\$14.36	\$17.96	\$21.55	\$25.14
		\$0.100	\$7.56	\$11.34	\$15.12	\$18.90	\$22.68	\$26.46
		\$0.105	\$7.94	\$11.91	\$15.88	\$19.85	\$23.81	\$27.78
		\$0.110	\$8.32	\$12.47	\$16.63	\$20.79	\$24.95	\$29.11
		\$0.115	\$8.69	\$13.04	\$17.39	\$21.74	\$26.08	\$30.43
		\$0.120	\$9.07	\$13.61	\$18.14	\$22.68	\$27.22	\$31.75
		\$0.125	\$9.45	\$14.18	\$18.90	\$23.63	\$28.35	\$33.08
\$0.130	\$9.83	\$14.74	\$19.66	\$24.57	\$29.48	\$34.40		
\$0.135	\$10.21	\$15.31	\$20.41	\$25.52	\$30.62	\$35.72		
\$0.140	\$10.58	\$15.88	\$21.17	\$26.46	\$31.75	\$37.04		

Replacement of 60 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
15	F	\$0.060	\$8.88	\$13.31	\$17.75	\$22.19	\$26.63	\$31.06
	u	\$0.065	\$9.61	\$14.42	\$19.23	\$24.04	\$28.84	\$33.65
	e	\$0.070	\$10.35	\$15.53	\$20.71	\$25.89	\$31.06	\$36.24
	l	\$0.075	\$11.09	\$16.64	\$22.19	\$27.73	\$33.28	\$38.83
	C	\$0.080	\$11.83	\$17.75	\$23.67	\$29.58	\$35.50	\$41.42
	o	\$0.085	\$12.57	\$18.86	\$25.15	\$31.43	\$37.72	\$44.01
	s	\$0.090	\$13.31	\$19.97	\$26.63	\$33.28	\$39.94	\$46.59
	t	\$0.095	\$14.05	\$21.08	\$28.10	\$35.13	\$42.16	\$49.18
	i	\$0.100	\$14.79	\$22.19	\$29.58	\$36.98	\$44.38	\$51.77
	n	\$0.105	\$15.53	\$23.30	\$31.06	\$38.83	\$46.59	\$54.36
	C	\$0.110	\$16.27	\$24.41	\$32.54	\$40.68	\$48.81	\$56.95
	e	\$0.115	\$17.01	\$25.52	\$34.02	\$42.53	\$51.03	\$59.54
	n	\$0.120	\$17.75	\$26.63	\$35.50	\$44.38	\$53.25	\$62.13
	t	\$0.125	\$18.49	\$27.73	\$36.98	\$46.22	\$55.47	\$64.71
s	\$0.130	\$19.23	\$28.84	\$38.46	\$48.07	\$57.69	\$67.30	
p	\$0.135	\$19.97	\$29.95	\$39.94	\$49.92	\$59.91	\$69.89	
e	\$0.140	\$20.71	\$31.06	\$41.42	\$51.77	\$62.13	\$72.48	
r								
K								
w								
h								

Replacement of 60 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
18	F	\$0.060	\$8.28	\$12.43	\$16.57	\$20.71	\$24.85	\$28.99
	u	\$0.065	\$8.97	\$13.46	\$17.95	\$22.43	\$26.92	\$31.41
	e	\$0.070	\$9.66	\$14.50	\$19.33	\$24.16	\$28.99	\$33.82
	l	\$0.075	\$10.35	\$15.53	\$20.71	\$25.89	\$31.06	\$36.24
	C	\$0.080	\$11.04	\$16.57	\$22.09	\$27.61	\$33.13	\$38.66
	o	\$0.085	\$11.73	\$17.60	\$23.47	\$29.34	\$35.20	\$41.07
	s	\$0.090	\$12.43	\$18.64	\$24.85	\$31.06	\$37.28	\$43.49
	t	\$0.095	\$13.12	\$19.67	\$26.23	\$32.79	\$39.35	\$45.90
	i	\$0.100	\$13.81	\$20.71	\$27.61	\$34.51	\$41.42	\$48.32
	n	\$0.105	\$14.50	\$21.74	\$28.99	\$36.24	\$43.49	\$50.74
	C	\$0.110	\$15.19	\$22.78	\$30.37	\$37.97	\$45.56	\$53.15
	e	\$0.115	\$15.88	\$23.81	\$31.75	\$39.69	\$47.63	\$55.57
	n	\$0.120	\$16.57	\$24.85	\$33.13	\$41.42	\$49.70	\$57.98
	t	\$0.125	\$17.26	\$25.89	\$34.51	\$43.14	\$51.77	\$60.40
s	\$0.130	\$17.95	\$26.92	\$35.89	\$44.87	\$53.84	\$62.82	
p	\$0.135	\$18.64	\$27.96	\$37.28	\$46.59	\$55.91	\$65.23	
e	\$0.140	\$19.33	\$28.99	\$38.66	\$48.32	\$57.98	\$67.65	
r								
K								
w								
h								

Replacement of 60 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
20	F	\$0.060	\$7.89	\$11.83	\$15.78	\$19.72	\$23.67	\$27.61
	u	\$0.065	\$8.55	\$12.82	\$17.09	\$21.37	\$25.64	\$29.91
	e	\$0.070	\$9.20	\$13.81	\$18.41	\$23.01	\$27.61	\$32.21
	l	\$0.075	\$9.86	\$14.79	\$19.72	\$24.65	\$29.58	\$34.51
	C	\$0.080	\$10.52	\$15.78	\$21.04	\$26.30	\$31.56	\$36.81
	o	\$0.085	\$11.18	\$16.76	\$22.35	\$27.94	\$33.53	\$39.12
	s	\$0.090	\$11.83	\$17.75	\$23.67	\$29.58	\$35.50	\$41.42
	t	\$0.095	\$12.49	\$18.74	\$24.98	\$31.23	\$37.47	\$43.72
	i	\$0.100	\$13.15	\$19.72	\$26.30	\$32.87	\$39.44	\$46.02
	n	\$0.105	\$13.81	\$20.71	\$27.61	\$34.51	\$41.42	\$48.32
	C	\$0.110	\$14.46	\$21.69	\$28.93	\$36.16	\$43.39	\$50.62
	e	\$0.115	\$15.12	\$22.68	\$30.24	\$37.80	\$45.36	\$52.92
	n	\$0.120	\$15.78	\$23.67	\$31.56	\$39.44	\$47.33	\$55.22
	t	\$0.125	\$16.44	\$24.65	\$32.87	\$41.09	\$49.31	\$57.52
s	\$0.130	\$17.09	\$25.64	\$34.19	\$42.73	\$51.28	\$59.82	
p	\$0.135	\$17.75	\$26.63	\$35.50	\$44.38	\$53.25	\$62.13	
e	\$0.140	\$18.41	\$27.61	\$36.81	\$46.02	\$55.22	\$64.43	
r								
K								
w								
h								

Replacement of 60 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
23	F	\$0.060	\$7.30	\$10.95	\$14.59	\$18.24	\$21.89	\$25.54
	u	\$0.065	\$7.91	\$11.86	\$15.81	\$19.76	\$23.72	\$27.67
	e	\$0.070	\$8.51	\$12.77	\$17.03	\$21.28	\$25.54	\$29.80
	l	\$0.075	\$9.12	\$13.68	\$18.24	\$22.80	\$27.36	\$31.93
	C	\$0.080	\$9.73	\$14.59	\$19.46	\$24.32	\$29.19	\$34.05
	o	\$0.085	\$10.34	\$15.51	\$20.68	\$25.84	\$31.01	\$36.18
	s	\$0.090	\$10.95	\$16.42	\$21.89	\$27.36	\$32.84	\$38.31
	t	\$0.095	\$11.55	\$17.33	\$23.11	\$28.88	\$34.66	\$40.44
	i	\$0.100	\$12.16	\$18.24	\$24.32	\$30.41	\$36.49	\$42.57
	n	\$0.105	\$12.77	\$19.16	\$25.54	\$31.93	\$38.31	\$44.70
	C	\$0.110	\$13.38	\$20.07	\$26.76	\$33.45	\$40.13	\$46.82
	e	\$0.115	\$13.99	\$20.98	\$27.97	\$34.97	\$41.96	\$48.95
	n	\$0.120	\$14.59	\$21.89	\$29.19	\$36.49	\$43.78	\$51.08
	t	\$0.125	\$15.20	\$22.80	\$30.41	\$38.01	\$45.61	\$53.21
s	\$0.130	\$15.81	\$23.72	\$31.62	\$39.53	\$47.43	\$55.34	
p	\$0.135	\$16.42	\$24.63	\$32.84	\$41.05	\$49.26	\$57.47	
e								
r								
K								
w								
h								

Replacement of 60 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
<b>27</b>	F	\$0.060	\$6.51	\$9.76	\$13.02	\$16.27	\$19.53	\$22.78
	u	\$0.065	\$7.05	\$10.58	\$14.10	\$17.63	\$21.15	\$24.68
	e	\$0.070	\$7.59	\$11.39	\$15.19	\$18.98	\$22.78	\$26.58
	l	\$0.075	\$8.14	\$12.20	\$16.27	\$20.34	\$24.41	\$28.47
	C	\$0.080	\$8.68	\$13.02	\$17.36	\$21.69	\$26.03	\$30.37
	o	\$0.085	\$9.22	\$13.83	\$18.44	\$23.05	\$27.66	\$32.27
	s	\$0.090	\$9.76	\$14.64	\$19.53	\$24.41	\$29.29	\$34.17
	t	\$0.095	\$10.30	\$15.46	\$20.61	\$25.76	\$30.91	\$36.07
	i	\$0.100	\$10.85	\$16.27	\$21.69	\$27.12	\$32.54	\$37.97
	n	\$0.105	\$11.39	\$17.08	\$22.78	\$28.47	\$34.17	\$39.86
	C	\$0.110	\$11.93	\$17.90	\$23.86	\$29.83	\$35.80	\$41.76
	e	\$0.115	\$12.47	\$18.71	\$24.95	\$31.19	\$37.42	\$43.66
	n	\$0.120	\$13.02	\$19.53	\$26.03	\$32.54	\$39.05	\$45.56
	t	\$0.125	\$13.56	\$20.34	\$27.12	\$33.90	\$40.68	\$47.46
s	\$0.130	\$14.10	\$21.15	\$28.20	\$35.25	\$42.30	\$49.35	
p	\$0.135	\$14.64	\$21.97	\$29.29	\$36.61	\$43.93	\$51.25	
e	\$0.140	\$15.19	\$22.78	\$30.37	\$37.97	\$45.56	\$53.15	
r								
K								
w								
h								

Replacement of 75 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
15	F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$11.83	\$17.75	\$23.67	\$29.58	\$35.50	\$41.42
		\$0.065	\$12.82	\$19.23	\$25.64	\$32.05	\$38.46	\$44.87
		\$0.070	\$13.81	\$20.71	\$27.61	\$34.51	\$41.42	\$48.32
		\$0.075	\$14.79	\$22.19	\$29.58	\$36.98	\$44.38	\$51.77
		\$0.080	\$15.78	\$23.67	\$31.56	\$39.44	\$47.33	\$55.22
		\$0.085	\$16.76	\$25.15	\$33.53	\$41.91	\$50.29	\$58.67
		\$0.090	\$17.75	\$26.63	\$35.50	\$44.38	\$53.25	\$62.13
		\$0.095	\$18.74	\$28.10	\$37.47	\$46.84	\$56.21	\$65.58
		\$0.100	\$19.72	\$29.58	\$39.44	\$49.31	\$59.17	\$69.03
		\$0.105	\$20.71	\$31.06	\$41.42	\$51.77	\$62.13	\$72.48
		\$0.110	\$21.69	\$32.54	\$43.39	\$54.24	\$65.08	\$75.93
		\$0.115	\$22.68	\$34.02	\$45.36	\$56.70	\$68.04	\$79.38
		\$0.120	\$23.67	\$35.50	\$47.33	\$59.17	\$71.00	\$82.83
		\$0.125	\$24.65	\$36.98	\$49.31	\$61.63	\$73.96	\$86.28
\$0.130	\$25.64	\$38.46	\$51.28	\$64.10	\$76.92	\$89.74		
\$0.135	\$26.63	\$39.94	\$53.25	\$66.56	\$79.88	\$93.19		
\$0.140	\$27.61	\$41.42	\$55.22	\$69.03	\$82.83	\$96.64		

