2014 Weatherization Standards

Iowa Weatherization Program

Department of Human Rights
Division of Community Action Agencies
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SECTION 1000 GENERAL INFORMATION

1010 SUMMARY OF STANDARDS

Zone Leakage Testing

- Zone pressure testing must be completed on every house to determine if zones are inter-connected. Pressure testing must be documented on the Client Home Energy Audit Form.
- Attached or tuck-under garage leakage - Target of <200 CFM50, house WRT garage, testing is required, and is to be reported in WAMS.

Carbon Monoxide Alarms *SWS 2.0100.1e; 2.0301.2; 3.1501.1f; 5.3003.7h; 5.3104.2h; 5.3104.3r; 7.8102.2m; 7.8102.3p; 7.8103.1g; 7.8103.2l*

Carbon monoxide alarms are required in all dwellings.

Smoke Alarms *SWS 2.0301.1a, b;*

Installation required when:

- When space heaters are replaced with a vented space heater.
- When there is a solid fuel burner in the home.
- When manufactured homes are weatherized.
- When local codes require their installation.

Draft Pressures

Below 20°F	-5 Pascal
20°F - 40°F	-4 Pascal
40°F - 60°F	-3 Pascal
60°F - 80°F	-2 Pascal
Above 80°F	-1 Pascal

OR

Temperature ÷ 20 - 5.5

Duct Sealing (Normal blower door setup @ 50 Pascal)

- 1 Pascal at each register when the basement/crawlspace is open to the house (includes manufactured homes).

Duct Sealing (Furnace fan running)

- -3 Pascal or greater combustion appliance zone (CAZ) with reference to (WRT) outside with the baseline being subtracted and when both or either water heater and furnace are atmospheric draft.
- -15 Pascal or greater when both the water heater and furnace are induced draft WRT outside with the baseline being subtracted.

Pressure Testing (Furnace fan running)

- (Required) Room WRT main body (furnace fan running all interior doors closed). Reading must be between 3 Pa + or -.
- (Optional) Dominant duct (furnace fan running and all interior doors open), less than 1 Pa + or -, house WRT outside subtracting baseline.
- (Optional) Master bedroom (furnace fan running, interior doors open except master bedroom) -target of less than 5 Pa + or - main body WRT outside subtracting baseline.
- (Optional) All interior doors closed (furnace fan running), main body WRT outside should be 5 Pa + or -

Furnace and Mechanical Systems

- Combustion air – see Section 2022
- Heat rise - listed on nameplate or under 90°F.
- High limit - 275°F maximum, should be below 250°F.
- Gas pressure - Natural gas = 3.5 inches water column.

Liquid propane = 11 inches water column.

- Return air - 2 square inches of net free vent for every 1000 Btu's of output.
- Round duct sizing - 3.1416 x radius squared. Example 7" duct {3.1416 x (3.5 x3.5)}.
- The minimum ventilation level (MVL) is 10% of the volume.
- Static pressure – 125 or manufacturer's specifications. The maximum static pressure on either the supply or return side is 75 Pa.
- Air free carbon monoxide - A = carbon monoxide reading x 20.9 (oxygen O2 in air), B = 20.9 - oxygen content of flue gas, A ÷ B = air free CO.

Formulas

- Square feet or area = Length x width
- Cubic feet or volume = Length x width x height
- Converting inches of water column to Pascal
  - .1" water column = 25 Pascal
  - .2" water column = 50 Pascal
  - .5" water column = 125 Pascal
  - 1" water column = 250 Pascal
- U-value = 1 ÷ R-value
- R-value = 1 ÷ U-value

Calculations

The computerized programs utilized by weatherization have different methods to calculate volume, surface area, floor area, conditioned stories, building height, story height, number of occupants, and number of bedrooms. The minimum ventilation level (MVL) is 10% of the volume, as described below. The following is a brief description for each of these items.

House Volume

For the blower door, WAMS, MVL, and ASHRAE 62.2:

Enter the building volume in cubic feet above grade (this may include a foot or two of basement volume). If the basement is a walk-out basement or part of an entire basement wall is exposed include the entire basement of the house in the volume. When running the blower door test, leave the door open between the basement and the main floor. Include the crawlspace in the volume if the foundation walls are to be insulated and considered as the thermal boundary. If there is a door between the basement and crawlspace, keep the door open. If the crawlspace ceiling is to be insulated and considered the thermal boundary, don't include the crawlspace in the volume. If there is a door to the crawlspace, keep the door shut during the blower door test if the crawlspace is not part of the thermal boundary

House Surface Area

For the blower door:

Enter the above grade surface area (square feet) of the exterior envelope of the building. Include all attic surfaces and floors over unheated and vented crawlspaces. This would mean floors above basements would not be included.

Floor Area and Building/House Square Feet

For the NEAT Audit, WAMS:

Enter the number of square feet of the conditioned living area. The value is total floor area, not foot print area. Enter the floor area of the conditioned area for each floor (1200 square foot two story would have 2400 square foot total).

For the blower door, MVL, and ASHRAE 62.2:

Enter the floor area of the building in square feet. Include same floors as the volume calculation. This would be the floor area of those above grade.

Number of Conditioned Stories
For the NEAT Audit:
Enter the number of conditioned stories. Include a finished attic if heated and include a basement if the majority of the wall area is above grade. Decimal entries such as 1.5 may be used for split level or one and a half story upstairs.

For the blower door:
Enter the number of stories, which are above grade for the building being tested. For buildings with uneven above grade heights, walk-out basements, one and a half story buildings, enter the average number of stories by calculating the average above grade height (in feet) divided by 8'. For unheated crawlspaces do not include the above grade crawlspace in the height calculation.

Building Height
Enter the building height above grade in units of feet. For buildings with uneven above grade heights, walk-out basements, and one and a half story buildings, use the average height of the building.

Number of Occupants
For WAMS:
Enter the actual number of occupants living in the building.
For ASHRAE 62.2 calculations (RED Calc):
Enter the action number of occupants living in the building (minimum of 2).

Number of Bedrooms
For the blower door (TECTITE):
Enter the number of bedrooms for the building being tested. The program uses the actual number of occupants and the actual number of bedrooms.

1011 TI-89 Calculator Tips
To lighten or darken screen – press the green diamond key and the plus/minus key lighten or darken the screen.

Add a decimal point after whole numbers when using the calculator function for division.

Other tips and procedures are listed in the *Iowa Weatherization General Appendix*.

1020 POLICIES

STANDARD
To provide Iowa Weatherization Program clients with the most cost effective, long-lasting energy efficient measures in order to decrease energy consumption and increase general health and well-being of the client. This will be accomplished by providing high quality materials and workmanship using trained, competent staff and/or contractors.

Energy Auditor/Inspector
Refer to *Iowa Weatherization Policies and Procedures Manual* for details on program policies, including Occupational Safety and Health Administration (OSHA), crew safety, and State Historic Preservation Office (SHPO) requirements.

1021 Cost Limits
The Iowa Weatherization Program has a limit on the total amount of program funds spent on a home as well as limits on how much can be spent on various measures. These limits are listed in the *Iowa Weatherization General Appendix*. Agencies must obtain prior approval from DCAA to exceed established expenditure limits.

1022 Fuel Switching
Situations may arise when an agency should consider changing fuels for the furnace or water heater that uses a different fuel source. This is referred to as fuel switching. Due to the complaints the agency and program may receive from a fuel vendor who has lost business due to fuel switching, a lot of consideration must be given to this decision. (See Section 5.73 of the *Iowa Weatherization Policies and Procedures Manual*, which is also outlined below). The reasons for considering fuel switching are:

- When the client requests it. (Usually when the appliance currently uses oil or propane and now natural gas is available to the house.)
- When it is more cost effective to replace the existing appliance with one that uses a different fuel.
- When it is necessary for health and safety reasons. Usually when a gas water heater is backdrafting or has spillage and the only solution is to install an electric water heater. This may only be done if all other options, such as moving the existing water heater or installing a power-vented water heater, have been considered and will not work.

Client Approval
If fuel switching is being considered, the agency must obtain client written approval before installing an appliance that uses a different fuel. The reason for this is to prevent the fuel vendor, who had supplied the fuel that is being replaced, from complaining the program is "taking his/her business away." If a vendor complains, the client request is documented.

If a client requests the replacement appliance using a different fuel, and the reason is not for health and safety reasons, the fuel switch may only be done if it does not cost more. For example, the client's furnace is currently a propane furnace and the client wants a natural gas furnace installed because the house now has access to natural gas lines. If the cost of installing a natural gas furnace would be more than the cost of installing a propane furnace, the fuel switch should not be made, unless the client pays the difference between the cost of installing a propane furnace and the cost of installing a natural gas furnace, or it is more cost-effective based on the Fuel Switching Request Calculations Worksheet, which can be found in the Iowa Weatherization General Appendix or on the weatherization website at www.weatherization.iowa.gov.

If a client insists on switching to a higher cost fuel (i.e., from gas to electric) for other than health and safety reasons, and the installation cost of the new type of system is not greater than the installation cost would be for the same type of system, the fuel switch can be made provided the client signs a statement certifying he/she understands the operational costs of the different system will be higher.

Fuel Switch Approval
When determining whether it is cost-effective to switch fuels, all costs associated with the installation of a heating system using a different type of fuel must be considered. For example, if ductwork would have to be added, the cost of adding the ductwork needs to be included in the cost-effectiveness determination. Also, the cost of hooking up the house to a natural gas pipeline needs to be considered. Program funds cannot be used to pay the cost of LP tanks, running the LP line to the house, or running the gas line from the street. The cost analysis must include estimates of both installation and operation costs.

DCAA approval is required any time a fuel switch is made regardless of fuel vendor. This is done through the use of the Fuel Switching Request Form and the Fuel Switching Request Calculations Worksheet (if applicable). Both forms are available on the State of Iowa Weatherization website www.weatherization.iowa.gov in the Members Only section as well as in the Iowa Weatherization General Appendix. Once the fuel switch is approved by the DCAA, a copy of the forms must be in the client file.

1023 Quality of Work *SWS 2.0702.1; 5.3003.7i*
The quality of all materials and work performed for weatherization must be guaranteed to be free from defects in workmanship for a period of one year after date of completion.

Contractors must offer to the client an option for annual inspection and renewal of warranty and service agreement for new heating systems up to 10 years at a cost (requirement for installers). Contractors must

offer to the client an option for annual inspection and renewal of warranty and service agreement for new water heaters up to 6 years at a cost (requirement for installers).
An agency's continued inability and/or refusal to comply with these Standards are grounds for DCAA to suspend, terminate, or otherwise apply special conditions to the agency's contract to provide weatherization services.

1024 Material Specifications *SWS 2.0110.1a-c; 3.1001.4e; 3.1101.1c; 3.1101.2c; 3.1101.3d; 3.1201.5f;*
Materials used for energy efficiency measures must meet or exceed the specifications described in 10 CFR 440, Appendix A, "Standards for Weatherization Materials". Materials used for health and safety purposes and repairs are not required to meet or exceed the specifications described in 10 CFR, 440, Appendix A.

The complete 10 CFR, 440, Appendix A is available in the *Iowa Weatherization General Appendix*.

All materials shall be installed according to the National Uniform Building Code, local building codes, manufacturer specifications and/or these standards. If local codes or ordinances are more stringent than the Standards, the local codes or ordinances shall apply. If the Standards are more stringent than local codes or ordinances, the Standards shall apply.

Materials selected for work on manufactured homes will comply with manufactured housing rules and regulations.

SDS sheets will be provided onsite and available during all work.

If cellulose insulation is installed, it must be manufactured with boric acid. Cellulose insulation containing ammonia sulfate is not allowed.

1025 Required Tests and Documentation
The Iowa Weatherization Program requires agencies to conduct certain diagnostic tests and document results in the client (house) file. Some of this information must also be recorded on the Client Home Energy Audit Form and reported in WAMS. Following is a list of the required tests and documentation. Table 1 summarizes the required tests and documentation.

- Spillage results (for both pre- and post-weatherization) for the heating system and water heater under the worst-case scenario. (See Section 2041)
- Draft pressure results (for both pre- and post-weatherization) for both the heating system and water heater under the worst-case scenario. The outside temperature reading must also be included. (See Section 2042)
- Record baseline pressure readings of the combustion appliance zone (CAZ) with reference to (WRT) the outside. Record the pressure readings of the CAZ WRT the outside with the air handler on. Record the difference between the baseline reading and the reading with the air handler on. (This can be done by adding or subtracting the baseline reading from the reading with the air handler on.) Record results for both pre- and post-weatherization. (See Section 2041)
- Carbon monoxide (CO) readings (for both pre- and post-weatherization) for each gas appliance, except gas stove burners and clothes dryers. (See Section 2043)
- Temperatures on the supply and return plenums to obtain the temperature rise results. Record results for both pre- and post-weatherization. (See Section 2044)
- Pre- and post-weatherization pressure pan test reading. (See Section 2046)
- Pre- and post-weatherization garage leakage test readings for homes with attached or tuck-under garages. (See Section 2052.02)
- Pre- and post-weatherization blower door readings. (See Section 2051)
- MVL and DTL results. (See Section 2080)
- Room-to-room pressures. (See Section 2048.01)
- Appliance (refrigerator/freezer) meter readings.
- Static pressure testing on all furnaces.

- If pre- and post-weatherization attic by-pass leakage is tested, it needs to be reported in WAMS. (See Section 2052)

TABLE 1

Diagnostic Tests and Documentation Requirements			
Test *(Pre- and Post-Weatherization)*	**Client Home Energy Audit Form**	**H & S Assessment Form**	**WAMS**
Carbon Monoxide*	Y	Y	Y
Spillage*	Y		
Drafting*	Y	Y	
Temperature rise*	Y		
Static Pressures	Y		
Baseline pressures of CAZ WRT outside	Y		
Blower door*	Y		Y
Room-to-room pressure test* *(when required)*	Y		
Pressure pan test* *(when required)*	Y		
Garage leakage *(For homes with attached or tuck-under garages)*	Y		Y
Minimum Ventilation Level (MVL)*	Y		
Depressurization Tightness Limits (DTL)*	Y		
Appliance metering* *(pre-weatherization only)*	Y		Y
Attic by-pass leakage	Y		Y

*also applies to manufactured homes

1026 Completed Home
Standard Dwelling
The following measures and tests must be done in order for a standard dwelling to be considered a completion:

If NEAT Audit Cumulative SIR = 1.0 or > 1.0:
- Blower Door Test
  - Infiltration Reduction (if blower door reading is higher than MVL)
  - Attic By-pass Sealing (if needed) within health and safety guidelines

- Health & Safety procedures and diagnostic testing
- Other allowable health and safety measures (if needed)
  - Crawlspace vapor barrier (if accessible)
- All Energy Efficiency Measures with an individual SIR => 1.0 called for by the NEAT Audit, in sequence and within structural and health and safety guidelines.
- Other Measures (if appropriate and client consents). These measures must be included in the NEAT Audit to determine cost effectiveness.
  - Water Pipe Insulation
  - Low-flow showerheads and faucet aerators (with client permission)
  - Compact fluorescent light bulbs
- Refrigerator/freezer metering and replacement, if appropriate
- A final inspection of the dwelling must be performed by the local agency.

Manufactured Homes
For a manufactured home to be reported to the state as complete the following requirements must be met:

If MHEA Audit Cumulative SIR = 1.0 or > 1.0:
- Blower Door Test
  - Infiltration reduction (if needed)
  - By-pass sealing (if needed)
- Health and safety procedures and diagnostic testing
- Other allowable health and safety measures (if needed)
  - Crawl space vapor barrier (if accessible)
- All Energy Efficiency Measures with an individual SIR => 1.0 called for by the MHEA Audit, in sequence and within structural and health and safety guidelines.
- Other Measures (if appropriate and client consents). These measures must be included in the MHEA Audit to determine cost effectiveness.
  - Water pipe insulation
  - Low-flow showerheads and faucet aerators (with client permission)
  - Compact fluorescent light bulbs
- Refrigerator/freezer metering and replacement, if appropriate
- A final inspection of the dwelling performed by the agency

Multi-Unit Dwelling
Refer to the *Iowa Weatherization Policies and Procedures Manual* Section 5.61 for the definition of a completion for multi-unit dwellings.

NOTE: Multi-unit dwellings containing 5 or more units require DCAA and DOE prior approval before the dwelling can be weatherized.

Incomplete Home
An incomplete home is one the local agency has physically traveled to in order to begin the weatherization process, but could not begin work due to one or more of the factors. An incomplete home is also one in which work has started but cannot be completed due to one or more factors. Refer to Section 5.62 of the *Iowa Weatherization Policies and Procedures Manual* for more information.

1027 Work Deferral
Although a client may be eligible for the Weatherization Program, there are situations or conditions where weatherization services should be deferred (i.e., delayed or postponed). Hopefully, the decision to defer weatherization can be made before work, or any significant work, begins on a dwelling. However, there are times when work will have begun on a dwelling before one of the situations or conditions is identified. In those cases, the local agency should defer doing any additional work.

Deferring work on a dwelling does not mean the dwelling will never be weatherized. If the situation or condition causing the deferral changes, it may be possible to begin or complete the work. For example, a dwelling shouldn't be weatherized if it has a bad roof. However, the dwelling can be weatherized later if the roof is replaced or repaired. Another example is a dwelling undergoing remodeling. The dwelling should not be weatherized while it is being remodeled. However, after the remodeling is completed, the dwelling may be weatherized.

If a reason for deferral is identified at the time of audit, a carbon monoxide alarm and smoke alarm may be installed if needed. No other measures may be installed.

Deferral Notification *SWS 2.0111.5a*
When an agency defers work on a dwelling, it must notify the client, and the landlord when appropriate, in writing of the reason using the Deferral Documentation Form. A copy of the notification, with documentation justifying the decision to defer services, must be kept in the house file. Agencies should attempt to identify all reasons why work is being deferred on a home and notify the client and/or landlord of all the reasons and what must be done in order for weatherization work to begin.

In cases of deferral, the client is to be referred to other sources of funding to help alleviate the issues causing the deferral. Referrals are not limited to, but may include USDA 501 loans and grants, HUD, utility companies and local public health agencies.

Following are reasons weatherization services should be deferred. This list is not intended to be all inclusive:

- When a client:
  - Refuses to sign the "Release of Liability Form" (See Section 2010)
  - Is uncooperative including, but not limited to:
    - Refusing to allow the installation of top energy efficiency measures or important health and safety measures.
    - Refusing access to parts of the house that prevent the evaluation of the house from being performed or prevents important measures from being installed.
    - Refusing to change behavior that can cause health and safety problems (e.g., refusal to discontinue using excessive number of humidifiers).
  - Moves or dies while weatherization services are being provided. (Weatherization services may be completed if the majority of work is done prior to the client moving/dying.)

- When a client, or other occupant in a dwelling:
  - Is threatening or physically or verbally abusive.
  - Has known health conditions which prohibit the installation of insulation or other materials.
  - Is involved in illegal activities.

- When a dwelling:
  - Is posted as being "For Sale" or is known to be for sale (except homes currently in a housing rehabilitation program).
  - Is scheduled for demolition.
  - Poses a health or safety hazard to crew workers or contractors, for example, rats, bats, roaches, reptiles, insects, animals, or other vermin inappropriately or not properly contained on the premises.
  - Homes with insul-brick or slate siding which require sidewall insulation may need to be deferred unless the siding can be removed and replaced by a contractor who has a current permit from the Iowa Division of Labor or the walls are insulated from inside.
  - One or more health and safety hazards exist that must be corrected by the client (or landlord) before weatherization services may begin. Examples include, but are not limited to:
    - Severe mold or moisture problems (such as pooling in the crawlspace or standing water in the basement) so severe they cannot be resolved within program limits.
    - The presence of animal feces or raw sewage that prevents weatherization measures from being installed.

        - The presence of a primary heat source unvented space heater unless the unvented space heater is removed from the dwelling. If the unvented space heater is a secondary heat source it may be left in place if it meets ANSI Z21.11.2 requirements.
        - The presence of disconnected water waste pipes or hazardous electrical wiring.
        - The presence of asbestos, including vermiculite that contains asbestos, that prevents weatherization measures from being installed.
        - When health and safety hazards, including unsafe combustion appliances, could pose a health or safety threat to clients but the weatherization program cannot mitigate the hazards due to expenditure limits or program rule/policy limits.
    - Is undergoing remodeling or has unfinished areas, which directly affect the weatherization process. Weatherization work may be done when the remodeling is completed.
    - Is so full of clutter a weatherization evaluation or weatherization services cannot be done.
    - Is beyond the scope of the program due to major structural deficiencies or is in such a state of disrepair that failure is imminent and the conditions cannot be resolved in a cost-effective manner. Examples would be dwellings requiring a new roof or foundation repair or where lead exposure cannot be mitigated with safe work practices.

- When a manufactured home:
    - Has a heating system other than a heating system designed for manufactured homes. A sealed combustion high efficiency furnace with modifications per manufacturer's instructions and installed properly to include outside air for combustion is also allowable.
    - Has a solid-fuel burning appliance drawing combustion air from inside.
    - Has an installation deficiency that may affect worker safety.