Replacement of 75 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
18	F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$11.24	\$16.86	\$22.48	\$28.10	\$33.73	\$39.35
		\$0.065	\$12.18	\$18.27	\$24.36	\$30.45	\$36.54	\$42.62
		\$0.070	\$13.12	\$19.67	\$26.23	\$32.79	\$39.35	\$45.90
		\$0.075	\$14.05	\$21.08	\$28.10	\$35.13	\$42.16	\$49.18
		\$0.080	\$14.99	\$22.48	\$29.98	\$37.47	\$44.97	\$52.46
		\$0.085	\$15.93	\$23.89	\$31.85	\$39.81	\$47.78	\$55.74
		\$0.090	\$16.86	\$25.29	\$33.73	\$42.16	\$50.59	\$59.02
		\$0.095	\$17.80	\$26.70	\$35.60	\$44.50	\$53.40	\$62.30
		\$0.100	\$18.74	\$28.10	\$37.47	\$46.84	\$56.21	\$65.58
		\$0.105	\$19.67	\$29.51	\$39.35	\$49.18	\$59.02	\$68.86
		\$0.110	\$20.61	\$30.91	\$41.22	\$51.52	\$61.83	\$72.13
		\$0.115	\$21.55	\$32.32	\$43.09	\$53.87	\$64.64	\$75.41
		\$0.120	\$22.48	\$33.73	\$44.97	\$56.21	\$67.45	\$78.69
		\$0.125	\$23.42	\$35.13	\$46.84	\$58.55	\$70.26	\$81.97
\$0.130	\$24.36	\$36.54	\$48.71	\$60.89	\$73.07	\$85.25		
\$0.135	\$25.29	\$37.94	\$50.59	\$63.23	\$75.88	\$88.53		
\$0.140	\$26.23	\$39.35	\$52.46	\$65.58	\$78.69	\$91.81		

Replacement of 75 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
20	F	\$0.060	\$10.85	\$16.27	\$21.69	\$27.12	\$32.54	\$37.97
	u	\$0.065	\$11.75	\$17.63	\$23.50	\$29.38	\$35.25	\$41.13
	e	\$0.070	\$12.66	\$18.98	\$25.31	\$31.64	\$37.97	\$44.29
	l	\$0.075	\$13.56	\$20.34	\$27.12	\$33.90	\$40.68	\$47.46
	C	\$0.080	\$14.46	\$21.69	\$28.93	\$36.16	\$43.39	\$50.62
	o	\$0.085	\$15.37	\$23.05	\$30.73	\$38.42	\$46.10	\$53.78
	s	\$0.090	\$16.27	\$24.41	\$32.54	\$40.68	\$48.81	\$56.95
	t	\$0.095	\$17.17	\$25.76	\$34.35	\$42.94	\$51.52	\$60.11
	i	\$0.100	\$18.08	\$27.12	\$36.16	\$45.20	\$54.24	\$63.28
	n	\$0.105	\$18.98	\$28.47	\$37.97	\$47.46	\$56.95	\$66.44
	C	\$0.110	\$19.89	\$29.83	\$39.77	\$49.72	\$59.66	\$69.60
	e	\$0.115	\$20.79	\$31.19	\$41.58	\$51.98	\$62.37	\$72.77
	n	\$0.120	\$21.69	\$32.54	\$43.39	\$54.24	\$65.08	\$75.93
	t	\$0.125	\$22.60	\$33.90	\$45.20	\$56.50	\$67.80	\$79.09
s	\$0.130	\$23.50	\$35.25	\$47.00	\$58.76	\$70.51	\$82.26	
p	\$0.135	\$24.41	\$36.61	\$48.81	\$61.02	\$73.22	\$85.42	
e	\$0.140	\$25.31	\$37.97	\$50.62	\$63.28	\$75.93	\$88.59	
r								
K								
w								
h								

Replacement of 75 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
23	F	\$0.060	\$10.26	\$15.38	\$20.51	\$25.64	\$30.77	\$35.89
		\$0.065	\$11.11	\$16.67	\$22.22	\$27.78	\$33.33	\$38.89
	e	\$0.070	\$11.96	\$17.95	\$23.93	\$29.91	\$35.89	\$41.88
		\$0.075	\$12.82	\$19.23	\$25.64	\$32.05	\$38.46	\$44.87
	C	\$0.080	\$13.67	\$20.51	\$27.35	\$34.19	\$41.02	\$47.86
		\$0.085	\$14.53	\$21.79	\$29.06	\$36.32	\$43.59	\$50.85
	o	\$0.090	\$15.38	\$23.08	\$30.77	\$38.46	\$46.15	\$53.84
		\$0.095	\$16.24	\$24.36	\$32.48	\$40.59	\$48.71	\$56.83
	s	\$0.100	\$17.09	\$25.64	\$34.19	\$42.73	\$51.28	\$59.82
		\$0.105	\$17.95	\$26.92	\$35.89	\$44.87	\$53.84	\$62.82
	t	\$0.110	\$18.80	\$28.20	\$37.60	\$47.00	\$56.41	\$65.81
		\$0.115	\$19.66	\$29.48	\$39.31	\$49.14	\$58.97	\$68.80
	i	\$0.120	\$20.51	\$30.77	\$41.02	\$51.28	\$61.53	\$71.79
		\$0.125	\$21.37	\$32.05	\$42.73	\$53.41	\$64.10	\$74.78
n	\$0.130	\$22.22	\$33.33	\$44.44	\$55.55	\$66.66	\$77.77	
	\$0.135	\$23.08	\$34.61	\$46.15	\$57.69	\$69.23	\$80.76	
K	\$0.140	\$23.93	\$35.89	\$47.86	\$59.82	\$71.79	\$83.75	
w								
h								

Replacement of 75 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
27	F	\$0.060	\$9.47	\$14.20	\$18.93	\$23.67	\$28.40	\$33.13
	u	\$0.065	\$10.26	\$15.38	\$20.51	\$25.64	\$30.77	\$35.89
	e	\$0.070	\$11.04	\$16.57	\$22.09	\$27.61	\$33.13	\$38.66
	l	\$0.075	\$11.83	\$17.75	\$23.67	\$29.58	\$35.50	\$41.42
	C	\$0.080	\$12.62	\$18.93	\$25.24	\$31.56	\$37.87	\$44.18
	o	\$0.085	\$13.41	\$20.12	\$26.82	\$33.53	\$40.23	\$46.94
	s	\$0.090	\$14.20	\$21.30	\$28.40	\$35.50	\$42.60	\$49.70
	t	\$0.095	\$14.99	\$22.48	\$29.98	\$37.47	\$44.97	\$52.46
	i	\$0.100	\$15.78	\$23.67	\$31.56	\$39.44	\$47.33	\$55.22
	n	\$0.105	\$16.57	\$24.85	\$33.13	\$41.42	\$49.70	\$57.98
	C	\$0.110	\$17.36	\$26.03	\$34.71	\$43.39	\$52.07	\$60.74
	e	\$0.115	\$18.14	\$27.22	\$36.29	\$45.36	\$54.43	\$63.51
	n	\$0.120	\$18.93	\$28.40	\$37.87	\$47.33	\$56.80	\$66.27
	t	\$0.125	\$19.72	\$29.58	\$39.44	\$49.31	\$59.17	\$69.03
s	\$0.130	\$20.51	\$30.77	\$41.02	\$51.28	\$61.53	\$71.79	
p	\$0.135	\$21.30	\$31.95	\$42.60	\$53.25	\$63.90	\$74.55	
e	\$0.140	\$22.09	\$33.13	\$44.18	\$55.22	\$66.27	\$77.31	
r								
K								
w								
h								

Replacement of 90 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
15	F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$14.79	\$22.19	\$29.58	\$36.98	\$44.38	\$51.77
		\$0.065	\$16.02	\$24.04	\$32.05	\$40.06	\$48.07	\$56.09
		\$0.070	\$17.26	\$25.89	\$34.51	\$43.14	\$51.77	\$60.40
		\$0.075	\$18.49	\$27.73	\$36.98	\$46.22	\$55.47	\$64.71
		\$0.080	\$19.72	\$29.58	\$39.44	\$49.31	\$59.17	\$69.03
		\$0.085	\$20.95	\$31.43	\$41.91	\$52.39	\$62.86	\$73.34
		\$0.090	\$22.19	\$33.28	\$44.38	\$55.47	\$66.56	\$77.66
		\$0.095	\$23.42	\$35.13	\$46.84	\$58.55	\$70.26	\$81.97
		\$0.100	\$24.65	\$36.98	\$49.31	\$61.63	\$73.96	\$86.28
		\$0.105	\$25.89	\$38.83	\$51.77	\$64.71	\$77.66	\$90.60
		\$0.110	\$27.12	\$40.68	\$54.24	\$67.80	\$81.35	\$94.91
		\$0.115	\$28.35	\$42.53	\$56.70	\$70.88	\$85.05	\$99.23
		\$0.120	\$29.58	\$44.38	\$59.17	\$73.96	\$88.75	\$103.54
		\$0.125	\$30.82	\$46.22	\$61.63	\$77.04	\$92.45	\$107.86
\$0.130	\$32.05	\$48.07	\$64.10	\$80.12	\$96.15	\$112.17		
\$0.135	\$33.28	\$49.92	\$66.56	\$83.20	\$99.84	\$116.48		
\$0.140	\$34.51	\$51.77	\$69.03	\$86.28	\$103.54	\$120.80		

Replacement of 90 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
18	F	\$0.060	\$14.20	\$21.30	\$28.40	\$35.50	\$42.60	\$49.70
	u	\$0.065	\$15.38	\$23.08	\$30.77	\$38.46	\$46.15	\$53.84
	e	\$0.070	\$16.57	\$24.85	\$33.13	\$41.42	\$49.70	\$57.98
	l	\$0.075	\$17.75	\$26.63	\$35.50	\$44.38	\$53.25	\$62.13
	C	\$0.080	\$18.93	\$28.40	\$37.87	\$47.33	\$56.80	\$66.27
	o	\$0.085	\$20.12	\$30.18	\$40.23	\$50.29	\$60.35	\$70.41
	s	\$0.090	\$21.30	\$31.95	\$42.60	\$53.25	\$63.90	\$74.55
	t	\$0.095	\$22.48	\$33.73	\$44.97	\$56.21	\$67.45	\$78.69
	i	\$0.100	\$23.67	\$35.50	\$47.33	\$59.17	\$71.00	\$82.83
	n	\$0.105	\$24.85	\$37.28	\$49.70	\$62.13	\$74.55	\$86.98
	C	\$0.110	\$26.03	\$39.05	\$52.07	\$65.08	\$78.10	\$91.12
	e	\$0.115	\$27.22	\$40.83	\$54.43	\$68.04	\$81.65	\$95.26
	n	\$0.120	\$28.40	\$42.60	\$56.80	\$71.00	\$85.20	\$99.40
	t	\$0.125	\$29.58	\$44.38	\$59.17	\$73.96	\$88.75	\$103.54
s	\$0.130	\$30.77	\$46.15	\$61.53	\$76.92	\$92.30	\$107.68	
p	\$0.135	\$31.95	\$47.93	\$63.90	\$79.88	\$95.85	\$111.83	
e	\$0.140	\$33.13	\$49.70	\$66.27	\$82.83	\$99.40	\$115.97	
r								
K								
w								
h								

Replacement of 90 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7
20 F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$13.81	\$20.71	\$27.61	\$34.51	\$41.42	\$48.32
	\$0.065	\$14.96	\$22.43	\$29.91	\$37.39	\$44.87	\$52.35
	\$0.070	\$16.11	\$24.16	\$32.21	\$40.27	\$48.32	\$56.37
	\$0.075	\$17.26	\$25.89	\$34.51	\$43.14	\$51.77	\$60.40
	\$0.080	\$18.41	\$27.61	\$36.81	\$46.02	\$55.22	\$64.43
	\$0.085	\$19.56	\$29.34	\$39.12	\$48.89	\$58.67	\$68.45
	\$0.090	\$20.71	\$31.06	\$41.42	\$51.77	\$62.13	\$72.48
	\$0.095	\$21.86	\$32.79	\$43.72	\$54.65	\$65.58	\$76.51
	\$0.100	\$23.01	\$34.51	\$46.02	\$57.52	\$69.03	\$80.53
	\$0.105	\$24.16	\$36.24	\$48.32	\$60.40	\$72.48	\$84.56
	\$0.110	\$25.31	\$37.97	\$50.62	\$63.28	\$75.93	\$88.59
	\$0.115	\$26.46	\$39.69	\$52.92	\$66.15	\$79.38	\$92.61
	\$0.120	\$27.61	\$41.42	\$55.22	\$69.03	\$82.83	\$96.64
	\$0.125	\$28.76	\$43.14	\$57.52	\$71.90	\$86.28	\$100.67
\$0.130	\$29.91	\$44.87	\$59.82	\$74.78	\$89.74	\$104.69	
\$0.135	\$31.06	\$46.59	\$62.13	\$77.66	\$93.19	\$108.72	
\$0.140	\$32.21	\$48.32	\$64.43	\$80.53	\$96.64	\$112.75	

Replacement of 90 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
<b>23</b>	F u e l  C o s t  i n  C e n t s  p e r  K w h	<b>\$0.060</b>	\$13.21	\$19.82	\$26.43	\$33.03	\$39.64	\$46.25
		<b>\$0.065</b>	\$14.32	\$21.47	\$28.63	\$35.79	\$42.95	\$50.10
		<b>\$0.070</b>	\$15.42	\$23.12	\$30.83	\$38.54	\$46.25	\$53.96
		<b>\$0.075</b>	\$16.52	\$24.78	\$33.03	\$41.29	\$49.55	\$57.81
		<b>\$0.080</b>	\$17.62	\$26.43	\$35.24	\$44.05	\$52.86	\$61.66
		<b>\$0.085</b>	\$18.72	\$28.08	\$37.44	\$46.80	\$56.16	\$65.52
		<b>\$0.090</b>	\$19.82	\$29.73	\$39.64	\$49.55	\$59.46	\$69.37
		<b>\$0.095</b>	\$20.92	\$31.38	\$41.84	\$52.31	\$62.77	\$73.23
		<b>\$0.100</b>	\$22.02	\$33.03	\$44.05	\$55.06	\$66.07	\$77.08
		<b>\$0.105</b>	\$23.12	\$34.69	\$46.25	\$57.81	\$69.37	\$80.94
		<b>\$0.110</b>	\$24.23	\$36.34	\$48.45	\$60.56	\$72.68	\$84.79
		<b>\$0.115</b>	\$25.33	\$37.99	\$50.65	\$63.32	\$75.98	\$88.64
		<b>\$0.120</b>	\$26.43	\$39.64	\$52.86	\$66.07	\$79.28	\$92.50
		<b>\$0.125</b>	\$27.53	\$41.29	\$55.06	\$68.82	\$82.59	\$96.35
		<b>\$0.130</b>	\$28.63	\$42.95	\$57.26	\$71.58	\$85.89	\$100.21
<b>\$0.135</b>	\$29.73	\$44.60	\$59.46	\$74.33	\$89.19	\$104.06		

Replacement of 90 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
27	F	\$0.060	\$12.43	\$18.64	\$24.85	\$31.06	\$37.28	\$43.49
	u	\$0.065	\$10.26	\$15.38	\$20.51	\$25.64	\$30.77	\$35.89
	e	\$0.070	\$11.04	\$16.57	\$22.09	\$27.61	\$33.13	\$38.66
	l	\$0.075	\$11.83	\$17.75	\$23.67	\$29.58	\$35.50	\$41.42
	C	\$0.080	\$12.62	\$18.93	\$25.24	\$31.56	\$37.87	\$44.18
	o	\$0.085	\$13.41	\$20.12	\$26.82	\$33.53	\$40.23	\$46.94
	s	\$0.090	\$14.20	\$21.30	\$28.40	\$35.50	\$42.60	\$49.70
	t	\$0.095	\$14.99	\$22.48	\$29.98	\$37.47	\$44.97	\$52.46
	i	\$0.100	\$15.78	\$23.67	\$31.56	\$39.44	\$47.33	\$55.22
	n	\$0.105	\$16.57	\$24.85	\$33.13	\$41.42	\$49.70	\$57.98
	C	\$0.110	\$17.36	\$26.03	\$34.71	\$43.39	\$52.07	\$60.74
	e	\$0.115	\$18.14	\$27.22	\$36.29	\$45.36	\$54.43	\$63.51
	n	\$0.120	\$18.93	\$28.40	\$37.87	\$47.33	\$56.80	\$66.27
	t	\$0.125	\$19.72	\$29.58	\$39.44	\$49.31	\$59.17	\$69.03
s	\$0.130	\$20.51	\$30.77	\$41.02	\$51.28	\$61.53	\$71.79	
p	\$0.135	\$21.30	\$31.95	\$42.60	\$53.25	\$63.90	\$74.55	
e	\$0.140	\$22.09	\$33.13	\$44.18	\$55.22	\$66.27	\$77.31	
r								
K								
w								
h								

Replacement of 100 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7
15 F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$16.76	\$25.15	\$33.53	\$41.91	\$50.29	\$58.67
	\$0.065	\$18.16	\$27.24	\$36.32	\$45.40	\$54.48	\$63.56
	\$0.070	\$19.56	\$29.34	\$39.12	\$48.89	\$58.67	\$68.45
	\$0.075	\$20.95	\$31.43	\$41.91	\$52.39	\$62.86	\$73.34
	\$0.080	\$22.35	\$33.53	\$44.70	\$55.88	\$67.06	\$78.23
	\$0.085	\$23.75	\$35.62	\$47.50	\$59.37	\$71.25	\$83.12
	\$0.090	\$25.15	\$37.72	\$50.29	\$62.86	\$75.44	\$88.01
	\$0.095	\$26.54	\$39.81	\$53.09	\$66.36	\$79.63	\$92.90
	\$0.100	\$27.94	\$41.91	\$55.88	\$69.85	\$83.82	\$97.79
	\$0.105	\$29.34	\$44.01	\$58.67	\$73.34	\$88.01	\$102.68
	\$0.110	\$30.73	\$46.10	\$61.47	\$76.83	\$92.20	\$107.57
	\$0.115	\$32.13	\$48.20	\$64.26	\$80.33	\$96.39	\$112.46
	\$0.120	\$33.53	\$50.29	\$67.06	\$83.82	\$100.58	\$117.35
	\$0.125	\$34.92	\$52.39	\$69.85	\$87.31	\$104.77	\$122.24
\$0.130	\$36.32	\$54.48	\$72.64	\$90.80	\$108.97	\$127.13	
\$0.135	\$37.72	\$56.58	\$75.44	\$94.30	\$113.16	\$132.02	
\$0.140	\$39.12	\$58.67	\$78.23	\$97.79	\$117.35	\$136.91	

Replacement of 100 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
18	F	\$0.060	\$16.17	\$24.26	\$32.34	\$40.43	\$48.52	\$56.60
	u	\$0.065	\$17.52	\$26.28	\$35.04	\$43.80	\$52.56	\$61.32
	e	\$0.070	\$18.87	\$28.30	\$37.74	\$47.17	\$56.60	\$66.04
	i	\$0.075	\$20.22	\$30.32	\$40.43	\$50.54	\$60.65	\$70.75
	C	\$0.080	\$21.56	\$32.34	\$43.13	\$53.91	\$64.69	\$75.47
	o	\$0.085	\$22.91	\$34.37	\$45.82	\$57.28	\$68.73	\$80.19
	s	\$0.090	\$24.26	\$36.39	\$48.52	\$60.65	\$72.78	\$84.90
	t	\$0.095	\$25.61	\$38.41	\$51.21	\$64.02	\$76.82	\$89.62
	i	\$0.100	\$26.95	\$40.43	\$53.91	\$67.38	\$80.86	\$94.34
	n	\$0.105	\$28.30	\$42.45	\$56.60	\$70.75	\$84.90	\$99.06
	C	\$0.110	\$29.65	\$44.47	\$59.30	\$74.12	\$88.95	\$103.77
	e	\$0.115	\$31.00	\$46.50	\$61.99	\$77.49	\$92.99	\$108.49
	n	\$0.120	\$32.34	\$48.52	\$64.69	\$80.86	\$97.03	\$113.21
	t	\$0.125	\$33.69	\$50.54	\$67.38	\$84.23	\$101.08	\$117.92
s	\$0.130	\$35.04	\$52.56	\$70.08	\$87.60	\$105.12	\$122.64	
p	\$0.135	\$36.39	\$54.58	\$72.78	\$90.97	\$109.16	\$127.36	
e	\$0.140	\$37.74	\$56.60	\$75.47	\$94.34	\$113.21	\$132.07	
r								
K								
w								
h								

Replacement of 100 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
20	F	\$0.060	\$15.78	\$23.67	\$31.56	\$39.44	\$47.33	\$55.22
	u	\$0.065	\$17.09	\$25.64	\$34.19	\$42.73	\$51.28	\$59.82
	e	\$0.070	\$18.41	\$27.61	\$36.81	\$46.02	\$55.22	\$64.43
	l	\$0.075	\$19.72	\$29.58	\$39.44	\$49.31	\$59.17	\$69.03
	C	\$0.080	\$21.04	\$31.56	\$42.07	\$52.59	\$63.11	\$73.63
	o	\$0.085	\$22.35	\$33.53	\$44.70	\$55.88	\$67.06	\$78.23
	s	\$0.090	\$23.67	\$35.50	\$47.33	\$59.17	\$71.00	\$82.83
	t	\$0.095	\$24.98	\$37.47	\$49.96	\$62.45	\$74.94	\$87.44
	i	\$0.100	\$26.30	\$39.44	\$52.59	\$65.74	\$78.89	\$92.04
	n	\$0.105	\$27.61	\$41.42	\$55.22	\$69.03	\$82.83	\$96.64
	C	\$0.110	\$28.93	\$43.39	\$57.85	\$72.31	\$86.78	\$101.24
	e	\$0.115	\$30.24	\$45.36	\$60.48	\$75.60	\$90.72	\$105.84
	n	\$0.120	\$31.56	\$47.33	\$63.11	\$78.89	\$94.67	\$110.44
	t	\$0.125	\$32.87	\$49.31	\$65.74	\$82.18	\$98.61	\$115.05
s	\$0.130	\$34.19	\$51.28	\$68.37	\$85.46	\$102.56	\$119.65	
p	\$0.135	\$35.50	\$53.25	\$71.00	\$88.75	\$106.50	\$124.25	
e	\$0.140	\$36.81	\$55.22	\$73.63	\$92.04	\$110.44	\$128.85	
r								
K								
w								
h								