1030 Worker Safety *SWS 2.0100.1; 2.0100.2; 2.0103.1; 2.0104.1; 2.0105.1-2.0105.4; 2.0106.1; 2.0107.1; 2.0107.2; 2.0110.1; 2.0111.1-2.0111.5*

All agencies are required to have an agency-wide Health and Safety Plan as outlined by OSHA which must incorporate these guidelines.

All on-site weatherization workers, including Energy Auditors, crews, contractors, and Inspectors are expected to follow OSHA safe work practices as well as any practices spelled out in these standards.

All materials will be handled in accordance with manufacturer specification or Safety Data Sheets (SDS) standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers. Appropriate personal protective equipment (PPE) will be provided to agency staff. Workers will be trained on how to use PPE. Workers will be expected to always use appropriate PPE during work.

2000 HEALTH AND SAFETY

2010 Health and Safety Assessment

STANDARD
Before beginning work on the dwelling, the agency must ensure client health and safety. Eligible dwellings will be inspected for potential problems, including areas where the weatherization process could exacerbate issues. When possible, program funds will be utilized to alleviate those issues.

FIELD GUIDE

Energy Auditor/Inspector

The health and safety assessment includes, but is not limited to, the following:

1. Client informed consent process
2. Visual assessment of:
   - Electrical wiring, looking for bare wires and knob and tube wiring.
   - Mold/mildew and possible moisture problem areas.
   - Unsanitary conditions which preclude weatherization work.
   - Friable asbestos which preclude weatherization work.
   - Potential fire hazards.
   - Dryer ducts held together by screws.
   - Building structure to ensure a safe working area.
   - Lead-based paint which requires lead safe work practices.

3. Pre- and Post-Weatherization Testing:
   - Carbon monoxide levels for all combustion appliances in the home except dryers.
   - Spillage and drafting for all combustion appliances under the worst-case scenario. Conducting this test is optional for induced-draft units. Documentation regarding why the test was not run must be documented in the file.
   - Temperature rise for the heating system.
   - Static pressure testing on all furnaces.
   - Baseline pressures of the combustion appliance zone (CAZ) with reference to (WRT) the outside.
   - Air leakage using the blower door.
   - Room-to-room pressure test.
   - Duct leakage to the outside using pressure pan test.
   - Garage leakage using zone pressure test in homes with an attached or tuck-under garage.
   - Fuel line leaks.
   - Zonal testing for missed opportunities.

Agencies must use the Release of Liability Form – Release of Liability and Waiver of Claims, the Health and Safety Assessment Findings Forms, Part 1 & 2, and Client Home Energy Audit Forms as part of the health and safety assessment.

Health and safety problems found during the health and safety assessment will result in the agency taking one of three actions

1. If the problem will not prevent the dwelling from being weatherized and installing weatherization measures won't exacerbate the problem, the agency can proceed with weatherizing the dwelling but should notify the client of the problem.
2. If the problem must be remedied before weatherization measures can be installed, the agency must determine if the program can remedy the problem or if the client or landlord will have to correct the problem. If the program can remedy the problem, weatherization can proceed once the agency has corrected the problem.

3. In those cases where the client or landlord is responsible for correcting the problem, the agency must ensure the client understands either he/she or the landlord is responsible for correcting the problem before weatherization can begin. The agency must notify the client of the problem regardless of who is responsible for correcting it.

Health and safety testing must also be repeated after weatherization to ensure the activities did not create a health and safety problem in the home. Program funds may be used to conduct the assessment and testing, and to abate certain health and safety problems.

It is very important the agency document any health and safety problems and any problems or conditions which could result in health and safety problems. Documentation *must* include photos. Good documentation can protect the agency from claims made by clients that the work done by or on behalf of the agency caused a health and safety problem.

Client Informed Consent and Release of Liability Form

Because it is possible weatherization activities could have an adverse effect on an occupant's health, it is important clients provide an "informed consent," consenting to the weatherization activities before they are started. The Release of Liability form is reviewed with the client at the time of initial home assessment. Agencies must inform all clients weatherization activities can release dust and dust-like particles in the air. Occupants with certain health conditions could have those conditions aggravated by the dust and dust-like particles and should be out of the house when insulation is being blown. Health conditions aggravated by dust include:

- Asthma
- Emphysema
- Allergies
- Respiratory problems
- Pregnancy
- Decreased immune function
- Other serious health conditions

It is also recommended infants less than 12 months old should be out of the house when blown insulation or two-part foam is being installed. Persons who leave the dwelling during the insulation process should remain outside the house for the amount of time specified in the manufacturer's instructions.

Clients are required to sign a Release of Liability and Waiver of Claims (Release of Liability) Form informing them of this. The consent form should be signed before the dwelling is evaluated. If the client refuses to sign the form, no work will be completed on the home and it will be closed incomplete. The original of the signed Release of Liability Form must be in the client file, and the copy will be left with the client.

The Release of Liability and Waiver of Claims is a 2-part NCR form that is provided by the Weatherization Program. A sample can be found in the Forms section of the *Iowa Weatherization General Appendix* as well as on the Members Only section of the Weatherization webpage.

The Release of Liability Form is important because it documents the client has been informed weatherization activities could result in airborne particles being released in the home which could aggravate a health condition of one or more of the occupants in the home. It documents the client authorizes the agency to weatherize the home.

If a client is not available to sign the Release of Liability Form when the Energy Auditor arrives to conduct the energy audit of the home, the Energy Auditor may proceed with the energy audit. However, the Energy Auditor must leave a copy of the Release of Liability Form, a return envelope, and instructions to the client that no work will be done on the home until the client signs the form and returns it to the agency.

Health and Safety Visual Assessment
A visual assessment of the dwelling must be performed in order to identify any existing health or safety problems or conditions, such as leaky water pipes, could result in health and safety problems. Information about what should be checked is summarized in these standards.

Health and Safety Assessment Forms
The Health and Safety Assessment Findings Forms, Part 1 & 2 and the Client Home Energy Audit Form must be used by agencies to document certain health and safety problems identified in the dwelling and to document the results of certain safety tests. If the health and safety problem has to be remedied before weatherization measures can be installed, and the program does not allow for the remediation by the agency, the client or landlord is responsible for remediation of the problem. The client or landlord must remediate the problem before weatherization activities can begin.

The Health and Safety Assessment Findings Forms, Part 1 & 2 are to always be signed by the client. A copy of the form must be given to the client and/or landlord and the original signed form must be filed in the client file.

If the health and safety problem has to be remedied before weatherization measures can be installed, and the program allows for the remediation by the agency, the health and safety problems must still be documented on the Health and Safety Assessment Form.

If a health and safety problem is identified by the agency but the problem will not prevent the dwelling from being weatherized and installing weatherization measures won't exacerbate the problem, the agency can proceed with weatherizing the dwelling but should notify the client of the problem. Agencies must document these problems on the Health and Safety Assessment Form.

A copy of the Health and Safety Assessment Findings Forms, Part 1 and 2, and the Client Home Energy Audit are in the *Iowa Weatherization General Appendix* and are available on the weatherization website www.weatherization.iowa.gov in the Members Only Section.

2020 Combustion Appliance Testing and Repair/Replacement

STANDARD
To provide a safe, reliable, and efficient heat and hot water source that meets occupant needs at lowest possible cost of ownership and operation. To meet this goal, accurate information about appliance operation is gathered. The program's health and safety inspection protocol require all combustion appliances be tested and ensure system components function and operate in the correct sequence. Tests are preformed prior to the start of any weatherization work. Tests are repeated after work is completed. Carbon monoxide problems must be corrected before any air-sealing work is started on dwellings. The required work will be completed in accordance with the most recent IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter).

2021 Fuel Lines *SWS 2.0105.1c; 2.0111.2a; 2.0201.1a, b, c; 5.3104.2a; 5.3104.3b; 7.8103.1b; 7.8103.2b, j;*

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Check all gas piping on all combustion appliances, including gas cooking stoves and dryers, for leaks. Use a combustible gas leak detector to check all gas lines, including flexible brass and flexible copper, for leaks. If checking natural gas lines, test above the lines. If propane, the probe must be placed under the lines because propane is heavier and will sink. Gas line connections must be tested by moving the probe around the connections at a rate of 1" per second. Gas leaks must be verified by soapy or bubbling solution to eliminate false positives. No weatherization can be done until leaks detected by any means are repaired by the program. Copper piping on natural gas appliances is not to be replaced unless leaking or required by local code or the appliance is being replaced with weatherization funds (furnace or water heater). All gas piping must be installed according to the American Gas Association (AGA) specifications

and any other appropriate codes. Flexible brass fuel lines must be replaced on all appliances. Flexible connectors manufactured before 1973 must be replaced. These can be identified by the manufacturer's tag on the connector.

Inspect for fuel leakage in kerosene and fuel oil heating units. Inspect fuel oil tank for leaks. No weatherization work may be done until oil or kerosene leaks are corrected.

WX Worker

When installing a new appliance (furnace or water heater) fuel lines coming down from the ceiling to the appliance gas valve must be hard pipe.

Corrugated stainless steel tubing (CSST) will not be used to drop to the appliance. When used for other purposes, must be installed in accordance with manufacturer guidelines and the National Electrical Code.

If required, fuel leaks will be repaired and inspected in accordance with the most current IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter).

2022 Combustion Air Requirements *SWS 2.0201.2a; 2.0203.1a, b; 2.0203.2d, e; 2.0203.5*

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During combustion testing under worst case, if CO levels exceed 35 PPM in the combustion zone, abort the test, turn off appliance and ventilate space. The home must be evacuated until CO levels drop below 35 PPM. The appliance must be repaired/replaced prior to completing combustion safety diagnostics.

After CO levels drop below 35 PPM, appliance must be tested under natural drafting conditions. If CO levels exceed 35 PPM under natural conditions, disable the appliance until repaired/replaced. If below 35 PPM the appliance may be left in service until repaired/replaced.

Carbon monoxide alarms must be installed immediately by the energy auditor whenever an agency finds a combustion appliance that is putting off carbon monoxide at an unacceptable level.

The required volume of combustion air will be determined in accordance with the combustion air section of the most current IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter).

Many building codes and code officials no longer allow openings between the CAZ and the interior of the house. If this is the case, extra combustion air must be obtained from outside. This air can come from a crawlspace but is not allowed to come from the attic.

WX Worker

If supplemental combustion air is required, installation must be made in compliance with most current IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter).

Supplemental Combustion Air from Outside Dwelling

Energy Auditor/Inspector

Use the following procedures for adding a measured amount of supply air to the CAZ from outside to provide adequate combustion air.

Measure the static pressure at the mid-point of a main return duct or trunk where an additional combustion air supply branch and register can be installed. This combustion air supply branch must be at least 6' from the heat exchanger. If this method is used, be sure there is a supply register installed in the combustion zone that has adequate airflow to meet the combustion air requirements.

Using Table 1 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).

TABLE 1

Assuring Adequate Combustion Air for Btu/Hr Input over the Volume of CAZ By static pressure and duct diameter						
BTU/HR	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"

Use the calculation and table below to determine the diameter of duct necessary to meet the additional combustion air requirement for a CAZ.

50 cubic feet of air volume is required for each 1000 Btu/hr. of combustion.

50 cubic feet per hour / 60 minutes = .83 CFM of air per 1000 Btu/hr. of combustion.

1000 Btu/hr. x .83 CFM = Total CFM additional air necessary for combustion.

Using Table 2 below, find the duct diameter that will deliver the minimum supply flow, given the static pressure across the duct where it will be installed.

TABLE 2

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

WX Worker

Supplemental combustion air from outside may be brought in through a permanent duct, located a minimum of 6' from the heat exchanger and sized with a free opening of 1 square inch per 5000 Btu/hour.

If central air conditioning exists, 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 operation explained to the client.

2023 Furnaces *SWS 2.0111.2g; 2.0201.2; 5.3003.1-4; 5.3003.6-7; 5.3003.9-12; 5.3003.14-16 5.3101.1-2*

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2023.01 Heating Unit Efficiency Testing

Furnaces may be replaced for efficiency reasons if, after running the steady state efficiency test, the NEAT Audit lists the measure with an individual SIR of 1.0 or greater.

Combustion Analysis
This is an optional test unless replacing the unit for efficiency reasons. With the heating unit operating in winter operating condition, for induced draft furnaces insert the sampling probe of a combustion analyzer in the flue one (1) to two feet (2') before (if possible) or after the first elbow. For atmospheric burning furnaces, insert the probe into the heat exchanger before the draft diverter. Each chamber must be tested separately.

When checking a high efficiency furnace with (one-pipe system) the flue pipe must be drilled with a unibit so the particles don't fall into the furnace blower unit, if local codes allow. Insert combustion probe into the exhaust pipe. Seal with metallic tape that encompasses the complete pipe.

When checking a high efficiency furnace with **two-pipe system** (power vent or sealed combustion), each pipe must be drilled (if local codes allow) with a unibit so the particles don't fall into the furnace blower unit. PVC should be drilled two feet from the inducer motor blower. Insert temperature probe of combustion analyzer into intake pipe to measure ambient combustion air. Insert combustion probe into the exhaust pipe. The combustion analyzer will then determine a more accurate efficiency test of the furnace by using ambient combustion air rather than ambient basement temperature. Seal both pipes with metallic tape that encompasses the complete pipe. **THIS IS NOT A BPI STANDARD. BPI DOES NOT ALLOW PVC PIPE TO BE DRILLED – READINGS MUST BE TAKEN AT TERMINATION.**

After the unit has reached steady state or has been operating at least ten minutes, measure and record the steady state efficiency. However, if the analyzer can only register O2 (oxygen) and net stack temperature reading; determine whether the readings are within the acceptable limits listed in Table 3.

Oxygen Change (Optional)
Note: During the combustion efficiency test on forced air systems, measure and record any change in the oxygen level when the furnace blower motor comes on. If there is a change in the reading, re-check the heat exchanger for cracks.

TABLE 3

Heating Unit type	(02) Oxygen	Net Stack Temp
Atmospheric gas (Natural gas, propane)	4 – 9%	300°-600° F
Fan Assisted	4 – 9%	300°-480° F
Space Heater	5 – 15%	300°-650° F
Standard Power Burner	4 – 9%	275°-550° F

2023.02 Heating Unit Safety *SWS 2.0105.4; 2.0201.1a; 2.0202.1; 2.0203.3a; 2.0203.6; 2.0401.1d; 5.3003.4; 5.3003.6; 5.3003.16*

Energy Auditor/Inspector

During the heating season, no weatherization work may be done until a non-operational or hazardous primary heating unit is repaired or replaced.

All primary heat source unvented fuel-fired heating units which cannot be vented must be removed or replaced with properly vented units. No weatherization work can be completed until the problem is corrected.

If the unvented space heater is a secondary heat source it may be left in place if it meets ANSI Z21.11.2 requirements.

When a new vented space heater is installed, the agency must ensure an operable smoke alarm exists.

If a furnace is located in a garage, an enclosure should be built around the furnace to separate it from the garage. Unless the furnace is a sealed unit, combustion air will need to be addressed.

The sequence of operation will be verified in accordance with the manufacturer installation, operation, and maintenance manual.

Use a combustible gas leak detector to check all gas lines, including flexible brass and flexible copper, for leaks (Refer to Section 2021). Inspect for fuel leakage in kerosene and fuel oil heating units. Inspect fuel oil tank for leaks. No weatherization work may be done until all fuel leaks detected by any manner are repaired.

Test the pilot safety switch. If the pilot safety switch is non-functioning or non-existent, one must be installed if possible or the furnace must be replaced.

Any existing humidifier should be removed with client permission.

Inspect the wiring to the heating unit. Determine whether the electric line to the heating unit is a dedicated circuit and is properly grounded, sized and fused according to electrical codes. If no dedicated circuit exists, it is not necessary unless the heating unit is being replaced.

Inspect all wiring at or in the heating unit for charred, frayed, or missing insulation on the wire and improper or loose connections. If the wiring is hazardous it must be corrected before beginning other weatherization work. Program funds may be used to correct the problem within allowable expenditure limits. If the problem cannot be corrected within the expenditure limit, inform the client all work will be deferred until the problem is corrected by the client.

Check that the blower compartment safety switch is operating properly. Repair if needed.

Inspect the heat exchanger for evidence of deterioration and cracks or holes. If a crack in the heat exchanger is verified (i.e., visually, tracer gas or smoke bomb), then the heat exchanger or the heating unit must be replaced. Inspect for water leakage in boilers.

With the heating unit operating, use a CO tester to test for carbon monoxide in the ambient air possibly caused by a crack in the heat exchanger. If the source of the CO is not the heating unit, then look for other possible sources of CO. (See Section 2043)

During the combustion efficiency test on forced air systems, measure and record any change in the oxygen level when the furnace blower motor comes on. If there is a change in the reading, re-inspect the heat exchanger.

Inspect the unit to determine whether combustibles or flammable items are around the furnace. If items are within three feet (3’), they need to be removed and the client needs to be notified of this safety problem.

Record the make and model of the furnace, and input rating for future use in NEAT.

As houses become tighter, there is a concern about sufficient combustion air. One simple check is to observe the flame. There are several symptoms of insufficient air. They are:

- Light blue flames with yellow tips
- Lazy flame with poorly defined edges that appear to be “reaching-out” for air
- Long flames that roll around, sometimes completely off the burner ports
- Flames that roll out the front of the cabinet
- Carbon monoxide production

If the flame shows any of these symptoms, open an outside door or window in the CAZ. If this improves the flame, extra air is definitely needed. See Section 2022 for combustion air requirements.

If one does not exist, a filter rack cover must be installed.

Manufactured Homes
All units shall be sealed combustion. If the combustion air is being drawn from the inside, repair or replace the heating system before beginning weatherization activities.

The sequence of operation will be verified in accordance with the manufacturer installation, operation, and maintenance manual.

2023.03 Heating Unit Clean & Tune *SWS 3.1602.4d; 5.3003.1-3; 5.3003.12 5.3003.14-15; 5.3104.2; 5.3104.3;*
WX Worker
Based on heating unit conditions, the Energy Auditor may determine a clean & tune is necessary. When required, the clean and tune must be performed as described below.

Gas Forced Air
- Ensure the thermostat is level and dirt free. Relocate if necessary.
- Clean out the blower wheel and blower compartment (cleaning may entail removal of the blower motor, vacuuming, wiping parts with solvent, etc.).
- Change and/or clean existing filter. If no filter rack exists, install one (outside the furnace cabinet is preferable).
- If one does not exist, a filter rack cover must be installed.
- Inspect the blower assembly's electrical wiring system for bad insulation and loose connections and repair as necessary. Inspect blower and squirrel cage for excessive free play and correct as necessary.
- Check that the amperage of the blower and compressor do not exceed manufacturer full load amperage.
- Verify the blower speed is set in accordance with manufacturer specifications. Adjust if needed.
- Inspect the heat exchanger for evidence of deterioration and cracks or holes. If a crack in the heat exchanger is verified (i.e., visually, tracer gas or smoke bomb), then the heat exchanger or the heating unit must be replaced.
- Inspect pulleys and drive assembly for alignment, wear, and tension and correct as necessary. Inspect belt for wear and replace as necessary.
- Inspect motor bracket for tightness and correct as necessary.
- Lubricate motor and motor bearing cups if necessary.
- Clean burner of lint, rust, scales, etc.
- If necessary adjust primary and secondary air PMI or per NFPA – 54-80,8.2.
- Adjust pilot flame so the flame envelops the hot tip of the thermocouple.
- Test pilot safety switch (thermocouple) for both the furnace and the gas water heater. Maximum drop out time is 2.5 minutes. If there is not an existing pilot safety switch, one must be installed if possible or the furnace must be replaced.
- Check manifold gas pressure and adjust if necessary (11" WC for LP and 3.5" WC for natural gas).
- Set heat anticipator to the proper amp setting by matching amp draw of the gas valve.
- Check limit control (fan on/fan off control, if applicable) to determine if it is operating properly and repair, if necessary.
- Check static pressure. (See Section 2044)
- Check temperature rise. (See Section 2044)
- Operate unit with blower disconnected to check high limit control and repair as necessary.
- Where two or more appliances are connected to a single vent or chimney, verify the connections meet NFPA 54-80,7.9.4 codes. (See Section 2031)
- Ensure that vented heating units have adequate draft and no spillage. (See Section 2042)

- Inspect and clean, if necessary, chimney, vents and vent connectors to ensure adequate draft, clearance, soundness and freedom from combustible deposits.
- If an air conditioning A-coil exists, follow procedures described in Section 6020.
- **Manufactured Homes**
  ELECTRICAL SAFETY
  - Visually inspect all wiring at or in the heating unit for charred, frayed, or missing insulation on the wire and improper or loose connections.
  - If the wiring is hazardous, program funds may be used to correct the problem within the furnace repair/replacement expenditure limit. If the problem cannot be corrected within the expenditure limit, inform the client that the manufactured home cannot be weatherized until the problem is corrected by the client.
  - Polarity of equipment will be verified by a qualified technician if wiring is to be modified or repaired.
  - Voltage will be in accordance with manufacturer specifications.
  - Voltage drop will be within acceptable range in accordance with manufacturer specifications.
  - Grounding will be connected in compliance with local code requirements, ANSI/NEMA GR 1-2007, and NFPA 70 National Electric Code.
  - Amperage will not exceed manufacturer full load amperage.
  - Blower compartment safety switch operation will be verified, if present.