Replacement of 100 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7
23 F u e l C o s t i n C e n t s p e r K w h	\$0.060	\$15.19	\$22.78	\$30.37	\$37.97	\$45.56	\$53.15
	\$0.065	\$16.45	\$24.68	\$32.90	\$41.13	\$49.35	\$57.58
	\$0.070	\$17.72	\$26.58	\$35.43	\$44.29	\$53.15	\$62.01
	\$0.075	\$18.98	\$28.47	\$37.97	\$47.46	\$56.95	\$66.44
	\$0.080	\$20.25	\$30.37	\$40.50	\$50.62	\$60.74	\$70.87
	\$0.085	\$21.51	\$32.27	\$43.03	\$53.78	\$64.54	\$75.30
	\$0.090	\$22.78	\$34.17	\$45.56	\$56.95	\$68.34	\$79.73
	\$0.095	\$24.04	\$36.07	\$48.09	\$60.11	\$72.13	\$84.16
	\$0.100	\$25.31	\$37.97	\$50.62	\$63.28	\$75.93	\$88.59
	\$0.105	\$26.58	\$39.86	\$53.15	\$66.44	\$79.73	\$93.02
	\$0.110	\$27.84	\$41.76	\$55.68	\$69.60	\$83.52	\$97.44
	\$0.115	\$29.11	\$43.66	\$58.21	\$72.77	\$87.32	\$101.87
	\$0.120	\$30.37	\$45.56	\$60.74	\$75.93	\$91.12	\$106.30
	\$0.125	\$31.64	\$47.46	\$63.28	\$79.09	\$94.91	\$110.73
\$0.130	\$32.90	\$49.35	\$65.81	\$82.26	\$98.71	\$115.16	
\$0.135	\$34.17	\$51.25	\$68.34	\$85.42	\$102.51	\$119.59	
\$0.140	\$35.43	\$53.15	\$70.87	\$88.59	\$106.30	\$124.02	

Replacement of 100 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
27	F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$14.40	\$21.60	\$28.79	\$35.99	\$43.19	\$50.39
		\$0.065	\$15.60	\$23.40	\$31.19	\$38.99	\$46.79	\$54.59
		\$0.070	\$16.80	\$25.20	\$33.59	\$41.99	\$50.39	\$58.79
		\$0.075	\$18.00	\$26.99	\$35.99	\$44.99	\$53.99	\$62.99
		\$0.080	\$19.20	\$28.79	\$38.39	\$47.99	\$57.59	\$67.19
		\$0.085	\$20.40	\$30.59	\$40.79	\$50.99	\$61.19	\$71.39
		\$0.090	\$21.60	\$32.39	\$43.19	\$53.99	\$64.79	\$75.59
		\$0.095	\$22.80	\$34.19	\$45.59	\$56.99	\$68.39	\$79.78
		\$0.100	\$24.00	\$35.99	\$47.99	\$59.99	\$71.99	\$83.98
		\$0.105	\$25.20	\$37.79	\$50.39	\$62.99	\$75.59	\$88.18
		\$0.110	\$26.39	\$39.59	\$52.79	\$65.99	\$79.18	\$92.38
		\$0.115	\$27.59	\$41.39	\$55.19	\$68.99	\$82.78	\$96.58
		\$0.120	\$28.79	\$43.19	\$57.59	\$71.99	\$86.38	\$100.78
		\$0.125	\$29.99	\$44.99	\$59.99	\$74.99	\$89.98	\$104.98
\$0.130	\$31.19	\$46.79	\$62.39	\$77.99	\$93.58	\$109.18		
\$0.135	\$32.39	\$48.59	\$64.79	\$80.98	\$97.18	\$113.38		
\$0.140	\$33.59	\$50.39	\$67.19	\$83.98	\$100.78	\$117.58		

Replacement of 150 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
15	F	\$0.060	\$26.63	\$39.94	\$53.25	\$66.56	\$79.88	\$93.19
	u	\$0.065	\$28.84	\$43.27	\$57.69	\$72.11	\$86.53	\$100.95
	e	\$0.070	\$31.06	\$46.59	\$62.13	\$77.66	\$93.19	\$108.72
	l	\$0.075	\$33.28	\$49.92	\$66.56	\$83.20	\$99.84	\$116.48
	C	\$0.080	\$35.50	\$53.25	\$71.00	\$88.75	\$106.50	\$124.25
	o	\$0.085	\$37.72	\$56.58	\$75.44	\$94.30	\$113.16	\$132.02
	s	\$0.090	\$39.94	\$59.91	\$79.88	\$99.84	\$119.81	\$139.78
	t	\$0.095	\$42.16	\$63.23	\$84.31	\$105.39	\$126.47	\$147.55
	i	\$0.100	\$44.38	\$66.56	\$88.75	\$110.94	\$133.13	\$155.31
	n	\$0.105	\$46.59	\$69.89	\$93.19	\$116.48	\$139.78	\$163.08
	C	\$0.110	\$48.81	\$73.22	\$97.63	\$122.03	\$146.44	\$170.84
	e	\$0.115	\$51.03	\$76.55	\$102.06	\$127.58	\$153.09	\$178.61
	n	\$0.120	\$53.25	\$79.88	\$106.50	\$133.13	\$159.75	\$186.38
	t	\$0.125	\$55.47	\$83.20	\$110.94	\$138.67	\$166.41	\$194.14
s	\$0.130	\$57.69	\$86.53	\$115.38	\$144.22	\$173.06	\$201.91	
p	\$0.135	\$59.91	\$89.86	\$119.81	\$149.77	\$179.72	\$209.67	
e	\$0.140	\$62.13	\$93.19	\$124.25	\$155.31	\$186.38	\$217.44	
r								
K								
w								
h								

Replacement of 150 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7
18 F u e l C o s t i n C e n t s P e r K w h	\$0.060	\$26.03	\$39.05	\$52.07	\$65.08	\$78.10	\$91.12
	\$0.065	\$28.20	\$42.30	\$56.41	\$70.51	\$84.61	\$98.71
	\$0.070	\$30.37	\$45.56	\$60.74	\$75.93	\$91.12	\$106.30
	\$0.075	\$32.54	\$48.81	\$65.08	\$81.35	\$97.63	\$113.90
	\$0.080	\$34.71	\$52.07	\$69.42	\$86.78	\$104.13	\$121.49
	\$0.085	\$36.88	\$55.32	\$73.76	\$92.20	\$110.64	\$129.08
	\$0.090	\$39.05	\$58.58	\$78.10	\$97.63	\$117.15	\$136.68
	\$0.095	\$41.22	\$61.83	\$82.44	\$103.05	\$123.66	\$144.27
	\$0.100	\$43.39	\$65.08	\$86.78	\$108.47	\$130.17	\$151.86
	\$0.105	\$45.56	\$68.34	\$91.12	\$113.90	\$136.68	\$159.45
	\$0.110	\$47.73	\$71.59	\$95.46	\$119.32	\$143.18	\$167.05
	\$0.115	\$49.90	\$74.85	\$99.79	\$124.74	\$149.69	\$174.64
	\$0.120	\$52.07	\$78.10	\$104.13	\$130.17	\$156.20	\$182.23
	\$0.125	\$54.24	\$81.35	\$108.47	\$135.59	\$162.71	\$189.83
\$0.130	\$56.41	\$84.61	\$112.81	\$141.01	\$169.22	\$197.42	
\$0.135	\$58.58	\$87.86	\$117.15	\$146.44	\$175.73	\$205.01	
\$0.140	\$60.74	\$91.12	\$121.49	\$151.86	\$182.23	\$212.61	

Replacement of 150 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
20	F u e l  C o s t  i n  C e n t s  p e r  K w h	\$0.060	\$25.64	\$38.46	\$51.28	\$64.10	\$76.92	\$89.74
		\$0.065	\$27.78	\$41.66	\$55.55	\$69.44	\$83.33	\$97.21
		\$0.070	\$29.91	\$44.87	\$59.82	\$74.78	\$89.74	\$104.69
		\$0.075	\$32.05	\$48.07	\$64.10	\$80.12	\$96.15	\$112.17
		\$0.080	\$34.19	\$51.28	\$68.37	\$85.46	\$102.56	\$119.65
		\$0.085	\$36.32	\$54.48	\$72.64	\$90.80	\$108.97	\$127.13
		\$0.090	\$38.46	\$57.69	\$76.92	\$96.15	\$115.38	\$134.60
		\$0.095	\$40.59	\$60.89	\$81.19	\$101.49	\$121.78	\$142.08
		\$0.100	\$42.73	\$64.10	\$85.46	\$106.83	\$128.19	\$149.56
		\$0.105	\$44.87	\$67.30	\$89.74	\$112.17	\$134.60	\$157.04
		\$0.110	\$47.00	\$70.51	\$94.01	\$117.51	\$141.01	\$164.52
		\$0.115	\$49.14	\$73.71	\$98.28	\$122.85	\$147.42	\$171.99
		\$0.120	\$51.28	\$76.92	\$102.56	\$128.19	\$153.83	\$179.47
		\$0.125	\$53.41	\$80.12	\$106.83	\$133.54	\$160.24	\$186.95
\$0.130	\$55.55	\$83.33	\$111.10	\$138.88	\$166.65	\$194.43		
\$0.135	\$57.69	\$86.53	\$115.38	\$144.22	\$173.06	\$201.91		
\$0.140	\$59.82	\$89.74	\$119.65	\$149.56	\$179.47	\$209.38		

Replacement of 150 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
23	F	\$0.060	\$25.05	\$37.57	\$50.09	\$62.62	\$75.14	\$87.67
	u	\$0.065	\$27.13	\$40.70	\$54.27	\$67.84	\$81.40	\$94.97
	e	\$0.070	\$29.22	\$43.83	\$58.44	\$73.05	\$87.67	\$102.28
	l	\$0.075	\$31.31	\$46.96	\$62.62	\$78.27	\$93.93	\$109.58
	C	\$0.080	\$33.40	\$50.09	\$66.79	\$83.49	\$100.19	\$116.89
	o	\$0.085	\$35.48	\$53.23	\$70.97	\$88.71	\$106.45	\$124.19
	s	\$0.090	\$37.57	\$56.36	\$75.14	\$93.93	\$112.71	\$131.50
	t	\$0.095	\$39.66	\$59.49	\$79.32	\$99.15	\$118.97	\$138.80
	i	\$0.100	\$41.75	\$62.62	\$83.49	\$104.36	\$125.24	\$146.11
	n	\$0.105	\$43.83	\$65.75	\$87.67	\$109.58	\$131.50	\$153.41
	C	\$0.110	\$45.92	\$68.88	\$91.84	\$114.80	\$137.76	\$160.72
	e	\$0.115	\$48.01	\$72.01	\$96.01	\$120.02	\$144.02	\$168.03
	n	\$0.120	\$50.09	\$75.14	\$100.19	\$125.24	\$150.28	\$175.33
	t	\$0.125	\$52.18	\$78.27	\$104.36	\$130.45	\$156.55	\$182.64
s	\$0.130	\$54.27	\$81.40	\$108.54	\$135.67	\$162.81	\$189.94	
p	\$0.135	\$56.36	\$84.53	\$112.71	\$140.89	\$169.07	\$197.25	
e	\$0.140	\$58.44	\$87.67	\$116.89	\$146.11	\$175.33	\$204.55	
r								
K								
w								
h								