Gas Boiler

- Ensure the thermostat is level and dirt free. Relocate if necessary.
- Clean burner of lint, rust, scales, etc.
- Inspect for water, steam, or fuel leaks.
- Inspect pipe insulation.
- If asbestos is suspected, do not disturb.
- Pipes through unconditioned areas must be insulated if possible.
- If necessary adjust primary and secondary air PMI or per NFPA 54-80, 8.2.
- Adjust pilot flame so the flame envelops the hot tip of the thermocouple.
- Test pilot safety switch (thermocouple) for both the furnace and gas water heater. Maximum drop out time is 2.5 minutes. If there is not an existing pilot safety switch, one must be installed if possible or the system must be replaced.
- Check that the amperage of the pump does not exceed manufacturer full load amperage.
- Inspect expansion tank. Replace if necessary.
- Check manifold gas pressure and adjust if necessary (11” WC for LP and 3.5” WC for natural gas).
- Inspect automatic fill valve to ensure it maintains system pressure. Correct if needed.
- If necessary, adjust the aquastat high limit and pump control in accordance with the manufacturer’s suggested set point.
- Lubricate circulator pump motor if necessary.
- Check for the existence of a pressure valve and verify that it is functional. If not, repair, replace, or add as necessary.
- Check system pressure will be 1 pound per square inch gauge (psig) per 28” of system height.
- Bleed air out of distribution system if necessary.
- Vacuum and clean fins if possible.
- Verify that the water pumps, low water cutoff, automatic feed control, and high-pressure controls are in operating condition and repair if necessary.
- Where two or more appliances are connected to a single vent or chimney, verify the connections meet NFPA 54-80,7.9.4 codes. (See Section 2031)
- Ensure that vented heating units have adequate draft and no spillage. (See Section 2042)
- Inspect and clean, if necessary, chimney, vents, and vent connectors to ensure adequate draft, clearance, soundness and freedom from combustible deposits.
- Ensure gauge glass is in good condition. Clean or replace if necessary.
- Make sure zone valves work, if present.

Oil Forced Air

Energy Auditor/Inspector

Oil systems must have a smoke test before completing any combustion tests. Smoke test reading will be in accordance with burner manufacturer specifications. If it is more than actionable levels, a tune and clean is required.

Steady state efficiency, net stack temperature, excess air, and CO and oxygen must be verified and in accordance with manufacturer specification.

Undiluted flue gases will be checked with a calibrated combustion analyzer. CO levels over 100 PPM as measured require corrective actions.

WX Worker

- Change oil filter and check storage system for water (drain if necessary).
- Clean out the blower wheel and blower compartment (cleaning may entail removal of the blower motor, vacuuming, wiping parts with solvent, etc.).
- Change and/or clean filter or add if needed.
- If one does not exist, a filter rack cover must be installed.
- Inspect the blower assembly's electrical wiring system for bad insulation and loose connections and repair as necessary.
- Verify the blower speed is set in accordance with manufacturer specifications. Adjust if needed.
- Inspect blower and squirrel cage for excessive free play and correct as necessary.
- Inspect the heat exchanger for evidence of deterioration and cracks or holes. If a crack in the heat exchanger is verified (i.e., visually, tracer gas or smoke bomb), then the heat exchanger or the heating unit must be replaced.
- Check that the amperage of the blower and compressor do not exceed manufacturer full load amperage.
- Inspect pulleys and drive assembly for alignment, wear, and tension and correct as necessary. Inspect belt for wear and replace as necessary.
- Inspect motor bracket for tightness and correct as necessary.
- Lubricate motor and motor bearing cups if necessary.
- Safety check primary controls (cad cell), to make sure it is functional and repair or replace as necessary.
- Inspect nozzle size for correct design input and within equipment firing rate. Replace the nozzle, if needed, according to manufacturer's specification and adjust and/or replace electrodes PMI.
- Check fuel pressure. Measurement must be in accordance with manufacturer specifications.
- Clean combustion chamber.
- If necessary adjust primary and secondary air PMI or per NFPA – 54-80,8.2.
- Set heat anticipator to the proper amp setting by matching amp draw of the gas valve.
- Check limit control (fan on/off control, if applicable) to determine if it is operating properly and repair if necessary.
- Check static pressure. (See Section 2044)
- Check temperature rise. (See Section 2044)
- Operate unit with blower disconnected to check high limit control and repair as necessary.
- Where two or more appliances are connected to a single vent or chimney, verify the connections meet NFPA 54-80,7.9.4 codes. (See Section 2031)
- Ensure that vented heating units have adequate draft and no spillage. (See Section 2042)
- Inspect and clean, if necessary, chimney, vents and vent connectors to ensure adequate draft, clearance, soundness and freedom from combustible deposits.
- If an air conditioning A-coil exists, follow procedures described in Section 6020.

Electric Warm Air Unit

- Inspect blower assembly's electrical wiring system for bad insulation and loose connections and repair as necessary.
- Verify the blower speed is set in accordance with manufacturer specifications. Adjust if needed.

- If one does not exist, a filter rack cover must be installed.
- Check that the amperage of the blower and compressor do not exceed manufacturer full load amperage.
- Inspect belt for wear and replace if necessary.
- Inspect blower for excessive free play and correct as necessary.
- Inspect pulleys and drive assembly for alignment, wear, and tension and correct as necessary.
- Inspect motor brackets for tightness and alignment and correct as necessary.
- Lubricate motor and motor bearing cups if necessary.
- Ensure thermostat is level and dirt free. Relocate if necessary.
- Check safety limits (if present) and correct as necessary.
- Check for proper sequencing and element operation.
- Check static pressure. (See Section 2044)
- Check temperature rise. (See Section 2044)
- Clean blower element vestibule and clean or replace filter.
- Check for adequate line voltage and correct as necessary.
- If an air conditioning A-coil exists, follow procedures described in Section 6020.

Electric Baseboard

- 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 client the importance of keeping the fins clean and furniture or other objects away from the heaters.

Heat Pump

- Do not test heat pumps when the exterior air temperature is above 70° or below 30°.
- Inspect the wiring to the heat pump unit. Determine whether the unit has a dedicated circuit that is properly sized and fused. Do not fix unless the unit is being replaced.
- Visually inspect the outside unit to determine that clearances meet manufacturer's instructions (PMI). Make sure the cooling fins are not obstructed or dirty. Determine whether access to the unit is blocked. Explain to the client why this is important.
- Visually inspect the inside unit to determine if there is proper condensate drainage. Make sure there are no puddles or residue present.
- Visually inspect the A-coil for dirty or obstructed fins and for the existence of cracks or holes. The A-coil may be repaired using program funds if it can be done within heating system repair expenditure limits. If Freon is needed, an EPA certified contractor must complete this work.
- With the unit operating, measure the temperature at the supply and return ducts. Subtract the measured temperatures to determine temperature rise/drop. Determine if the temperature is within the manufacturer’s instructions.
- Check that the amperage of the blower and compressor do not exceed manufacturer full load amperage.
- Determine whether the thermostat is operating correctly. Adjust the temperature to determine whether the thermostat properly activates the heating and cooling unit.
- Determine that the emergency heat circuit is functioning properly.
- Any refrigerant that must be evacuated must be captured rather than illegally releasing it to the atmosphere. For systems with fixed metering devices (capillary tube of fixed orifice), the evaporator superheat method should be used along with the manufacturer’s recommendations. For systems with thermostatic expansion valves (TXV), the sub-cooling method should be used along with the manufacturer’s recommendations.
- Test for refrigerant leaks using a leak detector.
- Check for and seal duct leakage in central systems. Duct sealing and insulation is especially important for ductwork running through unconditioned spaces.
- Inspect electric terminals, clean and tighten connections, and apply a nonconductive coating if necessary.
- Oil motors and inspect belts for tightness and wear.

- Check the accuracy of the thermostat.
- Test for proper operation of the heat pump defrost control. This control for the outdoor coil must be adjusted to optimize heating efficiency.
- Check static pressures. (See Section 2044)

2023.04 Heating Unit Installation *SWS 2.0201.2b; 2.0203.3e; 2.0203.6; 5.3001.1a-b; 5.3002.1; 5.3003.1; 5.3003.7; 5.3101.1; 5.3101.2; 5.3104.3o;*

Energy Auditor/Inspector

All furnace work shall be performed by a qualified, furnace technician, or trained agency personnel. Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J and manufacturer specification. Energy Auditor must perform either an estimated Manual J calculation (Residential Heat Loss Calculation form) or full Manual J calculations to be included with the invitation to bid. All calculations must be included in the client house file.

Furnace repair shall be performed in conformance with ANSI Z223.1-1999 (same as NFPA 54-2009) including Appendix H and shall be done in accordance with program spending limits. All furnace work must be in compliance with:

International Residential Code (IRC)
The Uniform Mechanical Code
National Fire Prevention Association (NFPA)
Local Codes adopted by the authority having jurisdiction (where they exist)
The Furnace Manufacturer's Specifications (must be left in the home)

If a new space heater is installed it must be vented and the agency must ensure there is an operable smoke alarm. (See Section 2060)

Perform a temperature rise and total external static pressure test to ensure they are within the manufacturer's guidelines.

Perform CO testing to ensure it does not exceed 100 PPM, without any alterations to the furnace, lowering gas pressure below manufacturer recommendations, or changing orifice size.

Basic operation of the new equipment will be explained to the occupant including:
- Efficiency measures
- Proper operation of controls
- Electrical and fuel disconnects or shut offs
- Location of combustion air intake including importance of not blocking the intake
- Importance of cleaning dust and debris from return grilles
- Importance of not blocking return or supply registers
- Importance of proper filter selection and how to change the filter
- Importance of routine maintenance

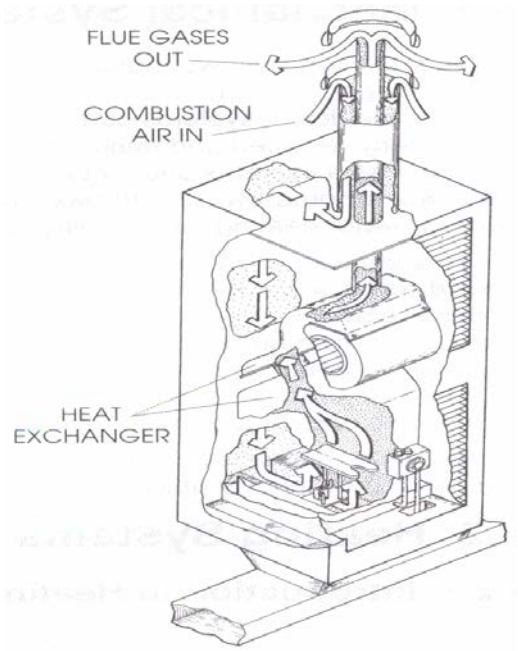
Manufactured Homes

All units shall be sealed combustion. If the combustion air is being drawn from the inside, repair or replace the heating system before beginning weatherization activities.

Furnace Types

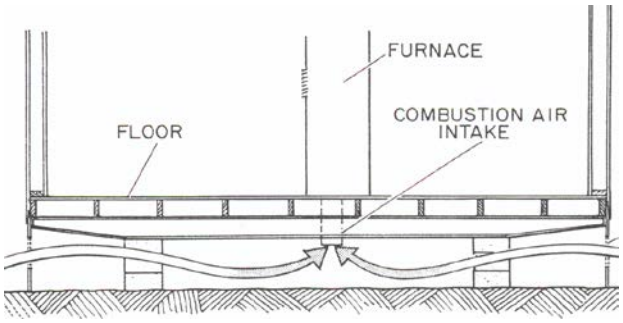
- Concentric Pipe Combustion Air
  Combustion air from the roof comes down the outside of the flue pipe, around the furnace cabinet, and into the heat exchanger where it mixes with gas during combustion. (See Figure 1)

FIGURE 1



- Floor Supply Combustion Air
  A floor supply, sealed combustion air system supplies combustion air directly to the heat exchanger through a duct from under the manufactured home. (See Figure 2)

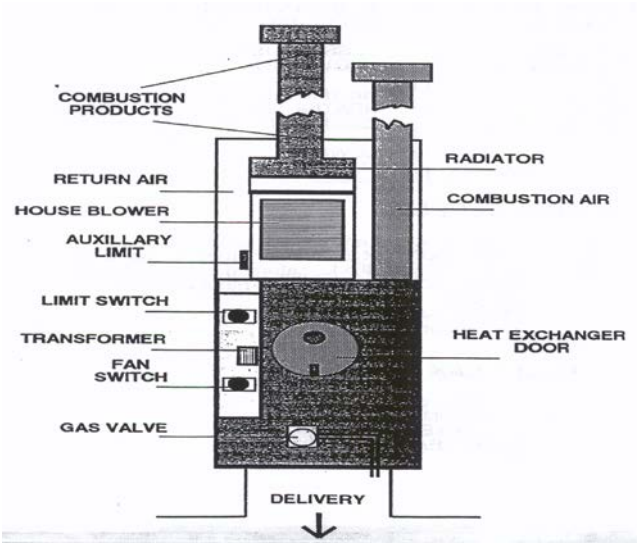
FIGURE 2



- Dual Pipe Combustion Air
  A dual pipe, sealed combustion air system supplies combustion air to the heat exchanger from above the manufactured home through a separate pipe. (See Figure 3)

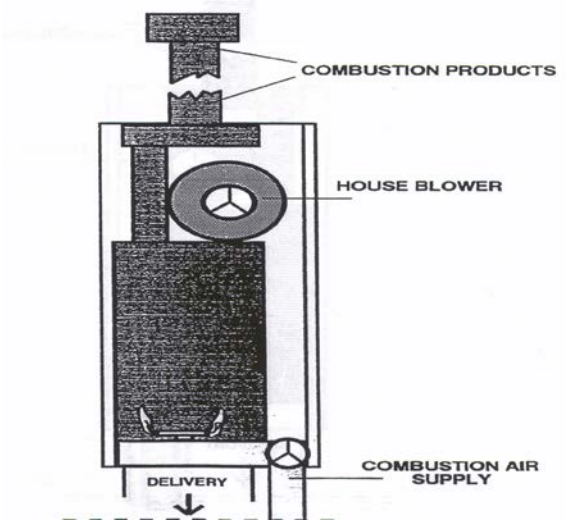
FIGURE 3

Induced Combustion Air



An induced combustion air, sealed combustion air system supplies combustion air to the heat exchanger using a small blower. An induced system may bring the air in from above or below the manufactured home. (See Figure 4)

FIGURE 4



WX Worker

Contractors must offer to the client an option for annual inspection and renewal of warranty and service agreement for new heating systems up to 10 years at a cost (requirement for installers).

No used furnaces may be installed.

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

The output rating of all replacement heating units shall be properly sized as in accordance to Manual J.

When installing a new furnace, it must be installed at least ¾" off the floor on blocks or a plastic pad. Concrete pads are not acceptable. Concrete blocks may be used but air must be able to circulate between the bottom of the furnace and the concrete. The return air drop also needs to be off the floor with the same specifications as the furnace.

All furnaces must have a filter rack outside the cabinet with a cover and shall have no open returns in the combustion area.

Furnaces installed in manufactured homes must be for that purpose or a sealed combustion high efficiency furnace may be installed with proper modifications per manufacturer's instructions.

New forced air furnaces must be a minimum of 95% or higher AFUE except in cases of attic or garage installation or manufactured homes. A minimum of 80% is required in those cases. A two-pipe system is required. Condensate lines must go to a drain or drain line.

If the furnace panel of a high efficiency furnace is being used as combustion air chamber, there must be a rubber gasket around the panel to seal the combustion chamber. Grommets and/or rubber gaskets must be installed to seal openings in the furnace cabinet.

Ensure thermostats are working properly, replace if defective. When possible the thermostat must be wired for "fan only" function.

For new furnace installation, wiring from ceiling down to appliance must be secured at the top and bottom and in rigid or flexible metal conduit or non-metallic (gray) electrical PVC. Repair or replace any unsafe power supply and install a properly sized and fused switch on the appliance or within 24".

For gas line specifications, refer to Section 2021 or the NFPA 54-2009. Drip legs (sediment traps) need to be installed to code. When installing a new appliance (furnace or water heater) fuel lines coming down from the ceiling to the appliance gas valve must be hard pipe. Corrugated stainless steel tubing (CSST) will not be used to drop to the appliance. When used for other purposes, it must be installed in accordance with manufacturer guidelines and the National Electrical Code.

All venting shall be completed according to the manufacturer's specifications. Combustion and exhaust air must terminate outside (not be drawn or exhausted from under decks, in crawlspaces, or attics). They must both draw air from the same location. This applies to both new and existing terminations. Support for the PVC piping need to be installed per the manufacturers' specifications or a maximum of four feet apart.

If an atmospheric appliance (water heater) shares a chimney with a draft-induced appliance, the draft of the atmospheric appliance must be checked to ensure no drafting problems. (See Section 2031 & 2043)

Perform a temperature rise and total external static pressure test to ensure they are within the manufacturer's guidelines.

Perform CO testing to ensure it does not exceed 100 PPM, without any alterations to the furnace, lowering gas pressure below manufacturer recommendations, or changing orifice size.

All condensate lines must be ¾" line (unless using a condensate pump) and terminate to a drain line (see Figure 5 below for approved method to terminate drain line); they cannot terminate outside the envelope of the house or to a sump pump unless required by local code. Drain lines from a condensate pump must be 3/8" line. Condensate pump cord must have original plug, it cannot be cut and hard wired into the unit. There must be a single outlet receptacle for the pump. Ensure the condensate line does not present a trip hazard for the client. No copper piping may be used as a condensate line. High efficiency boiler condensate discharge will be an acceptable pH level in accordance with local code.

Figure 5

Contractor must record information from the equipment data plate for future service work.

Contractors must remove and dispose of equipment being replaced unless otherwise directed by the agency.

Manufactured Homes

- Furnaces installed in manufactured homes must be for that purpose or a sealed combustion high efficiency furnace may be installed with proper modifications per manufacturer's instructions.
- Condensate lines installed with high efficiency furnaces must go to a drain line and not through the bottom of the home because it could freeze.
- Space heaters will not be installed.
- Adjust the heating anticipator in the thermostat to match the amp draw of the system control.
- Repair or replace any unsafe power supply.
- All gas piping must be installed according to the American Gas Association (AGA) specification and any other appropriate codes. Hard pipe must be used to go into the furnace closet. Flexible gas line connector or hard gas pipe may be used to go through the wall of the furnace cabinet.
- All venting shall be completed according to the manufacturer's specifications. A collar should be installed at the ceiling around the flue pipe. Where the venting exits through the ceiling, it must be air sealed.

Attic Furnace

Attic furnaces are to be installed only if all other possible installation locations have been exhausted.

If not present, a code compliant walkway and service platform will be installed in attics. Walkway and platform will be above the level of insulation (if practical).

A secondary drain pan must be installed under the system if it includes air conditioning. It must drain to a sewer line or outside.

All loose fill insulation must have a 12" clearance around the back, sides, top, and plenum and a 24" clearance in the front.

Damming must be installed if the bottom of the unit is below the top of the insulation. Metal damming must be a minimum of .007" thick and permanently attached to the ceiling joist with staples, nails, or screws.

Unfaced fiberglass may also be used as a damming material, but it must equal the height of the loose fill insulation and extend 24" away from the furnace in all directions.

If the combustion air is taken from the bottom 6" clearance must be provided below the unit.

Whenever possible the return drop must allow for the filter to be changed by the client from the living side of the ceiling in a safe and easy manner. The client must sign-off if the filter cannot be changed from the living area.

Heat Pumps and Air Conditioners *SWS 5.3003.9*

Heat pumps in cooling mode work in a manner very similar to central air conditioners. However, in heating mode, their operation is quite different from a typical furnace. For an air-source heat pump, useful thermal energy is extracted from the outdoor air by the vapor compression cycle which uses a refrigerant liquid/gas, an electrically-driven compressor, an indoor condensing coil, and an outdoor evaporator coil.

At an outdoor temperature above about 35°F, the typical heat pump is designed and installed to supply all the heat a dwelling requires. When the temperature drops below 35°F, heat pumps begin to utilize auxiliary heat; as the outdoor temperature drops, more auxiliary heat is staged in. This auxiliary heat is usually electric resistance coils staged in 5kW increments.

Replacement heat pumps and air conditioners should be sized properly. All air-source heat pumps with electric auxiliary must be served by a control system – thermostat(s) – to minimize the operation of the electric heaters. The heat pump must also include a properly functioning outdoor lockout thermostat. The outdoor lockout thermostat must lock out the auxiliary heat (usually electric resistance) when the outdoor temperature is greater than the heat pump balance point (usually 25°F to 40°F, depending on the climate). This also serves to lock out the heat pump at the lower temperatures.