Replacement of 150 Watt Incandescent

CFL Watts	Hours On Per Day	2	3	4	5	6	7	
27	F	\$0.060	\$24.26	\$36.39	\$48.52	\$60.65	\$72.78	\$84.90
	u	\$0.065	\$26.28	\$39.42	\$52.56	\$65.70	\$78.84	\$91.98
	e	\$0.070	\$28.30	\$42.45	\$56.60	\$70.75	\$84.90	\$99.06
	l	\$0.075	\$30.32	\$45.48	\$60.65	\$75.81	\$90.97	\$106.13
	C	\$0.080	\$32.34	\$48.52	\$64.69	\$80.86	\$97.03	\$113.21
	o	\$0.085	\$34.37	\$51.55	\$68.73	\$85.92	\$103.10	\$120.28
	s	\$0.090	\$36.39	\$54.58	\$72.78	\$90.97	\$109.16	\$127.36
	t	\$0.095	\$38.41	\$57.61	\$76.82	\$96.02	\$115.23	\$134.43
	i	\$0.100	\$40.43	\$60.65	\$80.86	\$101.08	\$121.29	\$141.51
	n	\$0.105	\$42.45	\$63.68	\$84.90	\$106.13	\$127.36	\$148.58
	C	\$0.110	\$44.47	\$66.71	\$88.95	\$111.18	\$133.42	\$155.66
	e	\$0.115	\$46.50	\$69.74	\$92.99	\$116.24	\$139.49	\$162.73
	n	\$0.120	\$48.52	\$72.78	\$97.03	\$121.29	\$145.55	\$169.81
	t	\$0.125	\$50.54	\$75.81	\$101.08	\$126.35	\$151.61	\$176.88
s	\$0.130	\$52.56	\$78.84	\$105.12	\$131.40	\$157.68	\$183.96	
p	\$0.135	\$54.58	\$81.87	\$109.16	\$136.45	\$163.74	\$191.03	
e	\$0.140	\$56.60	\$84.90	\$113.21	\$141.51	\$169.81	\$198.11	
r								
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w								
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State of Ohio  
Weatherization Program  
Standards

Section **DIAGNOSTIC TESTING  
METHODS**

Subject **Room-to-Room  
Pressure Balancing**

*AIR HANDLER PRESSURE BALANCE TESTING*

*1506-7.1*

- Set house up in winter operating mode (blower door testing configuration). **winter operating mode**  
1506-7.1
- Run a hose to the exterior of the building. Run a hose to the combustion appliance zone. **hose locations**  
1506-7.1a
- Set up a magnahelic gauge zeroed at 30 Pa or a digital pressure gauge in the main body of the house. **zero gauge**  
1506-7.1b
- Turn on the air handler and take three pressure readings: **take pressure readings**  
1506-7.1c
- i. House with WRT the outside
  - ii. House WRT the CAZ
  - iii. CAZ WRT the outside
- Close all interior doors. **close interior doors**  
1506-7.1d
- Repeat pressure measurements. **repeat measurements**  
1506-7.1e
- i. House WRT outside
  - ii. House WRT CAZ
  - iii. CAZ WRT outside.
- Take the pressure gauge, being careful to level and zero on 30 Pa when using a magnahelic gauge, and measure the pressure difference across all interior doors. Pressure test and record measurements for all rooms WRT the main body of the house. **measure differences**  
1506-7.1f
- Take action if room pressure readings exceed  $\pm 4$  Pa or the CAZ WRT the outside exceeds -5 Pa. **action needed**  
1506-7.1g

*MOBILE HOME BELLY RETURN CONVERSION 1506-7.2***add door grill**  
1506-7.2a

Add a grill at least the size of the existing opening in the furnace cabinet door to the furnace closet door.

**block floor registers**  
1506-7.2b

Block all floor return registers with a positive air barrier being careful to find hidden registers under built-ins, behind furniture, and in the kitchen. Completely block all floor openings in the furnace closet using a fire retardant air barrier being careful to not seal the combustion air inlet.

**test grill size**  
1506-7.2c

Set up and zero a pressure differential gauge measuring the furnace closet WRT the outside. Activate the furnace fan and take a reading. A reading of greater than -10Pa indicates additional grill area needs to be added to the furnace closet.

**test rooms**  
1506-7.2d

Close all interior doors. Measure the pressure difference across all interior doors. Pressure test and record measurements for all rooms WRT the main body of the house.

**action needed**  
1506-7.2e

Action needs to be taken if the room pressure readings exceed  $\pm 4$  Pa or the furnace closet WRT the outside exceeds -10 Pa.



State of Ohio  
Weatherization Program  
Standards

Section	<b>DIAGNOSTIC TESTING METHODS</b>
Subject	<b>Heating Unit Safety and Efficiency</b>

*HEATING UNIT SAFETY AND EFFICIENCY 1506-8*

The following is a set of procedures to complete a safety and efficiency inspection of a combustion heating and DHW system. These procedures are based on the standards set by NFPA 31, 54, 211, and ANSI Z21.

*PREPARATION 1506-8.1*

Using a calibrated gas leak detector, test all gas lines between the gas meter and all gas appliances. It is recommended that gas leak detection be done as early as possible in the inspection process.

**detect leaks**  
1506-8.1a

Perform a visual inspection of venting, wiring, piping and ductwork. From the furnace and DHW identification plates, record model numbers, rated Btu inputs, etc.

**visual inspection**  
1506-8.1b

Measure the dimensions of the space from which the heating system and DHW unit take their combustion air. Ensure that this is an UNCONFINED space: Add up the Btuh input of all of the gas appliances in that space. NFPA 54 requires a minimum of 50 cubic feet of space for each 1000 BTUh of appliance input. A CONFINED space requires direct communication with additional combustion air from outside the space.

**measure CAZ**  
1506-8.1c

Drill test holes in the flue pipes, return plenum, and in a supply duct at a point six inches downstream of the supply plenum.

**test holes**  
1506-8.1d

Locate the test hole 1 1/2 times the diameter of the flue away from an elbow or flue collar.

**test hole location**  
1605-8.1e

Calibrate the combustion analyzer PMI.

**calibrate analyzer**  
1506-8.1f

Note: If a gas DHW unit shares a chimney with a gas heating unit, test the DHW unit first. An underheated, oversized chimney presents a hazard to establishing DHW unit draft. At all costs, a continuously backdrafting DHW unit must be remedied.

*DHW INSPECTION PROCEDURES 1506-8.2*

<b>worst case draft test</b> 1506-8.2a	Perform a worst case draft test on the DHW (see 1506-4).
<b>combustion efficiency test</b> 1506-8.2b	Start the efficiency test. Use the flue gas temperature to determine when the unit reaches steady-state.
<b>CO and combustion</b> 1506-8.2c	At steady-state, record the CO and combustion test readings.
<b>clock meter</b> 1506-8.2d	Ensuring that no other gas appliances are firing, clock the gas meter. A reading of $\pm 10\%$ of the rated input is acceptable.
<b>pilot safety drop-out test</b> 1506-8.2e	Perform a safety drop-out test on the DHW unit gas control valve. After the DHW unit has been firing for at least 10 minutes, turn the control knob to pilot, extinguish the pilot flame, time how long it takes for the safety valve to close. Use a calibrated gas leak detector to verify that gas is not leaking through the main gas supply valve. Three minutes or less is acceptable. Keep the gas shut off. For oil units check the primary control and cad cells.
<b>main valve safety drop-out test</b> 1506-8.2f	Perform a safety drop-out test on the main gas valve of the gas control valve. Turn the gas back on at the manual shut-off valve. Use a gas detector to ensure that the main gas valve has remained closed. If gas is detected, the gas valve is not safe and will need to be replaced.
<b>relight pilot</b> 1506-8.2g	Relight the pilot and ensure that the DHW unit is operating properly.
<b>visual inspection</b> 1506-8.2h	Visually inspect the combustion chamber for rust, dirt and proper burner alignment. Visually inspect venting, plumbing and gas piping. Check the tank for water leaks and note any NFPA or WPS violations.
<b>temperature setting</b> 1506-8.2i	Consult the occupant on the desired water temperature setting. Adjust the setting accordingly, setting it no lower than 120° F and no higher than 140° F.

*FURNACE INSPECTION PROCEDURE 1506-8.3*

<b>shut off power</b> 1506-8.3a	Shut off the power to the furnace. Use a non-contact voltage detector to confirm that the power to the unit has been shut off.
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Remove the thermostat and hook up an anticipator meter.	<b>hook up meter</b> 1506-8.3b
Turn the power on and fire the unit.	<b>turn power on</b> 1506-8.3c
Perform a draft test if applicable. If draft is not established at two (2) minutes, note it on the work order and continue (see 1506-4).	<b>perform draft test</b> 1506-8.3d
If at two (2) minutes the furnace backdrafts CO into the ambient air, stop the inspection, shut down the furnace, find the cause of the backdrafting and have the draft problem corrected.	
Start the combustion efficiency test PMI for the type of analyzer being used. Monitor the flue gas temperature for steady-state.	<b>combustion efficiency test</b> 1506-8.3e
When the unit reaches steady-state, perform a combustion efficiency test in each burner exhaust port for gas units, and before the barometric damper for oil or induced draft unit. If the CO or O <sub>2</sub> fluctuates after the blower fan comes on, this may indicate a cracked heat exchanger.	<b>test</b> 1506-8.3f
Measure the temperature in a hole drilled in a supply duct within 12 inches of the supply plenum. Return temperature may be taken in the return plenum or at the filter compartment. Calculate the temperature rise across the heat exchanger by subtracting the return air temperature from the supply air temperature. Compare this ACTUAL temperature rise to the RATED temperature rise indicated on the furnace ID plate (or within the acceptable range of 60 F and 90 F). A discrepancy between the rated and the actual temperature rises can be a good indicator of air flow-related problems within the distribution system.	<b>temperature rise</b> 1506-8.3g
Ensuring that no other gas appliances are firing, clock the gas meter. Plus or minus 10% from the rated input is acceptable for atmospheric appliances. Condensing appliances must be within plus or minus 4% (or PMI). For oil units, verify that the nozzle size is as rated on the data plate. For electric units, verify that all heating elements are working in sequence.	<b>clock meter</b> 1506-8.3h

**pilot safety drop-out test**

1506-8.3i

Perform a safety drop-out test on the gas control valve. After the unit has been firing for at least 10 minutes, turn the control knob to pilot, extinguish the pilot flame, and time how long it takes for the safety valve to close. Use a calibrated gas leak detector to verify that gas is not leaking through the main gas supply valve. Three minutes or less is acceptable. Keep the gas shut off. For oil units, check the primary control and cad cell.

**main valve safety drop-out test**

1506-8.3j

Perform a safety drop-out test on the main gas valve of the gas control valve. Turn the gas back on at the manual shut-off valve. Use a gas leak detector to ensure that the main gas valve has remained closed. If gas is detected, the gas valve is not safe and will need to be replaced.

**relight pilot**

1506-8.3k

Relight the pilot and ensure that the furnace is operating properly.

**shut off power**

1506-8.3l

Shut off power to the furnace and use a non-contact voltage detector to verify that the power is off.

**test limit control**

1506-8.3m

With the power to the furnace shut off, disconnect one wire from the fan control, or from the fan side of a fan/limit control; or remove the fan belt, or block off all return registers. Insert the temperature probe in the supply duct test hole and turn the power on. Monitor the supply air temperature as the furnace heats up. Compare the temperature at which the limit control shuts off the burners or elements to the temperature at which the limit is set. Plus or minus 10% is the acceptable range.

**shut off power**

1506-8.3n

Shut off the power to the unit and verify that the power is off. Reconnect the fan wire (or put the fan belt back on, or unblock the return registers). Turn the power on.

**visual inspection**

1506-8.3o

Visually inspect the interior of the heat exchanger with a mirror and flashlight. Verify any suspected cracks with an AGA-approved testing method.

**worst case draft test**

1506-8.3p

As a final precaution, perform a worst case draft test on the furnace and the DHW together (see 1506-4)

**adjust anticipator**

1506-8.3q

Measure the amp draw at the thermostat. Adjust the anticipator or specify adjustment on the work order. Reconnect the thermostat, making sure it is level.

Note 1: If a humidifier and/or an electronic air cleaner are controlled by the same 24 volt circuit as the furnace, those units must also be running when the amp draw on the 24 volt circuit is measured.

Note 2: If an adjustment is made to the anticipator, run the furnace through one cycle to ensure proper cycling.



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>DIAGNOSTIC TESTING METHODS</b>
		Subject	<b>Moisture Assessment</b>

### *MOISTURE ASSESSMENT 1506-9*

All homes should be checked for previous or existing moisture problems. The moisture assessment section of the Building Test Data Information Sheet must be filled out along with special attention to the following signs:

**detect moisture problems**  
1506-9.1a

Evidence of condensation on windows and walls indicated by stains or mold.

**condensation**  
1506-9.1b

Standing water, open sumps, open wells, dirt floors, water stains, etc. in basements. Also check to see if firewood is stored in the basement and whether laundry is hung to dry during the winter months.

**basement**  
1506-9.1c

Leaking supply or waste pipes.

**leaky pipes** 1506-9.1d

Attic roof sheathing shows signs of mold or mildew as evidenced by dark staining on the sheathing.

**attic sheathing**  
1506-9.1e

If existing moisture problems are found, no air sealing should be done unless the source of the moisture can be eliminated 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 crawlspaces from the house, or sealing attic leakage to eliminate condensation on the roof deck).

**existing problems**  
1506-9.2a

Because air tightening may cause an increase in relative humidity, consumer education should include information about moisture problems and possible solutions.

**consumer education**  
1506-9.3a

In the course of weatherization, any low cost measures which 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 a vapor retarder on dirt floors.

**reduce humidity**  
1506-9.4a

Any major work needed for moisture control paid for with HWAP funds should be cleared with the Office of Energy Efficiency.

**major work**  
1506-9.5a

**BTL**  
1506-9.6a

The minimum Building Tightness Limit (BTL) is no guarantee that moisture will not be a problem in that home.



State of Ohio  
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Section **DIAGNOSTIC TESTING  
METHODS**

Subject **Building Tightness  
Limits (BTL)**

*BUILDING TIGHTNESS LIMITS (BTL) 1506-10.1*

The calculated BTL is intended to prevent the over tightening of buildings. Similar to the OVERALLS (NO WORK) range, if a home is below its BTL, this does not mean that no work should be done. Conductive heat loss measures, heating system work, forced-air sealing and balancing, along with ventilation assessment and corrective actions should still be accomplished. **Regardless of the Building Tightness Limits calculated, air sealing shall not be undertaken if the house has an indoor air quality problem that has not or can not be remedied.**

**intention**  
1506-10.1a

*N-VALUE 1509-10.2*

Calculate the building's N value. The N value is determined using the Lawrence Berkeley Laboratory (LBL) correlation factors for height, wind shielding and climate correlation. In Ohio, the climate correlation factor will be 18.5. Basements and attics will not be counted as stories unless they are finished and are used as a living space. If finished, a basement will usually be considered a ½ story unless all of the basement walls are exposed. An attic will be considered a full story unless the square footage is less than 50% of the floor below. Windshielding factor is based on the blower door values.

**calculating n-value**  
1506-10.2a

The calculation for the N value is as follows:

$N = \text{Height factor} \times \text{Wind Shielding factor} \times \text{Climate factor}$

**n-values with climate  
factor of 18.5**  
1506-10.2b

	# of stories				
windshield	1	1.5	2	2.5	3
shielded(1.2)	22.2	20.0	17.8	16.4	15.5
normal (1.)	18.5	16.7	14.8	13.7	13.0
exposed (.9)	16.7	15.0	13.3	12.3	11.7

*ACCEPTABLE METHODS 1506-10.3*

**method 1 (BTL based on 15 CFM)**  
1506-10.3a

The first method is a BTL based on 15 CFM<sub>n</sub> per person, i.e. 15 cubic feet per minute of natural infiltration per person. This method assures that there is proper ventilation for the occupants and is based on the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 62-1989.

**rules**  
1506-10.3a.i

$$\text{BTL @ } 15\text{CFM}_n/\text{person} = 15 \times \text{number of people} \times N$$

The following rules apply to this calculation:

- a. Minimum number of people is 5.
- b. Add one person to the total for every smoker.
- c. Add one person for every pet or group of pets over 75 pounds.
- d. Do not use this method if the building's square footage exceeds 320 ft<sup>2</sup> per person.

**completed charts**  
1506-10.3a.ii

**5 occupants**

	# of stories				
windshield	1	1.5	2	2.5	3
shielded	1665	1500	1335	1230	1163
normal	1388	1253	1110	1028	975
exposed	1253	1125	998	923	878

**6 occupants**

	# of stories				
windshield	1	1.5	2	2.5	3
shielded	1998	1800	1602	1476	1395
normal	1665	1503	1332	1233	1170
exposed	1503	1350	1197	1107	1053

**7 occupants**

	# of stories				
windshield	1	1.5	2	2.5	3
shielded	2331	2100	1869	1722	1628
normal	1943	1754	1554	1439	1365
exposed	1754	1575	1397	1292	1229

**8 occupants**

	# of stories				
windshield	1	1.5	2	2.5	3
shielded	2664	2400	2136	1968	1860
normal	2220	2004	1776	1644	1560
exposed	2004	1800	1596	1476	1404

The second method is a BTL based on  $.35 \text{ ACH}_n$ , i.e.  $.35$  Air Changes per hour of natural infiltration. This method focuses on assuring ventilation for the building when the building itself is large enough to become a significant source of pollution.

**method 2 (BTL based on  $.35 \text{ ACH}_n$ )**  
1506-10.3b

$$\text{BTL @ } .35 \text{ ACH}_n = (.35 \times \text{Volume} \times N) / 60$$

The following rules apply to this calculation:

**rules**  
1506-10.3b.i

- a. Use if the building’s square footage exceeds 320 ft<sup>2</sup> per person.
- b. The basement should not be included in the volume unless it is a living space.
- c. The deciding factor is the volume of the building.

**method 3 (BTL based  
on estimated  
depressurization  
1506-10.3c**

The third method is based on estimating the exhaust potential of all devices located in the home. These devices are defined as mechanical equipment or combustion appliances which exhaust through a vent connected to the outside of the envelope and which draws air from the living space. This method allows the inspector to determine when a greater than 5 Pascal negative pressure can be produced in the building. A negative pressure greater than 5 Pascal increases the potential for back drafting.

**locate and record  
devices  
1506-10.3c.i**

Locate and record all devices located in the building. Use Table 1506-103c.i to record the effective flow of the devices.

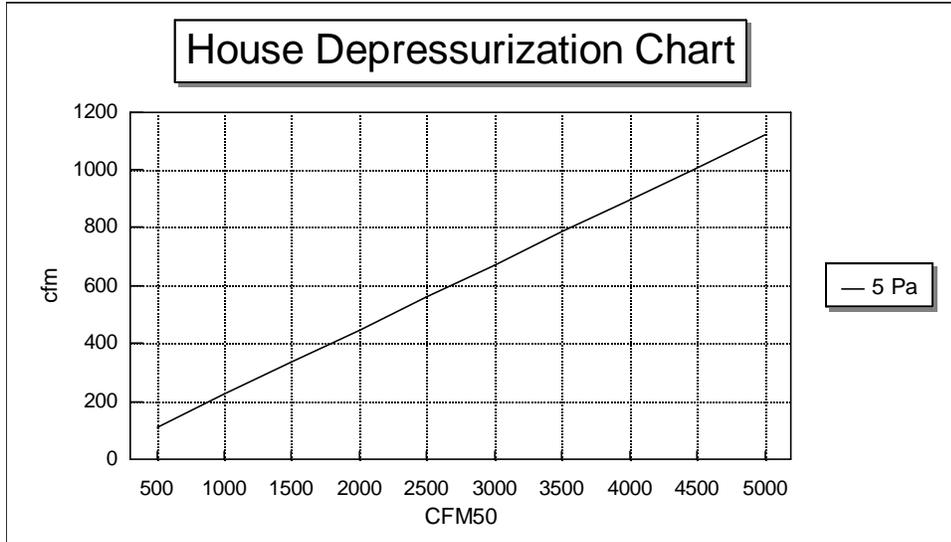
Table 1506-10.3c.i

Estimated Exhaust Potential			
Devices	Approximate Duct/Flue size (inches)	Typical Rated Flow CFM	Effective Flow CFM
Bathroom and rangehood fans	3	85	53
	3 1/4 x 10	85	53
	4	106	64
	7	212	127
	8	318	223
Exterior mounted kitchen fan	10	424	297
	10	636	445
Clothes dryer	4	85-127	106
Central vacuum			117
Jenn-Aire or similar range or counter top/ext. vent	5	800	300
	6	800	500
	3 1/4 x 10	800	600
Wood burning fireplace			300
Open wood stove			65
Airtight wood stove			50
Atmospheric gas oil or propane appliances (water heaters, boilers, furnaces)	3		21
	4		38
	5		47
	6		72

Sum of the effective flows for the building and locate this flow number on the Y-axis (left side-- cubic feet per minute) of Table 1506-10.3c.ii.

**total effective flows**  
1506-10.3c.ii

Table 1506-10.3c.ii



Read across the chart to the intersection of the 5 Pascal pressure line.

**read across chart**  
1506-10.3c.iii

Read down from this intersection to obtain the minimum CFM<sub>50</sub> for the building.

**read down chart**  
1506-10.3c.iv

Since this BTL is an estimate of exhaust potential and could overestimate the exhaust, there is some flexibility in this method. When this BTL is approached while air sealing, a worst case back draft test should be performed. If no problems exist, further air sealing is possible. The dwelling should never be tightened below the next highest BTL calculated.

**caution**  
1506-10.3d





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Section	<b>DIAGNOSTIC TESTING METHODS</b>
Subject	<b>Specifically Engineered Systems</b>

*SPECIFICALLY-ENGINEERED SYSTEMS 1506-11*

Use the following procedure for adding a measured amount of supply air to a basement to provide adequate combustion air. The input rating of sealed combustion appliances is not added to the total input rating for the purposes of this calculation.

**adding combustion air**  
1506-11.1a

Add the combined Btu/hr input of the combustion appliances located in the basement (CAZ) and determine the make-up air requirements.

**required volume for  
CAZ**  
1506-11.1b

Furnace Btu/hr input + domestic hot water Btu/hr input =  
Total Btu/hr input

Total Btu/hr input / 1,000 x 50 cubic feet = Required volume  
for CAZ

Determine the actual CAZ volume. Length x width x height  
= Cubic feet volume

**CAZ volume**  
1506-11.1c

Determine the amount of combustion input that requires  
make-up air in excess of that provided by the existing CAZ  
volume.

**determine needed  
combustion air**  
1506-11.1d

Required CAZ volume – Actual CAZ volume / 50 Btu/hr per  
1,000 cubic feet = Btu/hr of combustion that requires make-  
up air.

Use a pitot tube to measure the static pressure at the mid-  
point of a main supply branch duct or trunk where an  
additional supply branch and register can be installed. If  
there is a supply branch with a register already existing,  
assure that it has an un-dampened register installed and that  
it has adequate airflow to meet the combustion make-up air  
requirements.

**measure static  
pressure**  
1506-11.1e

Plenum or trunk mounted registers shall not be installed or  
used for this purpose. In most cases it is preferable to close  
or seal up these registers and provide branch mounted  
registers to meet the heating and combustion air  
requirements of the basement.

**duct sizing**  
1506-11.2e

Using the table below, find the appropriate minimum diameter duct for the Btu/hr requiring make-up air (vertical axis) and the static pressure measured across the duct (horizontal axis) closest to those determined in 1506-11.2a through 1506-11.2d above.

**Assuring adequate combustion air for the Btu/hr input over the volume of the CAZ. (by static pressure and duct diameter)**

BTU/H R	5 PA	10 PA	15 PA	20 PA	25 PA	50 PA
10,000	4"	3"	3"	3"	3"	3"
20,000	5"	4"	4"	3"	3"	3"
30,000	5"	5"	4"	4"	4"	3"
40,000	6"	5"	5"	4"	4"	4"
50,000	6"	5"	5"	5"	4"	4"
60,000	6"	6"	5"	5"	5"	4"

**alternative technique**  
1506-11.2f

Use the calculation and table below to determine the diameter of duct necessary to meet the additional combustion air requirement for a CAZ.