No used equipment may be installed.

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

Electric service must be adequate to handle the needs of the unit.

All furnaces must have a filter rack outside the cabinet with a cover and shall have no open returns in the combustion area.

Contractors must remove and dispose of equipment being replaced unless otherwise directed by the agency.

Measure air flow across the indoor coil. Airflow across this coil should be 400 CFM per ton for a wet coil (condensation on coil) and 425 CFM per ton for a dry coil (no condensation on coil), plus or minus 50 CFM.

Check for correct amount of refrigerant. Follow the manufacturer’s specification for refrigerant charge. The airflow across the indoor coil should be adjusted and verified before the refrigerant charge is checked.

The efficiency for new heat pumps is designated as Seasonal Energy Efficiency Rating (SEER) for cooling performance and Heating System Performance Factor (HSPF) for heating performance. New heat pumps have SEERs ranging from 13.0 to over 18.0 and HSPFs from 8.0 to over 10.0. For split heat pump systems with an indoor and outdoor coil, the system efficiency varies with the match of these coils. The manufacturer should be consulted to determine the combined efficiencies.

Clients will be provided maintenance and upkeep instructions for new heat pump.

2023.05 Thermostats *SWS 2.0105.2b; 5.3003.7; 5.3003.9; 5.3003.11; 5.3104.2; 5.3104.3*

FIELD GUIDE

Energy Auditor/Inspector

Document the location of the thermostat. Ensure it is not on an outside wall or near an outside door or over a heat supply/return duct. Thermostats should not be installed on a marriage wall of the manufactured home. If a thermostat is located in these areas, the thermostat may be moved using program funds and within program expenditure limits.

Compatibility will be verified (e.g., voltage, wiring condition, location) and documented. Location of existing thermostat will be assessed for appropriateness (e.g., central to the house, out of direct sunlight, away from supply air, protected from abnormal radiant surface temperatures).

Ensure the thermostat is level and dirt free. Relocate if necessary.

At Energy Auditor's discretion, a set-back thermostat may be installed if the NEAT/MHEA Audit calls for it. The energy auditor must activate the measure in the NEAT/MHEA Audit set up to determine cost effectiveness. The Energy Auditor must first determine if the client is capable of re-setting the thermostat.

Heat pump thermostat for with equipment supplementary heat lockout that can interface with an outside temperature sensor will be selected.

WX Worker

All thermostats must be installed according to the manufacturer's instructions.

If being replaced, mercury containing thermostats will be disposed of properly.

The client will be taught how to use the thermostat and written manufacturer's instructions are to be left with the client.

2023.06 Heating System Distribution *SWS 3.1601.3; 3.1601.4; 3.1601.5; 3.1602.7; 3.1602.8; 3.1602.9; 5.3001.2a – b; 5.3001.3; 5.3104.2; 5.3104.3; 6.6188.2*

Energy Auditor/Inspector

Forced Air

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

Note any supply/return registers in the garage. These must be removed and sealed.

Note the presence and condition of any suspected asbestos on the ductwork. Follow safe work practices when in the presence of asbestos and distribute the Asbestos in Homes handout to the client and/or owner. The handout can be found on the Members Only page of www.weatherization.iowa.gov. Do not disturb friable asbestos. Program funds can be used for minor asbestos removal within General Health & Safety expenditure limits. Refer to Section 2150 for more information.

Ductwork inspection:

- Inspect for supply and return duct leakage location. (See Section 2046 & 2047)
  - Basement and crawl spaces cannot be used as supply or return air sources.
- Inspect ductwork support system. Note any areas needing additional support.
- Note sections of the ductwork that are missing or disconnected, severely corroded, rusted through or punctured or other problems in the panned floor joist returns.
- Note any damage to the supply or return duct restricting airflow and repair as needed.
- Note the presence of ducts passing through unconditioned spaces. (See Table 4)
- Note the existence of any duct insulation. Determine if any insulation is needed and record measurements and the amount needed.

- Note the size of the furnace filter and whether it is dirty. Show the client how to change the filter.
- Note closeable rooms containing supply registers and no return.
- Note whether the central return is located in a room with a closeable door.
- Note the client's door closing habits. Discuss with the client the importance of having an uninterrupted airflow from the supply register to the return register. (See Section 2048)

TABLE 4

CLASSIFICATION & RETROFIT OF ZONES			
Zone	Conditioned	Unintentionally Conditioned	Unconditioned
	If the air temperature is near that of the living area	If the air temperature is between the inside and outside temperature	If the air temperature is near the outside temperature
How the area is used:	Living Area	Workshop or laundry	Cellar or storage
Area has:	Supply register, radiator or heating source	Distribution system, furnace/boiler cabinet loss	No heat
Intended communication with house	Door from zone to house open	Door from zone to house open	Door or outside access always closed
Retrofit			
Insulation:			
Perimeter?	Based on NEAT	Based on NEAT	Based on NEAT
Floor?	No	No	Yes
Duct/boiler pipes?	No	No	Yes
Water pipes?	No	No	Yes
Air Leakage:			
Seal envelope leaks	To outside	To outside	To both in and outside
Seal duct leaks			
Return?	Yes	Yes	Yes
Supply?	Based on tests	Based on tests	Yes
Ventilation?	No	No	No

New ductwork will be designed in accordance with ANSI/ACCA Manual D and manufacturer specifications. Termination design will be performed in accordance with ANSI/ACCA Manual T and manufacturer specifications.

WX Worker

Supply or return runs into the garage will be truncated as near to the supply plenum as possible.

- All holes in sheet metal ducts will be patched with sheet metal and secured with sufficient screws to hold the patch flat without gaps.
- All patches will be sealed with mastic meeting UL 181.
- Holes created by removing the register and boot will be patched and taped using material meeting local codes.

Replace ductwork as required by work order.

Support existing ductwork and all new ductwork as required by work order:

- Flexible and existing duct board will be supported every 4' using a minimum of 1 1/2" wide materials.

- If installing flex duct it must be rated to R-8.
- Metal ducts will be supported at least every 10' using 18-gauge metal straps or 12-gauge galvanized wire.

Boiler
Locate all water lines. Inspect for leakage. Repair leaks within allowable expenditure limits.

Check for the presence of insulation on the heated distribution pipes. Consult with the client about the usage patterns of the area to determine if the water lines should be insulated. All distribution pipes in unconditioned areas are to be insulated to R-3.5.

Note the presence and condition of any suspected asbestos on the pipes. Follow safe work practices when in the presence of asbestos and distribute the Asbestos in Homes handout to the client and/or owner. The handout can be found on the Members Only page of www.weatherization.iowa.gov. Do not disturb friable asbestos. Program funds can be used for minor asbestos removal within General Health & Safety expenditure limits. Refer to Section 2151 for more information.

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

Inspect all bleeder valves for signs of leakage.

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

Manufactured Homes
Energy Auditor/Inspector
Pre- and post-weatherization pressure pan testing must be completed in all manufactured homes to determine duct leakage to the outside. The pressure pan readings must be documented in the file and the Client Home Energy Audit Form.

Inspect duct system to determine location of ducts and registers. Visually check all boots and repair and seal with mastic, if necessary. Visually check any crossover ducts and repair and seal with mastic, if necessary. Make sure these ducts are supported properly. Visually check furnace-plenum joint and repair and seal with mastic, if necessary. All ducts should be sealed immediately after the final registers.

Supply Plenum (furnace to trunk duct connection)
- Plenum rebuild or repair
  - Plenum will be rebuilt or repaired using compatible materials and will be:
    - Mechanically fastened
    - Sealed
    - Durable
    - Structurally sound
    - Insulated
    - Equipped with a vapor retarder where climate appropriate
  - If possible, flow diverter or turning vanes will be installed for air flow and/or balancing (e.g., bullhead Ts, offset air handler)

Repair work access
- Point of access options include:
  - Option 1: Through the trunk duct
    - Repair and seal access hole in the trunk duct
    - Install insulation
    - Repair belly/bottom liner
  - Option 2: Remove crossover duct
    - Reattach crossover duct
    - Seal and insulate crossover duct
    - Repair belly/bottom liner

- Option 3: Remove air handler
  - Install new gasket, if necessary
  - Mechanically attach furnace to the structure
  - Reconnect utilities
  - Replace and seal panels
- Option 4: Through the furnace panel
  - Replace and seal panels

Pre- and Post-weatherization duct leakage will be performance tested using a duct blaster or pressure pan and results will be documented on the Client Home Energy Audit form.

Crossover Duct Repair and Treatment

- Crossover ducts shall be installed in a manner that prevents compressions or sharp bends, minimizes stress at connections, avoids standing water, and avoids excessive length. When skirting is not present, the crossover duct shall be protected against rodents, pets, etc.
- When replacing damaged crossover ducts, 26-gauge rigid ducts should be installed if possible. The rigid ducts must be insulated to R-8 or greater.
- Flexible crossover ducts shall have a minimum R-8 insulation. They shall be secured with mechanical fasteners (for example, stainless steel worm drive clamps, plastic/nylon straps applied with a tightening tool, etc.) and sealed with mastic or aluminum foil backed butyl.
- Existing flexible crossover duct with an insulation of R-4 or less which has been damaged should be replaced with new flexible duct with R-8 insulation.
- End cap must be sealed.
- The crossover must be replaced if the inner lining is brittle or made of mesh. If in doubt, replace it. In many cases, a leaky crossover can be repaired by cutting out the section of duct containing the leak. A fabricated sheet metal sleeve can be inserted between the remaining pieces of crossover duct. The metal sleeve must be attached to the flex duct crossover using ratcheting plastic straps.
- Crossover ductwork must be appropriately secured above the ground. It may be supported by strapping or blocking.
- Flexible duct shall not be allowed to sag more than 12 inches for a span of eight feet.
- Fiberglass (with the exception of duct board) shall not be left exposed in ductwork.

Forced Air Units - Manufactured home Belly-Return Conversion

Belly-return systems in manufactured homes are notoriously leaky. These leaky return systems can significantly increase the space heating costs and lead to thermal discomfort and indoor air quality problems.

All belly-return systems shall be converted to a living space return system. Follow the procedures described below.

Manufactured home belly return air systems must be permanently sealed from the living space. A living space return air system must be created by 1) either removing the furnace closet door or installing an adequately sized return air grille(s) in the furnace closet door; 2) allowing for return airflow under closed bedroom and bathroom doors; and 3) sealing the return air grille in the furnace closet.

WX Worker

Belly-Return Conversion Process

When converting a belly-return system in a manufactured home to a living space return, follow these procedures.

- Add a grille with at least 200 in2 of net free area to the furnace closet door.
- Block all floor return registers with a durable and tight air barrier being careful to find hidden registers under built-ins, behind furniture, and in kitchen kick spaces.
- Completely block all floor openings in the furnace closet using a fire retardant air barrier, being careful to not seal the combustion air inlet.

2024 Water Heaters *SWS 2.0201.1a; 7.8102.1*

2024.01 Water Heater Safety *SWS 2.0201.1a; 7.8102.1; 7.8103.1*

Energy Auditor/Inspector

All combustion water heaters must be properly vented before proceeding with any weatherization work. Any water heater which cannot be properly vented must be replaced.

See Section 2022 to determine if there is adequate combustion air for the appliance.

Determine if the gas valve is working properly. If not, replace the valve or the water heater, whichever is most cost-effective.

Examine the temperature setting on the gas valve or thermostat. Consult with client to determine if the temperature can be lowered to 120°F without affecting the client's life style. If the home has a dishwasher, the temperature should be set at 140°F.

Inspect the unit to determine whether combustibles or flammable items are around the water heater. If items are within 3', they need to be removed and the client needs to be notified of this safety problem.

Record the appliance make, model, and input ratings for additional testing if needed.

As houses become tighter, there is a concern about sufficient combustion air. One simple check is to observe the flame. There are several symptoms of insufficient air. They are:

- Light blue flames with yellow tips
- Lazy flame with poorly defined edges that appear to be "reaching-out" for air
- Long flames that roll around, sometimes completely off the burner ports
- Flames that roll out the front of the cabinet
- Carbon monoxide production

If the flame shows any of these symptoms, open an outside door or window in the CAZ. If this improves the flame, extra air is definitely needed.

Venting systems need to be inspected. Refer to Section 2030 for correct procedures.

Combustion appliances must be tested for proper drafting. All draft testing must be taken under "Worst-Case Scenario". (See Section 2041) The purpose of draft testing is to ensure the proper venting of all combustion devices in the home to reduce the incidence of back drafting. Testing should greatly reduce the incidence of back drafting.

Determine if the tank is leaking. If it is leaking, it should be determined if it is a health and safety concern and should be replaced.

Determine whether a temperature pressure relief valve and a discharge pipe are present. If the relief valve and/or the discharge pipe are not present and there is an existing location for them, determine whether it could be a safety concern and install if needed.

Examine the plumbing to determine if there are leaks. If leaks exist, they may be repaired within program limits for General Health & Safety repairs.

A water heater should not be replaced solely on the basis of its age. The age of a water heater does not provide an accurate indication of whether it should be replaced.

Table 5 should be used in determining when a water heater should be replaced or repaired.

TABLE 5

WATER HEATERS - REPLACE or REPAIR	
Requires water heater replacement	**Does not require water heater replacement**
● **Excessive tank corrosion has caused irreparable water leaks**	● **CO readings exceed the threshold because:** Combustion byproducts are not venting properly. *Blocked chimneys, vents terminating inside the living space and back drafting can be identified and remedied without having to replace the water heater. The flame is being impinged. The baffle or other parts may need adjusted so the flame burns properly.*
● **Missing parts are no longer available** - *for example, an original equipment replacement cannot be located for a draft hood and the CO cannot be adjusted to acceptable levels with a generic draft hood.*	The water heater has the wrong burner nozzle for the fuel type. *The nozzle can be replaced with one appropriate for the fuel type.* Combustion air and gas pressure settings are out of adjustments. *Air and pressure can be adjusted to reduce CO to acceptable levels.*
● **Water heater is full of corrosion and sediment** - *as a result, the water heater cannot provide an adequate amount of hot water for the household.* ● **Exceeds cost limit for repair**	● **If the water heater location prohibits weatherizing the dwelling -** *the crew or contractor could move the existing water heater.*

Manufactured Homes

Venting systems need to be inspected. If the water heater has a draft diverter, it must be replaced with a direct vent unit that pulls combustion air from underneath the manufactured home (see Figure 6).

Manufactured homes have a much smaller volume than most residential homes. For this reason care must be taken to avoid back drafting of vented combustion appliances such as the water heater.

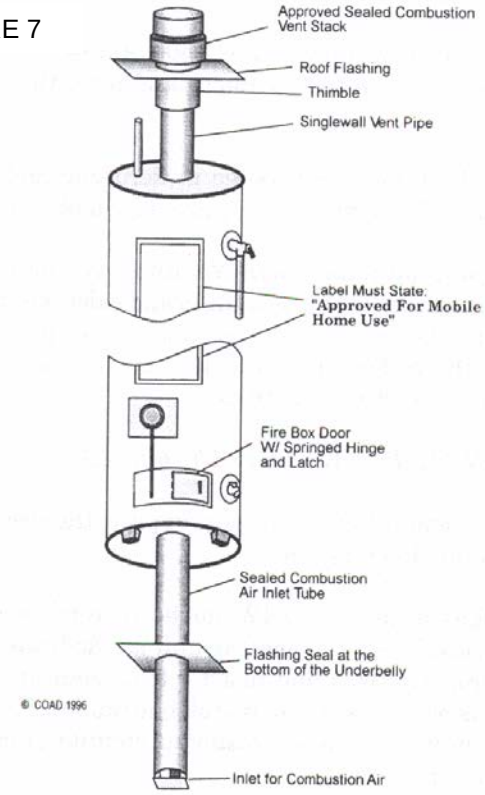
FIGURE 6

At a minimum, water heater closets with an exterior wall must be treated as follows:

- The exterior access door and adjacent exterior walls of closets containing electric or gas water heaters shall be insulated, if possible.
- If the door and adjacent wall can be insulated, the water heater shall not be wrapped with insulation.
- Cover any air vents in the door or adjacent exterior wall.
- Bring combustion air from underneath the belly or through the skirting by installing an appropriately sized metal chute with a rodent barrier.
- Holes in the closet walls that allow air leakage into the interior must be sealed.
- All plumbing within the closet that is susceptible to freezing must be insulated.
- An adequate amount of combustion air must be provided to gas water heaters.
- The floor of the water heater closet must be able to support the water heater in a secure, level position. If needed, the floor of the water heater closet may be repaired using program funds.

Figure 7 is an example of a sealed combustion domestic hot water tank.

FIGURE 7



2024.02 Water Heater Installation *SWS 2.0201.2b; 7.8102.1a; 7.8102.2*

WX Worker

All water heater work must be in compliance with the:

Uniform Mechanical Code
International Residential Code (IRC)
National Fire Prevention Association (NFPA)
Local codes adopted by authority having jurisdiction (where they exist)

Water heater manufacturer's specification (must be left in the home)

Contractors must offer to the client an option for annual inspection and renewal of warranty and service agreement for new water heaters up to 6 years at a cost (requirement for installers).

No used water heaters may be installed.

For new electric water heater installation, wiring from ceiling down to appliance must be secured at the top and bottom and in rigid or flexible metal conduit or non-metallic (gray) electrical PVC.

All new gas water heaters installed by the program must meet ENERGY STAR® guidelines. Manufactured homes are exempt from this requirement since water heaters labeled for use in manufactured homes do not meet ENERGY STAR® requirements. Combustion water heaters must be power vented (direct vent for manufactured homes) and have a low nitrogen oxide burner.

When installing a new appliance (furnace or water heater) fuel lines coming down from the ceiling to the appliance gas valve must be hard pipe. Corrugated stainless steel tubing (CSST) will not be used to drop to the appliance. When used for other purposes, it must be installed in accordance with manufacturer guidelines and the National Electrical Code.

For new installation or in case of a leaking pipe, dielectric unions will be installed in accordance with the most current IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter).and according to manufacturer specifications.

All water heaters installed must have a temperature pressure relief valve with extension to within 6" of the floor.

A potable water expansion tank will be installed on the cold water side of new water heaters with no valves between the water heater and the tank in accordance with the most current IRC adopted by governing jurisdiction, authority having jurisdiction, and according to manufacturer specifications. If the water heater is located in a confined space, such as in a manufactured home, this requirement is waived.

Backflow prevention will be installed in accordance with manufacturer specifications and all applicable codes on all new water heaters.

Water heaters being replaced should be sized according to household size. Generally a 30 or 40 gallon is adequate, but a larger water heater may be installed if deemed necessary.

The water heater temperature should be set at 120° (140° if there is a dishwasher present with no built in temperature boost).

Show the client how to operate the water heater including the temperature controls and maintenance.

When installing a new water heater, it must be installed at least ¾" off the floor on blocks or a plastic pad. Concrete pads are not acceptable. Concrete blocks may be used but air must be able to circulate between the bottom of the water heater and the concrete. Water heaters installed in a living area in an emergency drain pan are exempt from this rule.

If the water heater is installed in a living area or in an area that could be damaged by leaks, an emergency drain pan will be installed with sides that extend a minimum of 2½" above floor in accordance with P2801.5 of the most current IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter)**.** These water heaters do not need to be on ¾" blocks. A ¾" or larger drain line will be connected to tapping on pan and terminated in accordance with P2801.5.2 of the most current IRC adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter)**.**

There must be a grounded outlet close enough to the water heater so it may be plugged in directly without the use of an extension cord.

For gas line specifications, refer to Section 2021 or the NFPA 54-2009. Drip legs (sediment traps) need to be installed to code.

Occupants will be educated on the safe and efficient operation and maintenance of the system, including:

- Adjustment of water temperature and target temperature in accordance with local code
- Periodic drain and flush
- Expansion tank and backflow preventer (no occupant maintenance required)
- Periodic inspection, maintenance

Manufactured Homes

Contractors must offer to the client an option for annual inspection and renewal of warranty and service agreement for new water heaters up to 6 years at a cost (requirement for installers).

When a new water heater is installed it must be labeled as a manufactured home water heater. (See Figure 8) New units must be direct vent or electric. Replacement electric water heaters must be manufactured for manufactured homes. Existing electric water heaters, unless unsafe, should not be replaced.

All water heater work must be in compliance with the:

International Residential Code (IRC)
Uniform Mechanical Code
National Fire Prevention Association (NFPA)
Local codes (where they exist)

Water heater manufacturer's specification (must be left in the home).

All water heaters installed must have a temperature pressure relief valve with extension to within 6" of the floor.

Water heaters being replaced are to be replaced with the existing size, not to exceed 40 gallons. The water heater temperature should be set at 120° (140° if a dishwasher is present). Show the client how to operate the water heater including temperature controls.

FIGURE 8

2030 Combustion Appliance and Dryer Venting

STANDARD

Combustion appliance and dryer venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards. Any hazards identified will be corrected within program limits.