50 Cu ft of air volume is required for each 1000 Btu/hr of combustion

$50 \text{ Cubic feet per hr} / 60 \text{ min} = .83 \text{ CFM of air per } 1000 \text{ Btu/hr of combustion}$

$\# 1000\text{Btu/hr} \times .83 \text{ CFM} = \text{Total CFM additional air necessary for combustion}$

Using the table below, find the duct diameter that will deliver the minimum supply flow, given the static pressure across the duct it will be installed into.

**CFM of flow by duct diameter and static pressure**

	5 PA	10 PA	15 PA	20 PA	25 PA	50 PA
3"	<10	10	14	18	20	28
4"	10	22	28	36	40	60
5"	30	44	56	64	74	100
6"	50	70	90	108	120	170
8"	110	150	200	240	270	360
10"	200	280	360	420	460	660

Example:

40 (1000 Btu/hr) x .83 CFM = 33.2 CFM additional air for combustion

20 Pa measured static pressure across trunk requires a 4” added duct opening to deliver 36 CFM of flow.

Install a duct of the size indicated in the table (or determined using the calculations) using the current installation procedures recommended in the WPS. If there is central air conditioning existing, an inline damper shall be installed into the duct that can be closed during the summer. The damper handle should be clearly labeled summer (closed) and winter (open) and the operation explained to the occupants and/or homeowners.

**install duct**  
1506-11.2g

Retest the static pressure near the termination of the added duct to determine if the static pressure needed to provide the airflow into the basement is being met by the installed duct.

**test installation**  
1506-11.2h





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Section **EFFECTIVE INSULATION  
METHODS**

Subject **Site-Built Homes**

*GENERAL PRACTICES 1507-1.1*

All insulation methods require the insulation to fit snugly into the cavity being insulated. There must be no areas missed and the insulation should fit tightly to the wall, ceiling, floor, duct or pipe being insulated. Air will bypass the insulation or wash behind the insulation where there are any sags or gaps. This will result in the reduced effectiveness of the insulation.

**correct installation  
important**  
1507-1.1a

Insulation can be installed by several methods. Batt insulation can be installed by fastening the tabs with staples, by friction fitting the batts snugly in the cavity, or by simply laying the batt down. Loose fill insulation can be installed by blowing it in loosely, by drilling 1" holes and blowing it into a cavity until the cavity is full (blow to refusal), or by drilling a larger hole and inserting a tube into the cavity. The tube is then removed slowly as the cavity fills. This last method results in a densely packed insulation.

**installation methods**  
1507-1.1b

All persons installing, cutting, and handling fiberglass, cellulose, or rockwool insulation must wear masks or respirators, eye protection and gloves while working with the material (see sections 1401-1409).

**personal protective  
equipment**  
1507-1.1c

Each application may have several installation methods which will do the job. Choosing the most effective, least costly method which results in the highest performance of the insulation is a very important challenge for the weatherization installer staff. Some jobs will require the installers to use several methods on the same retrofit. Blown insulation is usually less expensive than batt insulation and cellulose is usually less expensive than fiberglass. Cellulose is, on the other hand, heavier than fiberglass making fiberglass preferable in places where the strength of the ceiling is in question. Cellulose, also, should never come in contact with metal roofing. Moisture is usually an important issue in decision making, and fiberglass is a better choice should water ever come in contact with the insulation. Techniques exist for blowing insulation in wall cavities which are covered on only one side.

**choose the  
appropriate method**  
1507-1.1d

**vapor retarder/fire rating**

1507-1.1e

Install vapor retarders on the side of the wall which will be warm in the winter. Vapor retarders must have a perm rating of less than one. Vapor barrier paint, 4 mil polyethylene sheeting, kraft paper, and foil are acceptable vapor retarders. No vapor retarder with a flame spread of greater than 25 (see appendix A, material standards) may be left uncovered. Sheet rock or another acceptable fireproofing material must cover the vapor retarder.

**bulk moisture**

1507-1.1f

Protect the insulation and the structure from moisture damage by repairing, flashing, or adding sealant to areas which may be prone to leaking such as roofs, wall vents, roof vents, sidewall plugs, window/door trim and sills, etc.

**batt insulation (stapled)**

1507-1.1g

Install faced batt insulation with the vapor retarder on the side which will be warm in the winter. Cut the insulation to fit snugly on all sides and around wiring, pipes, and other obstacles. Fit the insulation so it is tight against the warm in winter side. Install the insulation without compressing the batt. Fold the tabs out and staple along the tab on the face of the wall stud.

**batt insulation (friction fit)**

1507-1.1h

Install faced batt insulation with the vapor retarder on the side which will be warm in the winter. Cut the insulation to fit snugly on all sides and around wiring, pipes, and other obstacles. Fit the insulation so it is tight against the warm in winter side. Install the insulation without compressing the batt. The insulation must be mechanically fastened with wire supports or woven wire underneath the insulation. Woven plastic (manufactured specifically for insulation support) may be used provided the material allows for air movement and it has the structural strength for the load it will carry. Note that fabric air infiltration barriers such as Tyvec and other house wrap materials are not intended to be used for horizontal applications.

**batt insulation (laying)**

1507-1.1i

Install faced batt insulation with the vapor retarder on the side which will be warm in the winter. Cut the insulation to fit snugly on all sides and around wiring, pipes, and other obstacles. Fit the insulation so it is tight against the warm in winter side. Install the insulation without compressing the batt. When installing more than one layer of batt insulation, lay the second or any subsequent layer perpendicular to the preceding layer, thus criss-crossing the layers.

For applications on flat surfaces such as open attics, install the insulation to the manufacturers specifications for the R-value required. Always install the amount of insulation required, rather than the depth, as settling will vary depending on the air setting on the blowing equipment.

**blown cellulose (open)**  
1507-1.1j

Dense pack cellulose should be used for all sidewall cavities, floored attic areas, attic slopes, shallow shed roofs and other closed cavities where 2 ½ to 4 lbs. per cubic foot is required. Install the insulation using a tube inserted to the top (or bottom) of the cavity. Blow insulation to refusal, slowly withdrawing the tube as the cavity fills.

**blown cellulose (dense)**  
1507-1.1k

This method may be used for all sidewall cavities, floored attic areas, attic slopes, shallow shed roofs and other closed cavities where 2 to 2 ½ lbs. per cubic foot is acceptable (such as where the structure cannot withstand dense pack). The insulation in this method is installed from a hole drilled in the center of the area to be insulated. Air currents carry the insulation to the edges of the cavity, so locating the hole properly is vitally important. Drill 1" holes, centered to the width of the cavity so that there is no more than 5 feet between the top and bottom rows. Locate the holes in small cavities in the center of the cavity.

**blown cellulose (loose)**  
1507-1.1l

This method may be used for all sidewall cavities, floored attic areas, attic slopes, shallow shed roofs and other closed cavities where the weight of the insulation and moisture are concerns. Blown fiberglass is acceptable when installed against metal roofing. The insulation in this method is installed from a hole drilled in the center of the area to be insulated. Install this as you would loose blown cellulose, but consider whether the blowing equipment is rated to blow fiberglass.

**blown fiberglass (loose)**  
1507-1.1m

For applications on flat surfaces such as open attics. Install the insulation to the manufacturers specifications for the R-value required. Always install the amount of insulation required, rather than the depth, as settling will vary depending on the air setting on the blowing equipment. Install it similar to loose blown cellulose, but consider whether the blowing equipment is rated to blow fiberglass.

**blown fiberglass (open)**  
1507-1.1n

**proper tube**  
1507-1.1o

Use 1 1/4" inside diameter hose which has a 1/8" wall thickness.

Hard industrial vinyl works best when the air temperature is above freezing.

Soft industrial vinyl works best when the air temperature is below freezing.

Attach the vinyl hose to a 2" insulation hose using an automotive exhaust reducer tapered from 2" OD to 1 3/4" or 1 1/2" OD. Secure the tube with hose clamps.

**estimation of blown material**  
1507-1.1p

Net area (sq.ft.) X cavity depth (ft.) = cubic feet

Cubic feet X lbs. per cubic foot = lbs. insulation needed

Lbs. of insulation needed divided by lbs. per bag = number bags needed

**remove siding**  
1507-1.1q

With any of the sidewall insulation methods, remove as many rows of siding as is necessary according to the method being used. Vinyl siding may be removed by un-hooking the bottom lip of the row using a siding zip tool which is manufactured for this purpose. Most wooden clapboards may be removed by cutting or removing the nails of the row to be removed and the row directly above it with a flat pry bar. Care must be taken so that the siding does not split. Cement board siding may be removed by cutting two rows of nails as was described above. Note: some cement board siding contains asbestos. Removing siding is allowable; drilling asbestos containing material is not allowed. Always wear personal protective equipment when handling asbestos containing material.

**probe cavities**  
1507-1.1r

The probe must be made of a non-conductive material. Probe both vertically and horizontally to determine the spacing of the wall studs and to determine the existence and location of fire stops or bracing. Probe all cavities.

**prep cavities**  
1507-1.1s

Seal all cavity openings with a permanent, air impermeable material to keep insulation from leaking out in the future and to address air movement. Temporarily seal tops of open cavities to prevent insulation escaping during installation.

*SIDEWALLS 1507-1.2*

**tubing method (exterior)**  
1507-1.2a

One row of exterior siding must be removed. Drill holes (drill size 2"-2 9/16") through the sub-siding. Replace the siding to match the original condition of the siding.

For interior drilling, the tubing method is preferable to the 2 hole method. Protect the customer's furnishings, carpets, etc. by covering the area with plastic sheeting. After drilling and insulating, holes in interior wall surfaces must be filled and returned to a finished condition. For wallpapered, textured or colored surfaces that cannot be matched, a chair rail molding may be used to cover the holes. Locate these holes accordingly.

**tubing method  
(interior)**  
1507-1.2b

For framing where the top or bottom plate (or both) are open, the insulation may be installed from the crawl space/ basement or the attic through the openings into the wall cavities. This may not be practical for hard to reach areas, but could save drilling time in some instances. Fiberglass batts should not be used in balloon framed structures.

**tubing method  
(balloon construction)**  
1507-1.2c

Windows may be drilled with a 1" hole at the sill and header at a location where the closed window will cover the holes. These holes must be filled with wooden plugs and sealed for water proofing. If this is not practical, locate holes above and below windows, etc. in the center of the cavity.

**windows**  
1507-1.2d

Drill holes so that there is no more than 5 feet between top and bottom rows. Locate holes that are above and below windows, etc. in the center of the cavity. Sidewall plugs should match the color of the siding they are installed in. Sealant may be added to protect the walls and insulation from water damage. Note that 3.25 - 3.75 lbs. per cubic foot is required for sidewalls if a technical reason does not exist that prevents this density.

**two hole method**  
1507-1.2e

For multi-story buildings, either tubing or the two hole method is acceptable. Fiberglass batts should not be used in balloon framed structures. Insulation will spill between the floors. This spillage is acceptable and may actually help reduce air movement through bypasses. Specify additional insulation for this purpose.

**two story buildings  
(balloon construction)**  
1507-1.2f

For multi-story buildings, either tubing or the two hole method is acceptable. If there is concern about lack of insulation at the band joist, then blowing cellulose in the perimeter through the exterior, interior floor, or interior ceiling is acceptable if correct methods for the application being used are followed.

**two story buildings  
(platform  
construction)**  
1507-1.2g

*KNEEWALLS 1507-1.3***fiberglass batts**  
1507-1.3a

Seal bypasses in floor cavities leading into the kneewall attic, and exterior and interior wall cavities using an air-impermeable material. Fiberglass batts (R-19) must be secured with mechanical fasteners.