SWS 2.0201.1c; 2.0203.2b; 2.0203.3a, b; 2.0203.5; 2.0203.6; 7.8004.2; 7.8103.1-2;

2031 Furnace and Water Heating Venting
FIELD GUIDE

Energy Auditor/Inspector

Solid-fuel burning system cannot share the same flue with a gas-fired appliance. The venting system must be separated. If the venting system cannot be reconfigured, the house will not be weatherized.

Inspect all vent systems (including solid-fuel) to ensure they extend from the heating unit to the outside of the dwelling. Look for excessive corrosion or rust, cracks, holes and unsealed or disconnected sections. Inspect the vent/chimney connections to determine whether they are securely fastened. Existing problems must be corrected.

Any horizontal run in the vent connector must have a rise of at least ¼" per foot. If the existing connector does not, it should be repaired if possible. (See Figure 9) Exception: If the appliance drafts properly under worst-case setup, this requirement is waived.

When a common flue is used for more than one appliance, a 'Y' connector is the preferred connection. Be sure that vent connections are not directly across from each other, when an induced appliance is used. (See Figure 10)

FIGURE 9

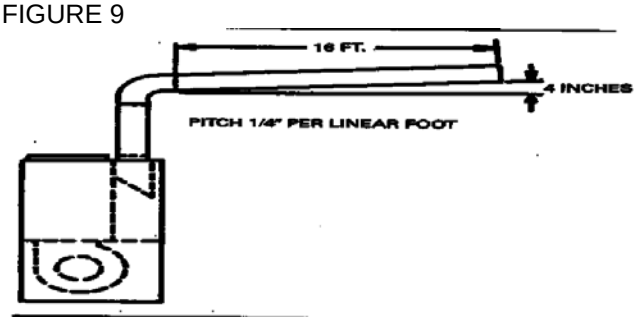
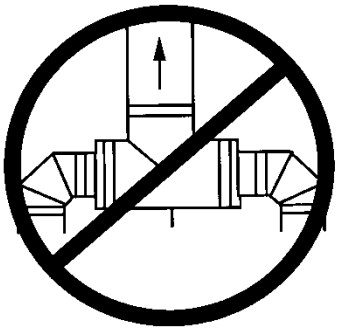


FIGURE 10



When checking vent sizing for proper venting, refer to local codes or the most recent IRC adopted by governing jurisdiction or the State of Iowa, whichever is stricter. If a seal combustion, two pipe furnace exists or is being installed, test the atmospheric draft water heater draft under worst-case conditions. Line the chimney according to code, if proper draft is not achieved.

Chimney vents will have an airspace clearance to combustibles in accordance with most current IRC adopted by governing jurisdiction or the State of Iowa, whichever is stricter.

If present, thermal flue dampers must be removed.

Determine whether all chimneys, including brick, blocks and mortar are in good condition and unobstructed. Necessary minor chimney repair must be made for air sealing, for example, seal between brick and metal liner in the attic. All disconnected non-functioning chimneys in the attic must be sealed. Determine whether chimney liners are in good condition and unobstructed. Necessary repairs or replacement of liners must be completed. Inspect the exterior of chimneys for proper termination height according to most current NFPA 54 Chapter 12 adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter) or according to manufacturer's specifications**.**

Install new chimney caps on all metal chimneys, if missing.

WX Worker

If present, thermal flue dampers must be removed.

Any horizontal run in the vent connector must have a rise of at least ¼" per foot.

Install new chimney caps on all metal chimneys, if missing.

2032 Dryer Venting *SWS 6.6005.1;*
FIELD GUIDE

Energy Auditor/Inspector

All dryers must be vented completely outside prior to beginning weatherization work. Dryer vents must not terminate in a crawlspace, garage, or attic.

Determine whether the dryer is vented with rigid duct, metal flex, or flexible duct that is approved for use with the applicable energy source. It must be installed in a manner that minimizes overall length, and provides sufficient support to eliminate sagging. Metal duct or metal flex duct must be used with gas dryers, vinyl may be used with any electric dryer. Existing foil duct does not need to be replaced if it can be verified that it is rated for a gas appliance. Any venting problems should be remedied as a health and safety expense.

Any inline diverter that is inside the envelope of the home must be removed.

Screws are not to be used to install any dryer exhaust because of a build-up of lint inside the vent. Metal tape should be used to connect the duct joints. Screws in existing dryer ducts must be removed and the joints sealed with metallic tape.

The use of a clamp to secure the vent pipe to the dryer outlet is required.

As short a run as practical of rigid sheet metal or semi-rigid sheet metal venting material will be used in accordance with manufacturer specifications. Determine whether the diameter of the dryer vent is at least the diameter of the appliance outlet. Determine the length of a 4-inch diameter dryer vent duct. The maximum length should 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 duct that passes through unheated areas must be insulated with a minimum of R-8 insulation (this includes dryer duct on manufactured homes that passes under the underbelly to the skirting).

Termination fitting manufactured for use with dryers will be installed. Dryer termination should match the color of the siding as close as possible or be white. A backdraft damper will be included, as described in termination fitting detail.

Manufactured Homes
All dryers must be vented completely outside the attic or beyond the skirting. Dryer duct that passes through unheated areas must be insulated with a minimum of R-8 insulation (this includes dryer duct on manufactured homes that passes under the underbelly to the skirting).

WX Worker
Dryer duct that passes through unheated areas must be insulated with a minimum of R-8 insulation (this includes dryer duct on manufactured homes that passes under the underbelly to the skirting).

Termination fitting manufactured for use with dryers will be installed. A backdraft damper will be included, as described in termination fitting detail.

The use of a clamp to secure the vent pipe to the dryer outlet is required.

Occupant will be instructed to keep lint filter and termination fitting clean.

Occupant will be instructed to keep dryer booster fan clean, if present.

Manufactured Homes
All dryers must be vented completely outside the attic or beyond the skirting. Dryer duct that passes through unheated areas must be insulated with a minimum of R-8 insulation (this includes dryer duct on manufactured homes that passes under the underbelly to the skirting).

2040 Combustion Appliance Diagnostics

STANDARD
Analysis on critical components and operations completed in accordance with industry and manufacturer specifications. This analysis includes: testing appliances with the house in worst case setup; testing for proper combustion and dilution air; testing the temperature rise and total external static pressure is to identify potential problems with the furnace; pressure pan testing; testing for duct leakage; and pressure differential testing.

2041 Worst Case Setup *SWS 2.0201.1d, e, i; 2.0201.3; 2.0299.1a-i; 5.3001.3d;*
FIELD GUIDE

Energy Auditor/Inspector

Documentation

The test results must be documented on the Client Home Energy Audit.

When Required

Houses must be configured in the worst case setup when conducting draft tests and carbon monoxide tests.

Procedures

The configuration of the house must be determined on a house to house basis. This configuration will include interior doors open or closed and the exhaust devices to be activated. In every case, the test should be done with the house in its worst-case situation.

Consideration must be given to the following:

- The type and location of the heating system.
- The location and strength of all the exhausting equipment (bath fans, dryer, kitchen exhaust devices, etc.).
- The location of wood stoves, fireplaces and water heater.
- The location of the forced air system returns.

Place the home in winter mode with all the windows and doors closed. If the blower door is set up, make sure the cover is on the fan.

Fireplace or wood stove dampers must be closed.

Deactivate all combustion appliances and exhaust fans. Check furnace filter, clean or remove. All supply or hot air ducts that are in the same zone or room as the furnace are to be closed. If the basement or CAZ has a return register that will not be sealed in a heated basement like a living area, this return register needs to be left open. If it is to be sealed permanently, close off temporarily with duct tape.

1. Close any existing door to the combustion appliance zone (CAZ). While standing in the combustion appliance zone using a digital pressure gauge run a hose to the exterior (outside) of the house to the “B” side reference tap on the digital gauge. This measures the CAZ with reference to (WRT) the outside. This is called the baseline measurement. Record this reading for future reference. Baseline is the natural pressure difference for the interior and exterior of the home caused by natural elements such as temperature, wind and stack affect. Leave the pressure gauge and hose in this set-up for more testing.

2. With all interior doors open, activate all exhausting equipment in the house except a whole house fan and furnace air handler. Record the pressure reading of the CAZ with reference to (WRT) the outside.

3. With the house still set up as in #2, activate the furnace air handler if present. Caution: If the only way to activate the air handler is to fire the furnace, extreme caution must be used due to the potential of combustion back drafting or flame rollout. It may be prudent to test for ambient CO levels in the combustion appliance zone during the test. If the ambient CO exceeds 35 PPM, abort the test. Using another DG 700, place a hose on the input tab, channel A. Starting at the room furthest from CAZ throw a hose in the room and close the door, if the room pressure is positive, leave door closed. If room pressure is negative, open the door. Complete these steps for all rooms with doors, moving back to the CAZ area. Once the door positions have been determined, take another CAZ reading WRT outside.

4. If CAZ pressure in step 3 is equal to or greater than step 2 reading, subtract baseline reading from step 3 reading. If CAZ reading in step 2 is greater than step 3 reading, subtract baseline reading from step 2 reading. 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 (CAZ) after subtracting the baseline reading. This pressure reading must be recorded in the file.

Recreate the configuration that results in the greatest negative pressure in the CAZ (Step 2 or Step 3). If depressurization in the CAZ with reference to the outside exceeds -5 Pascal with any atmospheric combustion appliances or –15 Pascal with induced draft appliances, be sure to monitor ambient CO levels while performing draft tests. If ambient CO levels exceed 35 PPM, abort test and refer Section 2022.

If these depressurization limits cannot be met, agency must use one of the following methods: Replace the atmospheric combustion appliances with power vent; or line the chimney. Note: lining the chimney might not provide adequate draft at all times.

Turn off all exhaust fans and return combustion appliances to normal settings.

If the house has a fireplace, a separate CAZ test is required unless combustion air for fireplace is drawn from outside. Follow steps 1 – 4 above for this test.

The concern about fireplaces is, after a fireplace has died down, other equipment in the house may cause it to back draft. In the case of the fireplace, only pressure readings can be used to determine if the depressurization potential can cause problems.

Caution: If depressurization in the fireplace zone with reference to the outside exceeds –5 Pa, there could be a potential for back drafting.

Turn off all exhaust fans and return combustion appliances to normal settings.

2042 Spillage/Draft Testing *SWS 2.0105.2c; 2.0201.1d, f, i; 2.0203.2a, c; 2.0203.3c; 2.0203.5; 2.0203.6*
FIELD GUIDE

Energy Auditor/Inspector

The purpose of the spillage and draft testing is to ensure the proper venting of all combustion devices in the home to reduce the chances of the appliances back drafting. Back drafting results in the spillage of combustion gases into the home. Spillage and draft testing must be done at the time of the energy audit and also during the final inspection on all natural and induced draft heating system and water heater. All spillage and draft testing must be taken under “Worst-Case Scenario” and under natural conditions if either or both spillage or draft fails under worst case scenario.

The procedure for draft testing measures the difference in the pressure between outside and inside the house at the combustion appliance zone (CAZ) under worst-case situations and measures the draft in the vent of atmospheric venting combustion appliances WRT CAZ. If vented combustion appliances are located in different areas of the house, a test must be performed for each different area.

Documentation

The test results must be documented on the Client Home Energy Audit and must also be recorded in WAMS.

When Required

Pre- and post-weatherization spillage and draft testing must be done on all dwellings except:

- Houses and apartments, which are total electric with no combustion appliances, wood stoves, or fireplaces.
- Houses with double-wall vent pipe (such as manufactured home furnaces).

Gas dryers are excluded from these tests.

Test Procedures
Put house in worst case setup.

A hole needs to be drilled in the vent pipe of all atmospheric and induced drafting appliances. Drill a hole in the flue one (1) to two feet (2') before (if possible) or after the first elbow. Hole must not exceed the diameter of the draft probe by more than 1/16". The probe must be inserted perpendicular to the vent pipe. Do not drill holes in double-walled vents or asbestos-based pipes. *SWS 2.0105.2c*

Connect the hose from the probe to the input of the digital pressure gauge; this will provide a reading of the flue with reference to the combustion appliance zone (CAZ).

When a chimney is shared by multiple appliances, fire the combustion appliances starting with the lowest Btu output first, and then the appliance with the next lowest Btu output. Check spillage for natural draft appliances at the draft diverter, induced draft heating system at the base of the chimney liner or flue, and if and induced draft heating system shares a chimney with an natural draft water, spillage needs to be checked at the water heater draft diverter. Spillage should end before 1 minute or spillage would need to be test under natural condition.

Draft testing for all natural drafting heating system and water heaters need to be tested when appliance reaches steady state, or at ten (10) minute mark. Draft should be tested 1-2 feet before the first elbow or 1-2 feet after the first elbow. See Table 6 for acceptable draft ranges.

If either spillage or draft testing fails during under worse case, turn off appliance, let vent cool and retest under natural condition. If either spillage or draft test fails under natural condition stop audit or inspection and do not continue audit or inspection until the appliance(s) are repaired or replaced.

Document pre- and post-weatherization spillage and draft testing

Pre-weatherization, if the water heater has minimal draft and/or has spillage the energy auditor must install CO alarms. If after weatherization is completed, the water heater is spilling, the water heater must be repaired or replaced.

Table 6

Acceptable Draft Test Ranges	
Outside temp	Minimum Draft Pressure Standard (Pa)
<10	-2.5
10-90	(outside Temp/40)-2.75
>90	-0.5

Table 7 indicates which types of combustion appliances must be tested for spillage, draft, and CO.

TABLE 7

Testing for Various Vented Combustion Appliances under Worst Case Conditions

Combustion Appliance Type	Tests Under Worst Case Conditions		
	Spillage Test (at 1 minute)	*Draft at SSE or at 10 minutes*	*CO Emissions Test* As-measured CO <100 PPM (*SSE or at 10 minutes*)
Gas-fired, natural draft and fan assisted	yes	yes	yes
Oil-fired w/typical power burner	yes	yes	yes
Gas-fired, side wall vented, but not direct vent/sealed combustion	no	no	yes
Manufactured home furnaces	no	no	yes

Solutions to Draft Failure or Spillage under Worst Case Conditions

If spillage is a problem or if a draft measurement is unacceptable, correct the problem by one of the following methods:

- Check for blockage in the vent system and, if found, correct the problem.
- Check vent system for leaks, including missing or loose cleanout doors or open or cracked mortar joints. Seal vent system as appropriate. Lining a chimney may solve this problem.
- Properly seal return duct leakage in the CAZ.
- Increase the CAZ air volume by connecting the CAZ to other areas within the conditioned volume of the dwelling (see NFPA 54, NFPA 31).
- Increase the CAZ air volume by connecting the CAZ to the outdoors (see NFPA 54, NFPA 31, or NFPA 211).
- Install fan to supply air to pressurize the CAZ. It is best to link the controls of such a make-up air fan to the operation of the combustion appliance(s) in the CAZ.

2043 Carbon Monoxide Testing *SWS 2.0105.1 b; 2.0201.1a, g, I; 2.0201.2c, d, e; 2.0203.2f; 2.0203.3d; 2.0203.5-6; 5.3003.2h; 5.3104.2f, g;*

FIELD GUIDE

Energy Auditor/Inspector

The purpose of carbon monoxide testing is to ensure unsafe levels of carbon monoxide gas are not being emitted from the combustion appliances in the dwelling. Carbon monoxide testing must be done at the time of the energy audit and also during the final inspection.

Documentation

The pre- and post-weatherization test results must be documented on the Client Home Energy Audit and must also be recorded in WAMS.

When Required

Pre- and post-weatherization carbon monoxide testing must be done on all combustion appliances in all dwellings except for dryers.

Test Procedure

Pre- and post-weatherization carbon monoxide testing should begin when entering the house.

Ambient Air in Dwelling

Before entering the house, zero the combustion analyzer or carbon monoxide detector in the outside ambient air.

Ambient CO will be monitored at the time of energy audit. Action levels are listed below:

- Zero to eight (8) PPM the audit/inspection may proceed.
- Nine (9) to 35 PPM auditor/inspector must advise client of CO levels and check all possible sources. Open all windows and doors.
- 36 to 69 PPM auditor/inspector must advise client of CO level and turn off all possible sources of CO. Open all windows and doors. After CO returns to acceptable levels, locate the source of the CO and contact appropriate personnel to have repairs completed before proceeding with audit/inspection.
- 70 PPM or greater, auditor/inspector will terminate work immediately and notify client to evacuate the building. Contact local appropriate personnel to remedy situation.

Ambient Air in CAZ

If at any time ambient air in CAZ exceeds 35 PPM during combustion testing, abort test and exhaust the CAZ. After readings drop to below 35 PPM, retest under natural draft conditions. If ambient air remains below 35 PPM under natural conditions, weatherization work may proceed. Carbon monoxide alarms must be installed immediately by the energy auditor. The problem must be corrected during the weatherization process. If the CAZ ambient air exceeds 35 PPM under natural conditions, the problem must be corrected before any other weatherization work begins. In either case, the client must notified of the potential hazard.

With the combustion appliance operating under worst-case condition (See Section 2041), insert the sampling probe from the CO detector or from a combustion analyzer in the appropriate location.

Measure and record the amount of CO in the flue gases. Flue gas CO readings must not exceed levels listed on Table 8. All CO readings must be recorded on the Health and Safety Assessment Form (Part 1) and have the client sign and leave a copy for the client**.** No weatherization work can be done until the problem is corrected. Carbon monoxide alarms must be installed by the energy auditor if the problem cannot be corrected immediately.

TABLE 8

Combustion Safety Test Action Levels

CO Test Result*	And/Or	Spillage & Draft Test Results	Action
0 – 25 ppm	*And*	Passes	Proceed with work
26 – 100 ppm	*And*	Passes	Proceed with work **BPI Standards** recommend problem be fixed
26 – 100 ppm	*And*	Fails at worst case only	Repair the problem or recommend service call
100 - 400 ppm	*Or*	Fails under natural conditions	Stop Work until system is serviced and problem corrected
> 400 ppm	*And*	Passes	Stop Work until system is serviced and problem corrected
> 400 ppm	*And*	Fails under any condition	Emergency: Shut off fuel to appliance and call for service

**CO measurements for undiluted flue gases at steady state*

Cooking Stove
Ensure all existing pilot lights are lit.

Visually inspect stove top burners for flame discoloration, flame impingement, or an irregular pattern or if burners are visibly dirty, corroded, or bent. If any of these issues are found, the client must correct the problem before weatherization may be started.

Locate the oven exhaust vent. Normally the vent is centered at the back of the stovetop. Ovens with glass doors may also have a vent in the door. Look in the oven to see if there are any pans or aluminum foil. Remove before starting oven. Make sure self-cleaning features are not activated.

Check the burners in the oven. Some have two burners, one for the oven and the other for the broiler. If the oven has two burners, each burner must be tested separately.

Turn on the exhaust hood and open window to reduce the risk of elevated CO.

Place the CO probe in the oven vent and turn on the oven. Allow it to run for 5 - 10 minutes or until the stack temperature stabilizes. Action levels are listed below:

1. 100-300 PPM install CO detector and inform the client of the problem. Recommend they have it services. Weatherization work may continue.
2. Over 300 PPM the unit must be serviced prior to weatherization work.

Solutions to High CO under Worst-Case Conditions
If CO level is unacceptable, correct the problem by one of the following methods:
- Check the gas pressure
- Check the combustion volume (see Section 2022)
- Check for dirty burner
- Air damper not set correctly
- Improper venting
- Check orifice size
- Check for blocked heat exchanger

2044 Temperature Rise & **Total External Static Pressure Testing** *SWS 5.3003.3a-c, h*
FIELD GUIDE
Energy Auditor/Inspector
The purpose of testing the temperature rise and total external static pressure is to identify potential problems with the furnace. Temperature rise is the temperature difference between the supply air ducts and the return air ducts. Static pressure is a measure of the differential air pressure between the air pressures inside an appliance versus ambient air pressure outside of an appliance. There is an inverse relationship between airflow and static pressure. As the pressure differential rises, airflow drops.

Documentation
Pre- and post-weatherization temperature rise test results must be documented on the Client Home Energy Audit.

When Required
Pre- and post-weatherization temperature rise testing must be done on all forced air heating systems in all dwellings.

Temperature Rise Test Procedure
1. Set up house in winter mode, all registers open and exterior doors and windows closed.
2. Tools needed for testing include two calibrated thermometers and drill with bit.
3. Do not drill through the air conditioning coil in the supply plenum.

4. Drill a hole in a supply side trunk line one foot from plenum. If there is more than one trunk line, test both and average the two readings. If there are no trunk lines, drill the plenum as far away from the A-coil as possible.
5. Drill a hole in the return drop before the furnace filter.
6. If dirty, the furnace filter should be removed or replaced before testing.
7. Insert a calibrated thermometer in holes drilled in the supply plenum and the return.
8. When furnace has run for 10 minutes or steady state is achieved, record the supply temperature and return temperature.
9. Subtract the return temperature from the supply temperature. This is the temperature rise. Temperature rise should be according to the manufacturer's name plate or under 90°F.
10. If the temperature rise is out of the range specified by the manufacturer, determine the problem by consulting Tables 9 & 10.

TABLE 9

Typical Solutions for High Temperature Rise		
Problem:	**Check For:**	**Remedy:**
High Temperature Rise (>90°F)	Fan speed too slow	Set fan speed higher or replace motor
	Obstruction in ductwork	Remove obstruction
	Inadequate return or supply/distribution ductwork	Install proper ductwork
	Blower belt/filter/AC coil defective or dirty	Clean or replace belt/ filter/AC coil
	Unit over-fired	Adjust fuel pressure, change orifices
	Dirty/defective blower	Clean or replace blower
	Cycling on high limit	Clean or replace blower, install more or larger ductwork

TABLE 10

Typical Solutions for Low Temperature Rise		
Problem:	**Check for:**	**Remedy:**
Low Temperature Rise (<40°F)	Fan speed too fast	Set fan speed slower or replace motor
	Excessive air flow from blower	Adjust air flow or replace blower
	Unit under-fired	Adjust fuel pressure or change orifices
	Low stack temperature	Resize the vent pipe

Static Pressure Test Procedure

Static pressure testing must be done on all forced air furnaces (new and existing).

This test is similar to testing temperature rise. The setup is the same and the holes that were drilled in the supply and return air can be used.

To test the static pressure, use a digital pressure gauge (or a water column gauge) with an L-shaped static pressure tube. The tube must face into the air flow.

Most furnace manufacturer's nameplates will list the recommended static pressures in water columns. In most cases, the recommended maximum external pressure will be .5 water columns. When using a digital pressure gauge, Pascal must be converted to water columns (125 Pascal = .5 water column).

Connect pressure hose from the return air to the "A" input tap of the digital gauge and the pressure hose from the supply air to the "A" reference tap of the digital gauge. With the furnace blower running, hold metal probe perpendicular to the airflow in the supply and return. This reading is the total static pressure of the equipment.

If static pressure is higher than the manufacturer's recommendations, check the return and supply sides separately. The side that has the higher static pressure will have more restrictions to be alleviated. If either side is greater than 75 Pascal, the cause of the high pressure must be eliminated.

Testing procedures for causes of high pressure could include:

- Test pressure drop across the A-coil and filter for blockage.
- Check ductwork for proper sizing.
- Total system air flow may be measured by:
  - Temperature rise
  - Flow plate
  - Flow meter
  - Fan depressurization device (e.g., Duct Blaster, DucTester)

2045 Clocking the Meter
FIELD GUIDE
Energy Auditor/Inspector

If an appliance is not burning properly, clocking the meter might show possible problems.

Clock the gas meter to measure gas input. Ensure that other gas appliances (water heater, dryer, range) do not fire when clocking the meter. Refer to Table 11 for input rates based on clocking the gas meter.

TABLE 11
Clocking the Gas Meter

Using a watch, measure the number of seconds for either the 1/2 cu ft or the 1 cu ft to make one complete revolution. Read the corresponding input rate in 1,000 of Btu/cu ft.

Seconds for One Revolution on Dial	½ cu ft	1 cu ft	Seconds for One Revolution on Dial	1/2 cu ft	1 cu ft
10	180	360	40	45	90
11	164	327	41	44	88
12	150	300	42	43	84
13	138	277	43	42	84
14	129	257	44	41	82
15	120	240	45	40	80
16	112	225	46	39	78
17	106	212	47	38	77
18	100	200	48	37	75
19	95	189	49	37	73
20	90	180	50	36	72
21	86	171	51	35	71

22	82	164	52	35	69
23	78	157	53	34	68
24	75	150	54	33	67
25	72	144	55	33	65
26	69	138	56	32	64
27	67	133	57	32	63
28	64	129	58	31	62
29	62	124	59	30	61
30	60	120	60	30	60
31	58	116	62	29	58
32	56	113	64	29	56
33	55	109	66	29	54
34	53	106	68	28	53
35	51	100	70	26	51
36	50	100	72	25	50
37	49	97	74	24	48
38	47	95	76	24	47
39	46	92	78	23	46

2046 Pressure Pan Testing *SWS 5.3003.3e*
FIELD GUIDE

Energy Auditor/Inspector

The purpose of pressure pan testing is to find ductwork leaks or disconnections that are connected to the outside. Pressure pan testing does not determine the amount of duct leakage, but determines whether there is duct leakage to the outside by reading the pressure at each register.

Documentation

Pre- and post-weatherization pressure pan test results must be documented on Client Home Energy Audit Form.

When Required

Pressure pan testing must be done in homes where the ducts are in unconditioned areas. It is important to determine if duct system has runs outside of the heated envelope, uses building cavities as ducts, or has ducts running within the building cavities. If a duct run is in a conditioned or an unintentionally conditioned area, and no air movement can be felt through the duct with the blower door running, it does not need to be tested. However, if air movement exists, the ducts must be tested.

Test Procedures

Auditor must Interview occupants to determine the location of over- or under-heated areas.

Inspect duct system to determine location of ducts and registers.

House Configuration

Set up house in normal winter condition. If the house has an interior basement or interior crawlspace door, leave it open. If the furnace has a fresh air intake from the outside, seal the intake during the test. If supply ducts are located in a garage or other unconditioned space, seal these registers so the register opening does not show up as a duct leak.

Make sure the furnace burner and air handler are off and will not start during the testing. Remove the furnace filter. Ensure that all grilles, registers, and dampers are fully open in the conditioned space of the house. Before fully opening or changing the position of balancing dampers, mark their position so they can be returned to that position after the pressure pan testing.

Set up blower door using established blower door testing procedures and precautions. (See Section 2051)

Depressurize the house to –50 Pascal and record the house to zone pressure.

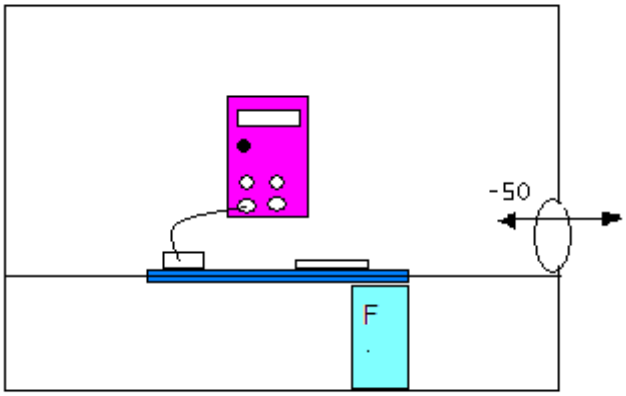
One at a time, cover each register with a pressure pan, masking tape, or tape and paper. Use the easiest method based on size, shape, and location of the register.

Connect a hose from the covered register to the reference tap on the digital gauge (see Figure 11). This will provide a measurement of house pressure with reference to the duct at that register.

Leakage to Outside
Record the pressure measurement across the register. Remove tape, paper, or pressure pan and move to the next register, record each reading.

In homes with an interior basement door, a reading of 1 Pascal or higher may indicate duct leakage to outside. Inspect the duct runs, boots and floor intersections for leakage from the outside. Start looking near the register that measures the highest pressure and work back to the register with the lowest measurement. Seal the largest holes first and keep testing and sealing until reading is under 1 Pascal per register.

FIGURE 11



Pressure-Pan Test Procedures in Unconditioned Areas
Ducts located in the attic or unconditioned space must have a pan reading of 1 Pascal or less. Manufactured homes must have a pan reading of 3 Pascal or less.

If unconditioned spaces in which ducts are located are not well connected to the outdoors or have very large connections to the house, then the unconditioned space will be at a pressure between the outside and inside house pressure during the blower door test. In this case, the pressure-pan reading will show an artificially low number. To correct this misleading number:

- With the house at -50 Pascal, measure the pressure difference between the house and the unconditioned space. (For example, the house-to-zone pressure is 10 Pascal and the pressure pan reading is 2.0 Pascal.)
- Multiply the pressure pan reading by the multiplier in Table 12 to get the adjusted reading. (For example, multiply the pressure pan reading of 2.0 Pascal by 5, resulting in a pressure pan reading of 10 Pascal.) Manufactured homes are exempt from this test.

Repeat the test for each register and grille on ducts located in unconditioned spaces in a systematic fashion. If a grille is too large or supply register is difficult to access (under a kitchen cabinet, for example), seal the entire grille or register with duct-mask tape. Insert a pressure probe through the duct-mask tape and record reading. This is more time consuming than using the pressure-pan, but it gives an accurate reading.

When two registers or grilles are closely connected to the same duct run (for example, two registers on opposite sides of the same partition wall), seal one and use the pressure-pan on the other unsealed register or grille.

TABLE 12

Pressure Pan Multipliers

House/Zone Pressure	*Pressure Pan Multiplier*
50	1.0
45	1.1
40	1.25
35	1.42
30	1.66
25	2.0
20	2.5
15	3.5
10	5.0
5	10.0

2047 Duct Leakage/Sealing *SWS 2.0201.1e; 3.1601.1a-j; 3.1601.3; 3.1602.1a-c; 3.1602.4a-c; 3.1602.11; 3.1602.12; 4.1601.1; 6.6102.3; 6.6102.4;*

FIELD GUIDE

Energy Auditor/Inspector

Ducts need to be tested for leakage prior to sealing or insulating them. (See Section 2046)

Duct sealing is to be done when:

- There is leakage in the duct system to the outside or unconditioned area (this also applies to separate air conditioning systems). (See Section 2046 Pressure Pan Testing), or
- There are drafting problems caused by duct leakage, or
- There is an insufficient draft measurement in the flue of any combustion appliance, or
- Either the furnace and/or water heater are an atmospheric draft appliance and there is a pressure reading in the CAZ with reference to the outside of -3 Pascal or greater (e.g., -4, -5, etc.) after subtracting the baseline with reference to outside, or
- Both the furnace and water heater are induced draft appliances and there is a pressure reading in the CAZ with reference to the outside of –15 Pascal or greater (e.g., –16, -17, etc.) after subtracting the baseline with reference to outside, or
- There are large openings or disconnected ducts, or
- There are return air registers in the combustion air zone unless the CAZ is a lived-in, heated area.

Seams and joints in the duct system shall be inspected. Seal all large openings and disconnected ducts.

Seal all return air register leaks in the combustion air zone unless the CAZ is a lived-in, heated area.

After duct sealing is done, the temperature rise, duct leakage to the outside, drafting, and CAZ WRT outside tests must be done again.

WX Worker

When required by work order, duct sealing will be completed.

Mastic shall have UL listing and conform to ASTM C557 and C919-79. Tape must be fiberglass mesh that is a minimum .006” thick. Mastic may be used without mesh tape if the gaps are ¼” or less.

If existing ductwork is insulated, insulation will be returned or replaced after sealing.

New and/or existing ductwork

- Required duct preparation before sealing:
  - Metal to metal ducts
    - Round ducts will be mechanically fastened to maintain alignment.
    - Other shaped ducts will be securely fastened with welds, gaskets, or adhesives.
  - Flex to metal
    - Joints will be fastened with tie bands using a tie band tensioning tool.
  - Plenum to air handler cabinet
    - Mechanically fasten plenum to cabinet.
  - Boot to wood
    - Screws or nails will be used to fasten boot to wood.
  - Boot to drywall
    - Boot hanger will be fastened to adjacent framing with nails or screws.
    - Boot will be connected to boot hanger with screws.
  - If flexible ducts are plastic lined and leaky they must be sealed by:
    - Slipping a metal collar of at least 20-gauge metal inside the plastic liner. Clamps or cable ties shall be used to secure the liner over the collar.
    - Mastic and mesh tape on the connection.
    - Insulation must completely cover the collar and the plastic core. The vapor barrier shall be secured with cable ties or a minimum 2” wide of metallic tape.
- Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic if within 10’ of air handler.
- Mastic alone will be acceptable for holes less than ¼" that are more than 10' from air handler.
- Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages:
  - They will be backed using foil tape as a support prior to sealing.
  - They will be sealed using fiberglass mesh and mastic.
- Seams, cracks, joints, holes, and penetrations larger than ¾" will be repaired using rigid duct material.
- Fiberglass mesh and mastic will overlap repair joint by at least 1" on all sides.
- Fiberglass mesh and mastic will be the primary seal.
- Furnace cabinet joints will be closed and cracks and holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape) or in accordance with the original equipment manufacturer directions (if available).

Cardboard panning is not allowed with new installation or to repair existing ductwork.

All existing cardboard panning material which is deteriorating must be replaced with metal panning materials.

2048 Pressure Differential Testing *SWS 5.3001.3c; 6.6201.2*
FIELD GUIDE

Energy Auditor/Inspector

An understanding of the dynamic interaction between house pressure, airflow, and mechanical system operation (Mechanical Air Distribution and Interacting Relationship) is required to fully utilize the procedures presented below.

Air handler fans commonly move 500 to 2000 cubic feet of air per minute (CFM). This is sufficient airflow to pressurize or depressurize a room, the basement, or even an entire house if the supply and return flows are not balanced. In addition to the increased infiltration, imbalanced forced air systems can

contribute to moisture entry, and potential heating system back drafting. Negative pressure as high as 30 Pascal have been measured in basements where the return air is all drawn from the basement.

Heating system duct leakage to the outside can also cause household pressure imbalances. Duct leakage to the outside commonly results from leaky ductwork running through unconditioned space (attic, crawlspaces or garages). However, significant leakage to the outside can occur when all ductwork is located within the building envelope. In these cases, leaky ducts passing through wall or floor cavities (or the cavities themselves may be used as supply or return ducts) create a pressure differential between the cavity containing the ductwork and other building cavities indirectly connected to the outside. If either the supply or return air ductwork has leaks to the outside, air will be forced though these leaks when the furnace fan is operating. If the leaks are in the supply ducts, air will be exhausted through the leaks and will tend to depressurize the house. If the leaks are in the return system, air will be sucked into the leaks and the house will tend to be pressurized. If there are equal amounts of leakage in both the supply and return, no change in the house pressure will occur, even though large energy losses may result.

The following test procedures are used to identify pressure imbalances caused by leaks between the duct system and the outside, and by imbalanced supply and return airflows throughout a house. These procedures include: Room-to-Room Pressure Test, Dominant Duct Leakage Test, and Interior Doors Closed Test.

2048.01 Room-to-Room Pressure Test (required)

Purpose

Room-to-room pressure testing measures the pressure difference between each room in the house and the main body of the house when the air handler is running. The test can indicate the degree to which:

- There is an imbalance of air distribution resulting from closed interior doors. The doors can act as dampers restricting the flow of air within the dwelling.
- There is an imbalance of air distribution resulting from airflow differences between the supply side and return side of the ductwork.

By providing the room-to-room pressure balance, the return air to the furnace is unrestricted from inside the heated portion of the dwelling. Air is lazy so when the air from the rooms cannot get back to the returns, it will draw air from where ever it can and in most of our homes that would be from the basement environment with all of its contaminants. It also makes the furnace run harder because it cannot pull the air from where it is being supplied at through the supplies and could lead to a static pressure problem.

Documentation

Document test results on the Client Home Energy Audit.

When Required

Room-to-room pressure testing must be done when a dwelling has a dominate return. The test is also required for manufactured homes.

Test Procedures

With all interior doors closed, stand in the main body of the house and place the hose from the pressure gauge input tap under each door.

Record the pressure difference from each room WRT the main body.

Pressure relief must be obtained by trimming the door by a maximum of 1½” or installing a transfer grille between rooms, when rooms are pressurized or depressurized by more than 3 Pascal (except for the bathroom).

Return registers in exterior wall cavities on the second floor should be sealed off and the return air rerouted through the house by trimming the doors or installing transfer grilles. Return registers in exterior wall cavities on the first floor must be sealed directly above the register.

Manufactured Homes Room-to-Room Pressures *SWS 5.3001.3c*
Room-to-room pressure testing is necessary to ensure balanced airflow throughout the house.

Measure room-to-room pressure differences and relieve pressure differences that are greater than 3 Pascal, except bathrooms and furnace closets, which may be higher. Pressure differences of greater than 10 Pascal in the furnace closets must be corrected.

Turn on furnace blower and close all interior doors. While standing in the main body of the manufactured home, place the hose from the pressure gauge under each door. Record the pressure difference from each room WRT the main body on the Client Home Energy Audit. If there is a door that closes off the hallway, that door must then be closed and the hallway tested as a room itself.

If the furnace is in a hallway closet, that hallway must be open to the main body of the manufactured home.

Open the door slightly while measuring the pressure difference across the door. Open the door until the pressure difference is 3 Pascal or less and measure the square inches of opening. This is the number of square inches of opening needed for pressure balancing.

Pressure balancing is achieved by one of the two following methods:
- The door must be undercut. (Doors are not to be undercut more than 1½”.)
- A direct grille, offset grilles, or jump duct must be installed properly to relieve the pressure imbalance caused by the distribution system when the door is closed.

Return dwelling to the pre-test condition.

2048.02 Dominant Duct Leakage Test (optional)
Purpose
This test measures whole house pressurization or depressurization caused by the air handler of the furnace. This is a quick way to determine if there is duct leakage to the outside, which would then require additional pressure pan testing.

Test Procedure
Close all exterior doors and windows. Open all interior doors and ensure all exhaust fans and the air handler fan is off. Set up a pressure gauge to measure the pressure difference between the inside and outside the house. Using a digital gauge, record the baseline house pressure WRT outside (hose to the outside should be connected to the reference pressure tap). Record the baseline for future use.

Turn on the air handler of the furnace and record the change in house pressure WRT outside.

If the furnace fan pressurizes the house, there is air being drawn into the house through the return side of the distribution system. If the house is depressurized, look for leaks in the supply air system. Sometimes wall and floor cavities are used as part of the supply or return system. Even without any pressurization or depressurization of the entire house, there still could be leaks between the ductwork and the outside. In cold climates, pressurizing a house to 1 Pascal could lead to moisture problems caused by forcing warm, moist air into the walls and attic. In warm humid climates, depressurization by 1 Pascal can also cause severe moisture problems.

Pressures may also be generated in individual rooms or in the basement when interior doors are closed. Bedrooms and bathrooms often have supply registers but no returns. When doors are shut these rooms get pressurized when the air handler fan is on. The amount of pressurization of a room depends on how much supply air is delivered to the room and on the size of the leaks between both the room and the outside and between the room and the rest of house. If there are large leaks between this room and outside, air will flow out and the rest of the house will be depressurized. It has been found that the furnace fan often depressurizes basements and furnace closets because return air ducts tend to be leakier than supply air ducts.

2048.03 Interior Doors Closed Test (optional)
Purpose
This test measures the added effect of closing all interior doors on the main body house pressure.

Test Procedure
With the air handler still running, close all interior doors. Record the pressure difference from the main body of the house WRT.

2050 Other Diagnostic Testing

STANDARD
Utilizing the blower door and pressure gauges, zone pressure testing is used to determine and align the thermal and pressure boundaries. If these are aligned, the amount of surface area through which heat loss can occur will be reduced, the effectiveness of the air reduction work, the performance of the thermal insulation, and the energy savings and comfort in a building will be increased.

2051 Blower Door Test
FIELD GUIDE
Energy Auditor/Inspector
Documentation
Pre- and post-blower door tests at CFM_{50} are required for the file, the NEAT/MHEA Audit, Client Home Energy Audit and WAMS. The information reported in WAMS must be the test results from Tectite or RESNET.

In order to receive credit for infiltration, the Effective Annual Average Infiltration Rate must be calculated using the normalized leakage calculated from measurements of envelope leakage using either ASTM E779 or CGSB 149.1. ASHRAE 62.2 standards require the use of blower door testing (see Section 2091.04). In order to meet these standards, the program will use the Minneapolis Blower Door Tectite system or RESNET. If using Tectite a co-efficiency of .98 is required. The authority having jurisdiction may approve the use of other means of calculating the effective leakage area such as RESNET Mortgage Industry National Home Energy Standards which is a one point reading using the DG-700.

Tectite is an automated blower door test using the DG-700 and a computer with cruise control on the blower door.

If using RESNET one point reading with DG-700:
1. Baseline pressure must be taken – if higher than 10 Pa (+ or -) the test will not be accurate and not allowed.
2. House pressure must be at least four times greater than baseline pressure to be an allowable test. If not, you must use multiple blower doors to achieve 50 Pa.
3. Indoor and outdoor temperature must be entered in RED Calc Advanced Blower Door Inputs to provide an adjusted CFM_{50}.

When Required
Pre- and post-weatherization blower door tests are required on all houses with the following exceptions:
- Do not perform a blower door test if a solid fuel heating unit is operational.
- If vermiculite is present in the house operate the blower door in pressurization mode.

For multi-unit dwellings (less than five units), blower door tests must be done for either:
- Recommend using multiple blower doors to depressurize the whole building.
- Each different type of unit, or
- The entire dwelling and divided among the units.