**blown cellulose**  
1507-1.3b

Install a fabric house wrap infiltration barrier along exposed kneewall framing. House wrap material should be cut and fastened to the roof in a way so the slope is continuous with the kneewall. House wrap material must be secured with staples (T-50) or another suitable fastener. Space fasteners no more than 3" apart. Pull the material tight between studs. 1/2" or 3/4" foam insulation board may also be used as an encapsulation barrier along exposed kneewall framing. It should fit snugly at the top plate, leaving a gap along the bottom plate. This gap is filled with a piece of fiberglass batting, serving as a pressure relief for the insulation installation. The insulation board is typically fastened with cap-nails or disks secured by screws. The cavities are tubed from the top, down. Access can be made using a common utility knife.

**bracing/house wrap material**  
1507-1.3c

Wall heights of 3 feet 6 inches or less require no additional bracing. Walls exceeding 3 feet 6 inches require a center horizontal band of either wood, metal, or plastic attached by either nails or screws to the studs. Securing straps need to be installed every 3 feet for walls over 6 feet.

**install insulation**  
1507-1.3d

Cut the house wrap to allow for access of a 2" hose. Blow insulation in slopes to refusal. Insulate the kneewall cavity as any other sidewall. Insulate just inside the floor/kneewall juncture with a plug of cellulose blown to refusal. Seal the access holes in the house wrap with small squares of belly patch to ensure barrier continuity. Insulate the flat open joist attic. Floored attics should be dense packed.

**kneewall door**  
1507-1.3e

Cover the kneewall door with insulation so that the effective R-value is equal the R-value of the kneewalls.

*ATTICS 1507-1.4***open joist**  
1507-1.4a

Seal the attic air leakage sites. Flag all junction boxes and add barriers to keep insulation from all heat producing devices. Correct all other existing hazards. Blow the insulation to the R-value specified.

Add a barrier to keep insulation away from the attic hatch (see 302-3.3c). Insulate the attic hatch to the same R-value as the attic.

**attic hatch**  
1507-1.4b

In attics previously insulated with batt insulation and where the soffits are vented, cut the batts back 2 feet from the eaves. Install vent baffles (if necessary). Insulate the area with blown insulation to ensure coverage over the outer wall top plate and to prevent wind washing under the existing batts. The quality of the installation of the existing batts should be verified before loose-fill insulation is installed on top. It may be necessary to remove or re-install improperly installed batts.

**existing batt**  
1507-1.4c

Access the cavities by drilling or removing the fascia. If drilling, the drill size should be 2" and the tubing method should be used. Use 2" plastic or wooden plugs. Blow insulation in each cavity area to refusal. Block the eave (if possible) to prevent insulation from spilling into the soffit.

**shed roof**  
1507-1.4d

#### *PERIMETER INSULATION 1507-1.5*

Moisture and air quality problems in the basement/crawl space must be corrected prior to the installation of perimeter insulation.

**moisture problems**  
1507-1.5a

Determine if the area will be a conditioned, unintentionally conditioned, or non-conditioned space upon the completion of weatherization. Perimeter insulation may be installed if the area will be a conditioned or unintentionally conditioned space.

**determine usage**  
1507-1.5b

Insulate the perimeter with R-11 vinyl faced insulation or equivalent material (based on R-value, cost, and code concerns).

**R-value**  
1507-1.5c

Seal any existing ventilation to the conditioned crawlspace/ basement area.

**ventilation**  
1507-1.5d

Install a vapor retarder/ground cover over any exposed earth. This vapor retarder must extend at least 6 inches up the foundation. Overlap any seams at least 6". Seal all joints with sealant.

**vapor retarder/ground cover**  
1507-1.5e

**install insulation**  
1507-1.5f

Install the insulation from the sillbox (including the bandjoist) to the crawlspace floor. The crawl space wall insulation shall extend vertically and horizontally a minimum total distance of 24" linearly from the outside finished ground level. The insulation must be mechanically fastened and all joints sealed with tape. The bottom edge must be weighted so that a tight fit against the wall is maintained.

*FLOOR INSULATION 1507-1.6***moisture problems**  
1507-1.6a

Moisture and air quality problems in the crawl space/ basement must be corrected prior to the installation of floor insulation.

**determine usage**  
1507-1.6b

Determine if the area will be a conditioned, unintentionally conditioned, or non-conditioned space upon the completion of weatherization. Floor insulation may be installed only if the area will be a non-conditioned space.

**vapor retarder/ground cover**  
1507-1.6c

Install a vapor retarder/ground cover over any exposed earth. This vapor retarder must extend at least 6 inches up the foundation. Overlap any seams at least 6" and seal all joints with sealant.

**ventilation**  
1507-1.6d

Where necessary, add ventilation to equal 1 sq. foot for every 1500 sq. feet of floor area. Ventilation may be disregarded if the area is dry and well drained. There must also be no evidence of standing water in the area and a complete ground cover must be installed if venting will be omitted.

**protect from freezing**  
1507-1.6e

Any water pipe located in a non-conditioned area must be protected from freezing when the floor above that area is insulated. Heat tape may be added if the temperature in the non-conditioned area stays near the outdoor temperature.

**R-value**  
1507-1.6f

Insulate the floor cavity with R-19 insulation.

**install insulation**  
1507-1.6g

Cut the insulation to fit snugly at all sides and cut the insulation to fit around bracing strips. Install the insulation horizontally from the sillbox (including the bandjoist).

Mechanically fasten the insulation if a vapor retarder is present. Tiger Claws (a.k.a. Lightning Rods or wire supports) or Insul-Strap may be used to support the insulation. Care must be taken to cut supports to the appropriate length in order to avoid over-compressing the insulation during installation.

**install insulation (con't)**  
1507-1.6g

Install woven plastic support material over the area to be insulated. This material is manufactured specifically for insulation support and is typically used for mobile homes. Ensure a tight fit of this material and brace as necessary. Note that fabric air infiltration barriers such as Tyvec and other house wrap materials are not intended to be used for horizontal applications. 1/2” or 3/4” foam insulation board may also be used as an encapsulation barrier. This material is typically supported by cap-nails or disks secured by screws. Blow fiberglass insulation to refusal following manufactures installation specifications. Cellulose should not be used in this application.

**blown insulation**  
1507-1.6h

*PIPE INSULATION 1507-1.7*

The first 6 feet of both the hot and cold water lines coming from the domestic water heater must be insulated with commercially available foam or fiberglass pipe insulation.

**hydronic heating pipes**  
1507-1.7b

Steam pipes require insulation rated for use on such pipes. All hot water supply pipes must be insulated with commercially available foam or fiberglass pipe insulation. Any hot water return pipes must be insulated with commercially available foam or fiberglass pipe insulation if they are located in a non-conditioned area.

**protect from freezing**  
1507-1.7c

Any water pipe located in a non-conditioned area must be protected from freezing when the floor above that area is insulated. Heat tape may be added if the temperature in the non-conditioned area stays near the outdoor temperature.

*DUCT INSULATION 1507-1.8*

Seal all duct work in accordance with section 301-5 prior to installing insulation.

**seal first**  
1507-1.8a

Insulate the ducts with R-6 vinyl or foil-backed duct insulation.

**R-value**  
1507-1.8b

**installation**  
1507-1.8c

**installation (con't)**  
1507-1.8c

The insulation must be mechanically fastened and all joints sealed with tape.

**new work**  
1507-1.8d

All new work must meet NFPA and local codes. A minimum of R-6 flex duct is allowable, however, rigid duct board may only be used to insulate over square metal ducts.

	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>PRIORITY LISTS</b>
		Subject	<b>Ohio Building Classification and Description</b>

**Ohio Building Classification and Description**

Type A	Wood Frame Home with Full Basement and Open Joist Attic
Type B	Wood Frame Home with Crawl Space and Open Joist Attic
Type C	Wood Frame Home with Combination Crawl Space Basement and Open Joist Attic
Type D	Wood Frame Home with Slab Foundation and Open Joist Attic
Type E	Wood Frame Home with Full Basement and Kneewall Attic
Type F	Wood Frame Home with Post Foundation and Open Joist Attic
Type G	Block, Concrete, or Log Home (Solid Wall) with Slab Foundation and Open Joist Attic
Type H	Mobile Home with Post Foundation
Type I	Block, Concrete, or Log Home (Solid Wall) with Basement and/or Crawl Space and Open Joist Attic



	<p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>PRIORITY LISTS</b>
		Subject	<b>Single Family and 2 - 4 Unit Buildings</b>

### Priority List for Single Family and Two to Four Unit Buildings

Standard Dwelling Type: A,B,C,D,E,F,G,I

Required Measures:

- Uniform Measures
  - Air leakage as determined by blower door testing.
  - Water heater insulation, always installed unless technical or safety reason exists.
  - Furnace tune-up as determined by required testing procedures using diagnostic equipment.
  - Duct insulation in non-conditioned areas.
  - Duct sealing.
  - Low flow shower head.
- Ceilings to <R-19 to R-38
- Uninsulated Walls to R-15
- Uninsulated Floors to R-19<sup>1</sup> and<sup>2</sup>

Optional Measures (NEAT Required, SIR of 1 or Greater):

- Partially Insulated Attics => R-19, Add to R-38
- Storm Windows Over Single Pane

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<sup>1</sup>Floors are only insulated if basement, crawlspace, or combination basement/crawl space separates a conditioned space from a non-conditioned space. If area is conditioned or unintentionally conditioned, this priority is not applicable. NEAT was done with Type U and was cost-effective.

<sup>2</sup>Perimeters are insulated in a conditioned basements, crawl spaces, or combinations if:

- a. Moisture can be controlled;
- b. Inhabitant activity suggests the insulation will stay in place undamaged; and
- c. the space can be cost-effectively air sealed from the exterior.

The perimeter surrounding unintentionally conditioned areas may be insulated, depending on the judgement of the inspector with input from the client as long as:

- a.      Moisture can be controlled and the cost of floor insulation, along with the cost of the resulting required measures of pipe insulation and duct insulation, will exceed the cost of perimeter insulation; and
- b.      The space can be cost-effectively air sealed from the exterior or interior.

Section 202-5 provides further clarification on footnotes 1 and 2.

 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>PRIORITY LISTS</b>
	Subject	<b>Individually Heated, Low Rise, 5+ Multi-Family Buildings</b>

**Priority List for Individually Heated, Low Rise, 5+ Multi-Family Buildings<sup>1</sup>**

Priority Rating by Housing Type

<u>Measures</u>	A	B	C	D	E	F	G	I
Uniform Measures	3	4	3	3	3	3	2	3
Ceilings <R-19 to R-38	1	1	1	1	1	1	1	1
Uninsulated Walls to R-15	2	2	2	2	2	4	-	-
Uninsulated Floors to R-19 <sup>2</sup> and <sup>3</sup>	4	3	4	-	4	2	-	2

<sup>1</sup> Centrally heated multi-family buildings with 5 or more units can have priorities determined by a DOE approved audit tool but only with OEE’s prior written authorization.

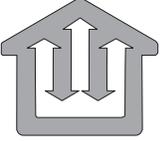
<sup>2</sup> Floors are only insulated if basement, crawlspace, or combination basement/crawl space separates a conditioned space from an unconditioned space. If area is conditioned or unintentionally conditioned this priority is not applicable.

<sup>3</sup> Perimeters are insulated in a conditioned basements, crawl spaces, or combinations if:

- a. Inhabitant activity suggests the insulation will stay in place undamaged;
- b. Moisture can be controlled.

Section 202-5 provides further clarification on footnotes 2 and 3.



 <p style="text-align: center;">State of Ohio Weatherization Program Standards</p>	Section	<b>PRIORITY LISTS</b>
	Subject	<b>Mobile Homes</b>

**Priority List for Mobile Homes (Type H)**

Required Measures:

- Uniform Measures<sup>1</sup>
- Insulate Floors to R-19 or 1.6 lb. per cubic foot with fiberglass insulation

Allowable Measures:

- Insulation of Attic Area
- Insulation of Sidewall Areas

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<sup>1</sup> Blower Door testing must be performed on every mobile home to determine the correct level of air leakage work to be performed, and all ductwork should be sealed.