Test Procedure
House Setup

Prepare the house for either depressurization or pressurization blower door test by performing the following steps:

- Set up the blower door unit in a favorable location, such as the front door, in an area free from obstructions and wind interference.
- 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.
- Deactivate all vented combustion-type appliances prior to depressurizing the structure by turning the thermostat down or the appliance off.
- A one-point pressurization test should be completed on structures with animal or bird feces in the attic that may be a health hazard if inhaled. (See pressurization test)
- 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.
- Inspect the house for loose or missing hatchways (scuttle hole or crawl door), paneling, ceiling tiles, or glazing panes. Secure any items that may become dislocated during the test and seal any missing hatchways.
- Close all prime windows, self-storing storm windows (if possible), exterior doors and latch them, as they normally would be found during the winter.
- Open all livable areas to the interior of the structure, even if the occupants close them off during the winter.
- Open interior basement doors and crawlspace doors (if crawlspace is inside thermal boundary) during test.
- Temporarily seal appropriate intentional fresh air openings (air ducted from the outdoors to the furnace, for example). Do not seal intentional exhaust air openings, such as combustion appliance flues, dryer vents or exhaust fans.
- Inspect all pilot lights of combustion appliances to ensure that blower door testing did not extinguish them.
- Reset thermostats of heaters and water heaters that were turned down or off for testing.

FIGURE 12

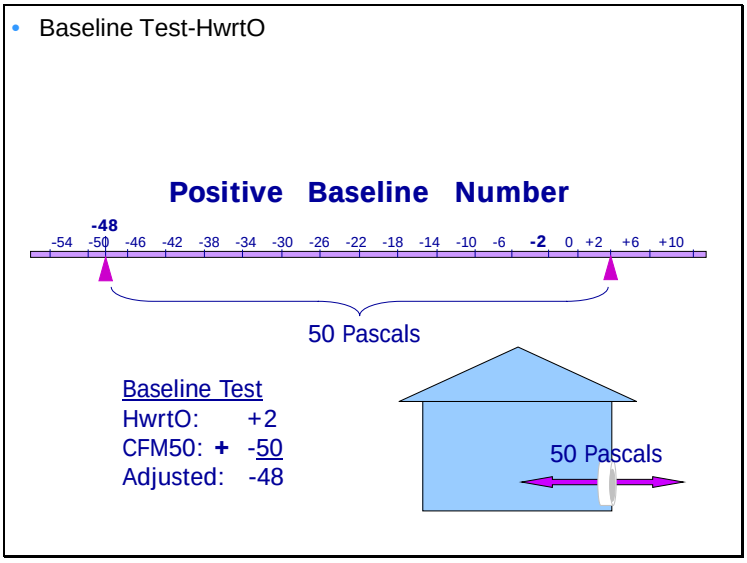
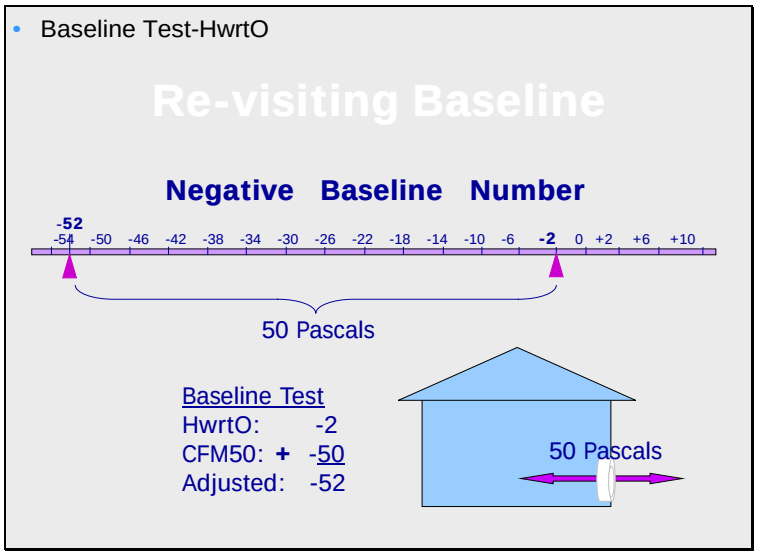


FIGURE 13



Figures 12 & 13 provided by Martha Benewicz, Wisconsin Weatherization Program

Using DG-700 Digital Gauge (Figure 14)

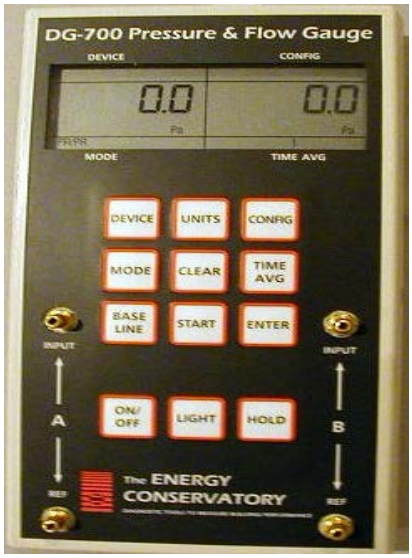
Hose Hookup

- Connect hose from outside to bottom port of Channel A on digital manometer (house WRT outside).
- Connect 2nd hose to fan, press tab on blower door fan.
- Connect other end of 2nd hose to top port of Channel B on manometer (fan WRT fan location).

Manometer Setup

- Turn manometer on, press Mode Button (2 times) to set Channel A to Pascal and Channel B to CFM_{50}.
- Device is already set for blower door Model 3 and configuration is set for open fan.
- With fan cover on, perform baseline test – press Baseline, Start and wait until number steadies then press Enter.
- Take cover off fan and slowly adjust fan speed to reach 50 Pascal on Channel A.
- Channel B will begin to estimate CFM_{50} once house pressure reaches a minimum of 15 Pascal. The CFM_{50} number will become more accurate as you approach 50 Pascal (+/- 1% when house pressure reads between 45 and 50 Pascal). It will be even more accurate if the Time Avg is changed to long term once house pressure nears 50 Pascal.
- Now read CFM_{50} once number has become steady.
- If CFM_{50} is less than 2400, turn blower door off and install ring A. Press Configuration button until it reads A1. Retake blower door reading.
- If house pressure does not reach 50 Pascal with open fan – the DG 700 will automatically estimate CFM_{50} reading once house pressure reaches 15 Pascal.

Figure 14



Performing a pressurization test – DG-3 and DG-700

Gauge set-up

- Connect tubing (red) to the B side input tap, the other end to the pressure tap on the fan.
- Connect tubing (green) on the A side reference tap running it to the outside.
- Connect another tube to the B side reference tap running it to the outside alongside of the fan, but not in the fan's airstream.
- If it is calm outside during the test, you can use the green tubing as the outside reference hose for both the building and fan. Use a "T" connector along with short pieces of tubing to connect the green hose to both reference taps on sides A and B.

Fan set-up

- When pressurizing the fan should be installed with the inlet side of the fan facing the outside (reverse of depressurization testing).
- Keep the fans direction switch in the same position so air will be blowing into the home pressurizing it.
- Secure the fan with the Velcro strap.
- Once the gauges and fan has been set up as described above the regular depressurization testing methods should be followed. For further description the Minneapolis Blower Door ™ should be consulted.

2052 Zone Pressure Test
FIELD GUIDE

Energy Auditor/Inspector

The purpose of zone pressure testing is to help align the thermal and pressure boundaries. If these are aligned, the amount of surface area through which heat loss can occur will be reduced, the effectiveness of the air reduction work, the performance of the thermal insulation, and the energy savings and comfort in a building will be increased.

Zone pressure testing can also be used for:

- Air leakage/energy loss concerns. If after initial tightening of large leaks the house still has significant, but not obvious, air leakage, performing ZPD can help identify whether leaks are in the attic floor, the house walls, or through the basement or crawlspace walls.
- Indoor Air Quality concerns. Examples include air movement from attached or tuck-under garages into a living area and moisture or soil gas movement from a crawlspace into the dwelling.
- Attic with potential or actual moisture-related problems. This might be the case if:
  - The attic has obvious moisture problems, or

- The dwelling has evidence of high winter relative humidity or significant sources of uncontrollable moisture are evident, or
- Ice dams are a concern.

- Secondary zones are zones with no access, such as porch roofs. Temporary hole between the zone and the dwelling or the zone and the outdoors cannot be created in secondary zones. Because of this, the flow between a secondary zone and the dwelling or outdoors cannot be determined. If possible, insert a pressure hose into the zone to measure the pressure difference between the zone and the dwelling or outdoors.

Zone pressure testing can also be used to measure the size of the leakage paths to various house zones. Leaking air often takes a path that moves through two surfaces with a cavity or zone in between the surfaces. These zones include attics, basements, garages, knee-wall areas, and attached porch roofs.

Zone pressure testing includes the measurement of pressure differences across air barriers (like the pressure difference between the house and the attic), while the house is depressurized by a blower door to –50 Pascal. The test also includes the calculation of flows across the air barriers. Once these flows are calculated, an estimate of the square inches of leakage through an air barrier can be determined.

Documentation
If zone pressure testing is done, results must be recorded on the Client Home Energy Audit and in WAMS. For garage leakage tests, record CFM leakage house to zone. If the pressure reading from the house to the zone is 48 Pascal or more it is not necessary to test for leakage between the house and the garage. Documentation of the pressure if 48 Pascal or more must be in the file and in the notes or memo field of WAMS. For attic by-pass leakage, record total CFM leakage path.

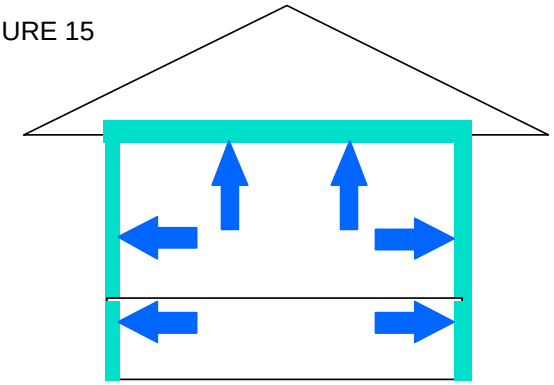
When Required
Zone pressure testing must be completed on every house with an attached garage or a tuck-under garage. There is a target of 200 CFM or less of post-weatherization leakage between the house and garage. If the pressure reading from the house to the zone is 48 Pascal or greater no further garage leakage testing is needed.

Attic by-pass leakage test is not required on every house. It is simply a tool that could indicate missed opportunities. Each Energy Auditor needs to know how to do pressure testing and use it as a tool to determine problem areas.

If bat or animal feces prevent the attic by-pass sealing from being done, conduct a pressure test in the attic. With the blower door @ 50 Pascal, if the house to zone (attic) pressure is 45 Pascal or more, do not do attic by-pass sealing or attic insulation,; however, other work can be completed. If the house to zone (attic) pressure is less than 45 Pascal, defer any work on the house. (We believe a pressure reading of 45 - 50 Pascal would indicate very little by-pass leakage, thus other work could be done on the home without concern about the by-passes not being sealed.)

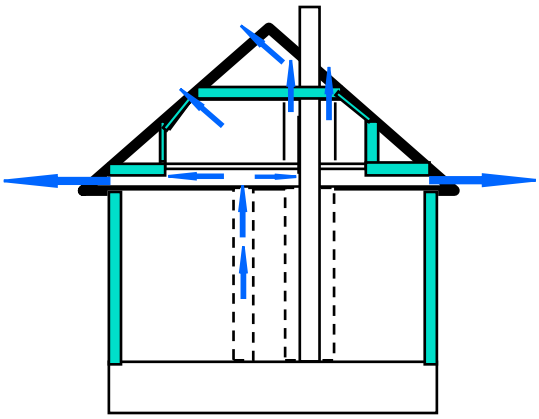
Test Procedure
Thermal Boundary
The thermal boundary is the insulation. If the attic, walls, and the foundation are insulated, the thermal boundary of the house will look like Figure 15.

FIGURE 15



Boundary Alignment
When the thermal boundary and the pressure boundary are not aligned, air escapes through breaks in the pressure boundary, making the insulation less effective. (See Figure 16) It can also cause moisture problems and ice dams.

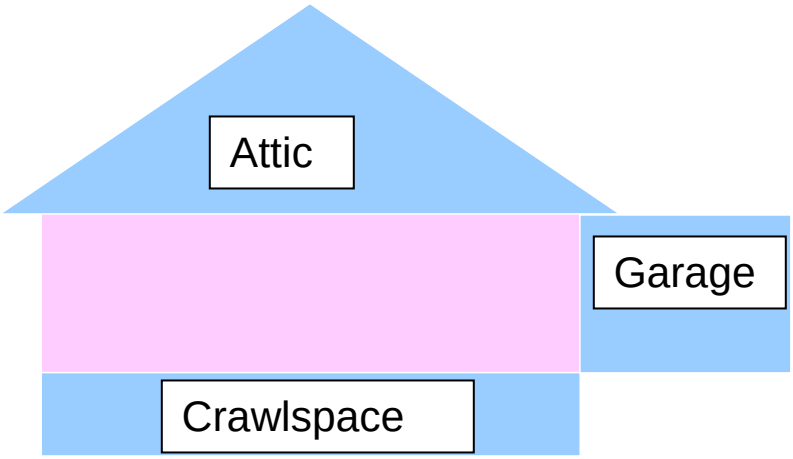
FIGURE 16



Figures 15 & 16 provided by Martha Benewicz, Wisconsin Weatherization Program

Buffer Zone
The buffer zone is a space in a building that separates the heated interior of the building from the outside. Buffer zones include kneewalls, crawlspaces, garages, attics, and floored cavities. (See Figure 17)

FIGURE 17

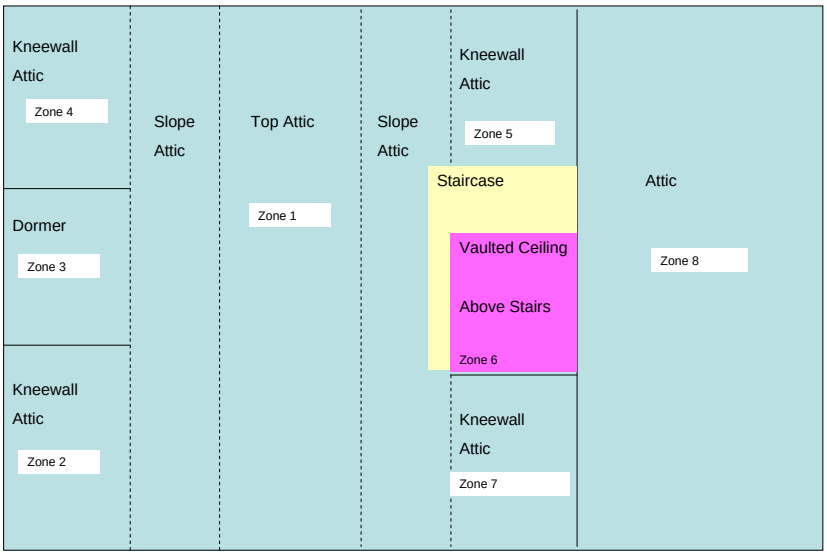


Zone pressures can determine if there are leaks (thermal by-passes) between a house and a buffer zone connected to a house (e.g., attic). Methods used to determine by-pass leakage are: the “add a hole” or “open a door” (used for garage leakage). These methods are used to estimate the size of the hole between the zone and the house. Further calculations can turn the size of the hole into a CFM_{50} estimate. For example, estimating the amount of by-pass leakage may be used to help decide if it is cost effective to seal the leak in an attic or zone that is already insulated.

Zone pressures only determine the relative size of the leaks between the zone and inside compared to the zone and the outside. To know whether the leakage rate is significant, determine the approximate leakiness of one side of the pressure boundary by using one of the measurement methods (i.e., add a hole, open a door).

The first step to finding pressure boundaries is to identify the thermal boundary and identify and map the zones. (See Figure 18)

FIGURE 18



To determine if there is an air-tight barrier (pressure boundary) between the heated envelope and the buffer zone, measure the pressure difference between the house and the zone. If there is a good pressure boundary between the house and the buffer zone when the house is at –50 Pascal, the zone pressure will be closer to –50 Pascal. (See Figure 19) In other words, the buffer zone is linked mostly to the outside. If there is a poor pressure boundary between the house and the buffer zone the pressure will be closer to 0 (the buffer zone is linked mostly to the house). (See Figure 20)

FIGURE 19

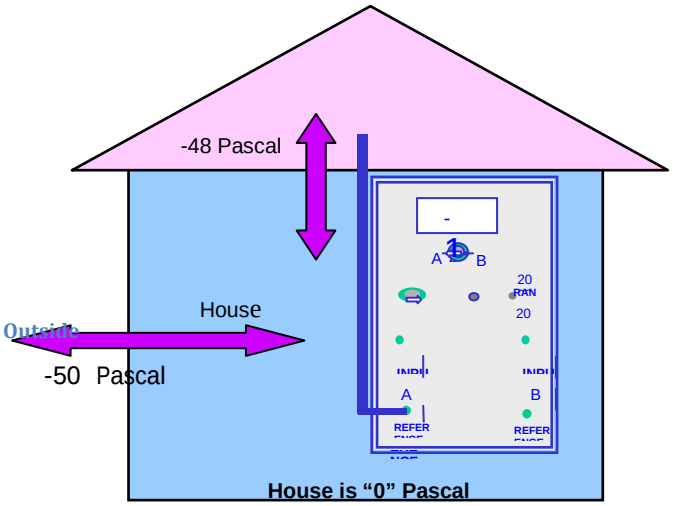
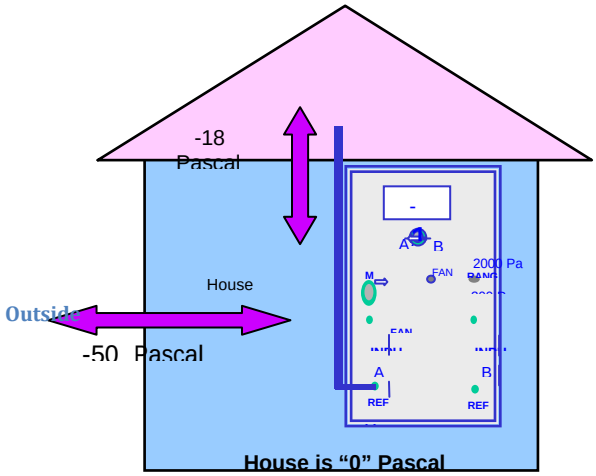


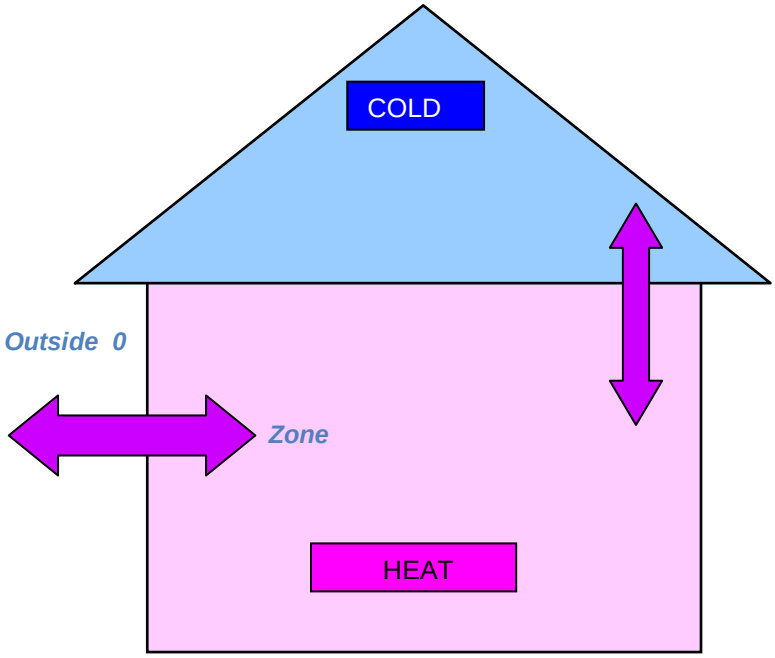
Figure 20



Figures 19 & 20 provided by Martha Benewicz, Wisconsin Weatherization Program

The buffer zone should be linked to the outside not to the house. (See Figure 21)

FIGURE 21



Basic Zone Test
Set up the blower door using established procedures and precautions. (See Section 2051) Run a hose to the outside of the house making sure it will not be affected by the blower door exhaust airflow.

Run a hose to the zones to be tested making sure the end of the hose is beyond any existing insulation, flooring or false ceiling, and will not be subjected to air flow through surrounding leakage areas when the blower door is operating.

Measure and record the baseline to adjust for stack and wind effects. Take a baseline reading with the blower door sealed and fan off using a digital gauge to take a reading of house with reference to (WRT) outside. Also take a baseline reading of house WRT to zone.

FIGURE 22

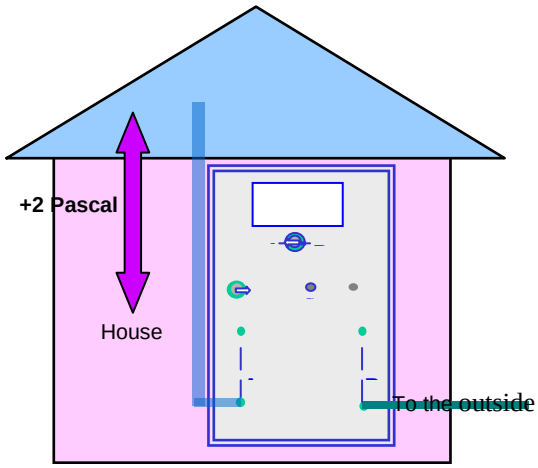


Figure 22 provided by Martha Benewicz, Wisconsin Weatherization Program

Using the pressure gauge setup to record the house WRT outside, depressurize the house to -50 Pascal. It is important to check throughout the testing procedures to assure the house to outside pressure differential remains at -50 Pascal.

Take a pressure measurement reading from the house WRT zone.

After measuring zone pressure, adjust pressure of the house with reference to zone by subtracting the baseline. For example in Figure 22 the baseline house WRT zone was +2 Pascal and in Figure 23 the house WRT zone pressure was -35 Pascal so the change in pressure was -37 Pascal.

If baseline house WRT zone would have been -2 and house WRT zone pressure –35, the change in pressure in the zone would have been -33 Pascal.

FIGURE 23

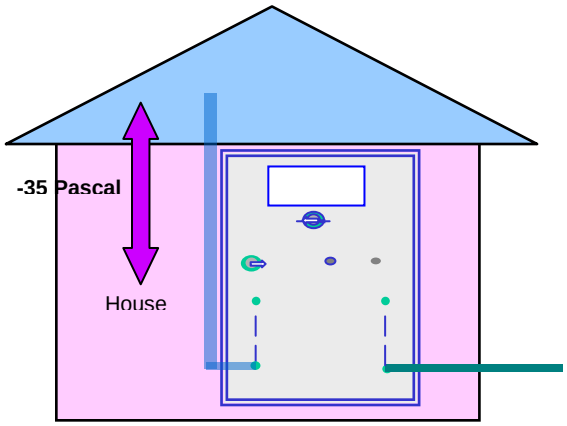


Figure 23 provided by Martha Benewicz, Wisconsin Weatherization Program

Measuring the zone is the first step in estimating the leakage to the zone. It tells us the ratio of the size of holes on the interior to the size of the hole on the exterior. The size of one of the holes must be known or estimated to understand the pressure differential measurement.

There are two methods to estimate leakage between house and zone:

1. Add a hole to the zone and calculate the size of the hole.
2. Open a door and close the door taking readings each time (used for garage leakage test).

2052.01 Add a Hole

Keep the input tap open to the house. Place the hose on the reference tap in the zone to be tested, close the scuttle.

Bring house to -50 Pascal and record the reading house WRT zone. Adjust all pressures for baseline. Subtract house WRT zone from -50 to determine zone to outside reading. Record this reading for later use in the TI-89.

Add a hole to the zone (or slide scuttle door open), measure and record opening size. Bring the house to -50 Pascal and calculate and record the house to zone reading again. Use the computer program in the TI-89 calculator to estimate leakage.

2052.02 Open a Door (Garage Leakage Test)

There are two methods to test garage leakage. Which one you use depends upon the closed door zonal pressure house WRT garage. Each method begins with the same setup:

1. All doors to garage should be CLOSED (house in winter mode).
2. Get Blower Door to -50 Pa WRT outside.
3. Measure house CFM_{50} for door closed.
4. Measure closed door zonal pressure house WRT garage. (If closed door zonal pressure is greater than 25 Pa, use the Open Door from Garage to House Method. If closed door zonal pressure is less than 25 Pa, use the Open Door from Garage to Outside Method.)

The TI-89 calculator may be used to estimate the leakage by recording all the blower door numbers from either method and entering into the calculator. Or use the charts and tables below to estimate the leakage.

Opening Door from Garage to House

1. Open the door from the house to the garage.
2. Get blower door back to -50 Pa WRT outside.
3. Measure house CFM_{50} for door open.
4. Measure zonal pressure house WRT garage (should be 0).
5. CFM_{50} difference = CFM_{50} door open – CFM_{50} door closed.
6. Look up closed door zonal pressure for house WRT garage on Table 14.
7. Enter the multipliers into labeled boxes on Table 13.
8. To calculate approximate square inches of leakage in each row, divide CFM_{50} by 10.

Table 13

CALCULATE DIFFERENCE

Closed Door Pressure House WRT Garage	CFM_{50} Door Open	CFM_{50} Door	CFM_{50} Difference

		Closed	

LEAKAGE FROM GARAGE TO HOUSE

CFM_{50} Difference	Multiplier (int)	CFM_{50}	Square Inches

LEAKAGE FROM GARAGE TO OUTSIDE

CFM_{50} Difference	Multiplier (ext)	CFM_{50}	Square Inches

TOTAL PATH LEAKAGE

CFM_{50} Difference	Multiplier (path)	Maximum CFM_{50}Reduction

TABLE 14

Open House Door to Garage

	Closed Pressure		*Multiply CFM_{50} change by:*		
	H/G	G/O	int	Ext	path
Check G/O	48	2	0.14	1.14	0.14
	47	3	0.2	1.19	0.19
	46	4	0.25	1.24	0.24
	45	5	0.31	1.29	2.9
	44	6	0.37	1.34	0.34
	43	7	0.43	1.39	0.39
	42	8	0.49	1.44	0.44
	41	9	0.56	1.49	0.49
	40	10	0.63	1.54	0.54
	39	11	0.7	1.6	0.6
	38	12	0.78	1.65	0.65
	37	13	0.87	1.71	0.71
	36	14	0.96	1.78	0.78
	35	15	1.06	1.84	0.84
	34	16	1.17	1.91	0.91
	33	17	1.29	1.98	0.98
	32	18	1.42	2.06	1.06
	31	19	1.56	2.14	1.14
	30	20	1.71	2.23	1.23
	29	21	1.88	2.32	1.32
	28	22	2.07	2.42	1.42
	27	23	2.27	2.52	1.52
	26	24	2.5	2.64	1.64
	25	25	2.76	2.76	1.76
	below here you should probably use the other chart				
	24	26	3.04	2.89	1.89
	23	27	3.36	3.03	2.03
	22	28	3.73	3.18	2.18
	21	29	4.14	3.35	2.35
	20	30	4.61	3.54	2.54
	19	31	5.15	3.74	2.74
	18	32	5.77	3.97	2.97

17	33	6.5	4.23	3.23
16	34	7.36	4.51	3.51
15	35	8.38	4.83	3.83

Opening the Door from the Garage to the Outside

1. Open the door from the garage to the outside.
2. Get blower door back to -50 Pa WRT outside.
3. Measure house CFM_{50} for door open.
4. Measure zonal pressure house WRT garage (should be 50).
5. CFM_{50} difference = CFM_{50} door open – CFM_{50} door closed.
6. Look up closed door zonal pressure for house WRT garage on Table 16.
7. Enter the multipliers into labeled boxes on Table 15.
8. To calculate approximate square inches of leakage in each row, divide CFM_{50} by 10.

Table 15

CALCULATE DIFFERENCE

Closed Door Pressure House WRT Garage	CFM_{50} Door Open	CFM_{50} Door Closed	CFM_{50} Difference

LEAKAGE FROM GARAGE TO HOUSE

CFM_{50} Difference	Multiplier (int)	CFM_{50}	Square Inches

LEAKAGE FROM GARAGE TO OUTSIDE

CFM_{50} Difference	Multiplier (ext)	CFM_{50}	Square Inches

TOTAL PATH LEAKAGE

CFM_{50} Difference	Multiplier (path)	Maximum CFM_{50} Reduction

TABLE 16

Open Garage Door to Outside

	Closed Pressure		*Multiply CFM_{50} change by:*		
	H/G	G/O	int	ext	path
Garage is leaker to the house than it is to the outside	2	48	1.14	0.14	0.14
	3	47	1.19	0.2	0.19
	4	46	1.24	0.25	0.24
	5	45	1.29	0.31	2.9
	6	44	1.34	0.37	0.34
	7	43	1.39	0.43	0.39
	8	42	1.44	0.49	0.44
	9	41	1.49	0.56	0.49
	10	40	1.54	0.63	0.54
	11	39	1.6	0.7	0.6
	12	38	1.65	0.78	0.65
	13	37	1.71	0.87	0.71
	14	36	1.78	0.96	0.78
	15	35	1.84	1.06	0.84
	16	34	1.91	1.17	0.91
	17	33	1.98	1.29	0.98

18	32	2.06	1.42	1.06
19	31	2.14	1.56	1.14
20	30	2.23	1.71	1.23
21	29	2.32	1.88	1.32
22	28	2.42	2.07	1.42
23	27	2.52	2.27	1.52
24	26	2.64	2.5	1.64
25	25	2.76	2.76	1.76
below here you should probably use the other chart				
26	24	2.89	3.04	1.89
27	23	3.03	3.36	2.03
28	22	3.18	3.73	2.18
29	21	3.35	4.14	2.35
30	20	3.54	4.61	2.54
31	19	3.74	5.15	2.74
32	18	3.97	5.77	2.97
33	17	4.23	6.5	3.23
34	16	4.51	7.36	3.51
35	15	4.83	8.38	3.83

2053 Quick Field Test

If an opening exists between the zone and the house, a quick test can be performed to give a visual indication of the size of hole to the zone. Measure the house to zone pressure with the house to outside pressure set at –50 Pascal.

Open the hole until the house to zone pressure drops in half while keeping the house to outside pressure at –50 Pascal. Once the target differential is obtained, look at the size of the hole that was created. This hole is approximately equal to the size of the existing hole between the house and the zone. It will not be cost-effective to address leakage that is less than 20 in².

2060 Carbon Monoxide, Smoke, & Propane Alarms

STANDARD

Hardwired alarms will be UL listed. All alarms will be installed in accordance with manufacturer's specifications and authority having jurisdiction.

FIELD GUIDE

Energy Auditor/Inspector

CO Alarms *SWS 2.0100.1e; 2.0301.1, 2.0203.2g; 2.0301.2; 3.1501.1f; 5.3003.7h; 5.3104.2h; 5.3104.3r; 7.8102.2m; 7.8102.3p; 7.8103.1g; 7.8103.2ll*

Carbon monoxide alarms may be purchased and installed using program funds. If installing more than one CO alarm, they should be installed outside each separate sleeping area.

Carbon monoxide alarms must be installed immediately by the energy auditor whenever an agency finds a combustion appliance that is putting off carbon monoxide at an unacceptable level. (See Section 2043)

A working carbon monoxide alarm must be present in every home. Program funds may be used to installed carbon monoxide alarms if one does not exist.

WX Worker

Carbon monoxide alarms are to be installed between 4' and 6' from the floor. CO alarms installed by the program must be either lithium-ion battery operated or electric with a battery back-up. When an electric alarm is installed, it will be the Energy Auditor's discretion to install a raceway to protect the wiring of the alarm.

Do not install the alarm in the following areas:
- Near bathrooms or in shower areas
- In closets
- Crawlspaces or unheated areas where extreme hot or cold temperatures occur
- Within five feet of fuel burning appliances
- Close to adjacent walls or in corners
- Near bathtubs or basins
- Directly above or below return air registers
- Behind drapes, furniture, or other objects that could block air-flow to the CO alarm

Alarms must meet UL2034 standards. Alarms should be warranted for a minimum of three (3) years.

Installed alarms must have the expiration date, as warranted by the manufacturer, written on the front of the mounting plate or back side of alarm in permanent ink. Verbal and written instructions are to be given to the client as to the use and maintenance of the alarm.

Smoke Alarms *SWS 2.0301.1a, b;*

Energy Auditor/Inspector

A maximum of two (2) smoke alarms, per dwelling, may be purchased and installed using program funds. Additional alarms may be installed using program funds if required by local codes for single family residences (specific code requirement must be noted in file).

When installing more than one smoke alarm, they must be on separate living levels.

Smoke alarms must be installed for the following reasons:
- When space heaters are replaced with a vented space heater
- When there is a solid fuel burner in the home
- When manufactured homes are weatherized
- When local codes require their installation

Areas that alarms should be installed:
- Install on basement ceiling level near basement stairs
- Install within 15 feet of rooms used for sleeping purposes
- Install on hall ceiling or wall centered as possible between bedrooms
- Install in rooms having a space heater
- Avoid placement near kitchen stoves or bathroom showers
- Exclude unoccupied attics

WX Worker

Smoke alarms must be dual sensor alarms which contain both an ionization sensor and a photoelectric sensor and which are designed to detect and trigger an alarm in response to smoke detected through either sensing device, or a smoke alarm which has at least two sensors and which is listed to Underwriters Laboratory Standard 217, Single and Multiple Station Smoke Alarm. The alarms may be powered by 9-volt battery and emit a signal when the battery is losing power.

The use of combination alarms (CO and smoke) does not change the requirements for separate CO alarms as described in this section because smoke alarms and CO alarms are not installed in the same location.
The product must be approved by the Underwriters Laboratories (UL).

Smoke alarms may be installed on the ceilings or in dead air space (four to six inches below the ceiling on the wall).

Smoke alarms should not be installed in front of air supply ducts.

Installed alarms must have the expiration date, as warranted by the manufacturer, written on the front of the mounting plate or back side of alarm in permanent ink. Verbal and written instructions are to be given to the client as to the use and maintenance of the alarm.

Propane Gas Alarms

Energy Auditor/Inspector

Propane alarms are required by weatherization in all houses using propane. Manufactured homes are exempt from this rule. There are different types of propane gas alarms – some are just alarms which sound when a leak is detected, others actually shut down the flow of gas into the house. The weatherization program will pay for propane alarms that detect the leak. If local code requires the alarm be connected to electricity, an outlet must be provided. Alarms are to be installed according to the manufacturer's instructions and meet the proper UL listing.

LP alarms must be installed near the furnace or other propane appliances within 12 - 24" of the floor.

WX Worker

Propane alarms must be installed according to the manufacturer's instructions and meet proper UL listing. LP alarms must be installed near the furnace or other propane appliances within 12 - 24" of the floor.

Verbal and written instructions are to be given to the client as to the use and maintenance of the alarm.

2070 Moisture/Mold Assessment

STANDARD

All homes must be inspected for previous and existing moisture problems and for conditions that could lead to future moisture problems. When a moisture problem is identified, Energy Auditors must determine the cause of the problem and then determine a solution for mitigating the problem. A visual assessment of the home must be done to check for existing mold or mildew. The visual assessment must also include looking for situations that could result in mold growth.

2071 Moisture and Moisture Assessment *SWS 2.0401.1; 3.1001.1a; 3.1001.2a; 3.1001.3a; 3.1002.1a; 3.1002.2a; 3.1002.3a; 3.1003.1a; 3.1003.2a, 3.1003.3a; 3.1003.4a; 3.1003.5a; 3.1003.6a; 3.1004.1a; 3.1005.1a;*

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Homes must also be inspected for existing mold. The Health and Safety Assessment Findings Form, Part 2 (a moisture/mold checklist) is used by all agency Energy Auditors to document existing moisture and mold problems. Photos or other visual documentation must also be taken of existing mold and available at the agency, preferably in the house file. The original Health and Safety Assessment Findings Form, Part 2 must be filed in the client/house file.

One of the worst indoor air quality problems is too much moisture (humidity) in a home. Too much moisture may result in moisture penetration, condensation, and build-up in walls and ceilings. Moisture accumulation may damage a house by causing wood rot. Too much indoor moisture (humidity) can also lead to the growth of mold and mildew which can cause adverse health effects to the occupants.

Some moisture is needed in a home. The lack of sufficient moisture in winter air can irritate noses and cause drying of the skin. The ideal indoor relative humidity during the heating season in Iowa ranges between 30 and 50 percent.

2072 Moisture Problem Symptoms and Sources *SWS 2.0401.1; 3.1001.1a; 3.1001.2a; 3.1001.3a; 3.1002.1a; 3.1002.2a; 3.1002.3a; 3.1003.1a; 3.1003.2a, 3.1003.3a; 3.1003.4a; 3.1003.5a; 3.1003.6a; 3.1004.1a; 3.1005.1a;*

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As the moisture assessment is conducted, Energy Auditors use the following symptoms to find potential moisture problem areas:

- Damp atmosphere and/or musty smell in house, basement, or crawlspace
- Client complaint of allergy-like symptoms
- Mold-like substance growth on walls and ceilings, especially in rooms with high moisture loads, such as bathrooms and kitchens, mold in corners or at the wall/ceiling junction (top plate)
- Mold-like substance growth on attic roof sheathing
- Signs of condensation on walls or windows
- Water damage or mold-like substance on the underside of roof decking
- Evidence of crawlspace moisture
- Peeling paint, particularly on bathroom and kitchen walls
- Rusted metal in basements, crawlspaces, bathrooms, and kitchens
- Efflorescence (white, powdery deposits) on concrete or masonry surfaces
- Water stains on foundation walls

Table 17 references moisture problems, the potential causes of those problems, and solutions for mitigating the problems. Following the table is a more detailed explanation of ways to solve moisture problems.

TABLE 17

Moisture Problems	Causes	Solutions
Attic Condensation	• The stack effect • Plumbing, wiring and mechanical penetrations • Recessed lights • Hi-power roof exhaust fans • Vapor barrier voids • Compressed insulation • Kitchen and bath fans exhausting into attic • Leaky attic HVAC ductwork • Excessively humid conditioned space below • Uninsulated ductwork • Insufficient or poorly installed insulation	• Attic air sealing • Moisture control in conditioned space below • Install appropriate insulation • Air-tight recessed lights • Air-tight ductwork • Ducted exhaust fans to outdoors
Wet Walls	• Wind-driven rain • Flood, fire, plumbing break or other water disaster • Capillary openings between siding units • Contact with damp soil or masonry • Deteriorated window flashing and caulk • Vapor barrier penetrations • Cold interior wall surfaces • Improperly installed flashing • Insufficient or poorly installed insulation	• Proper air sealing of exterior walls • Minor plumbing repairs • Insulation • Properly install flashing
Roof Leaks	• Complex rooflines • Poor selection of roofing material • Old or worn roofing • Ice dams • Improperly installed flashing	• Appropriate insulation to correct ice dams • Installation of gutters • Minor roof repairs • Black jack • Properly install flashing
Wet Basement	• Plumbing • Plugged drains • Leaky foundation • Furnace condensation line • Washer draining on floor • Open sump basket • Poor grading, gutters, sidewalk/driveways	• Minor plumbing repairs • Foundation caulk/concrete • Grading/banking • Furnace repair • Installation of gutters • Sump pumps and covers • Dehumidifiers

	sloped toward foundation	
Crawlspace	• Leaky foundation • Lack of vapor retarder	• Install vapor retarder • Foundation caulk/concrete • Installation of gutters • Sump pumps and covers • Dehumidifiers
Window Condensation	• High humidity level	• Lower humidity level
Indoor Air Quality	• House too tight • Pressure imbalances • Unvented space heaters/appliances • Improper drafting of appliances • High moisture content • Hang-drying clothes inside house • Drying wood inside house • Excessive plants • Aquariums • Excessive showering • House over-crowding • Humidifiers • Boiling water to use for cooking	• Exhaust fans/ dehumidistats • Remove unvented space heaters • Vent dryers outside • Client education on moisture problem causes • Pressure balancing • Removal of high moisture items

WX Worker

2073 Moisture Problem Solutions *SWS 2.0401.1c; 2.0401.2a; 2.0404.3; 2.0404.4c, f;*

Identifying and solving the source of moisture problems should be the first priority when a moisture problem is found. Following are possible solutions to moisture problems.

2073.01 Mechanical Ventilation *SWS 2.0401.2a 2.0404.3d; 2.0404.4c, f;*

FIELD GUIDE

Energy Auditor/Inspector

One of the main strategies for solving moisture problems in a home is effective mechanical ventilation. Installing intermittent or continuous ventilation is allowed. Moisture problems may be reduced or eliminated by ventilating areas that routinely generate large moisture loads such as bathrooms and kitchens.

Clients should be reminded of the importance of using kitchen exhaust fans while cooking and the importance of using bathroom exhaust fans after showers or baths. Clients should also be educated about the proper operation and use of the fans.

Refer to the Section 2090 for detailed guidance and procedures on mechanical ventilation.

2073.02 Site Drainage *SWS 2.0401.1d; 2.0402.1a; 2.0402.2*

Poor site drainage is often the reason for wet foundations, basements, crawlspaces, and slabs. The ground around the foundation of the house should be sloped away from the house so water runs away from the house and not toward it. Ideally, the ground adjacent to the foundation should slope away from the house at a minimum 5 percent (six inches of fall in the first 10 feet).

Check for the following site drainage situations:

- Does the site direct rain and snow melt toward the foundation rather than away from it?
- Are there depressions in the ground close to the house where water can collect?
- Are sidewalks or paved driveways sloped so they direct water toward the foundation rather than away from it?
- Does the house have an effective gutter/downspout system that collects and drains rain water away from the foundations?

Agencies may improve grading around foundations as a General Health and Safety Repair, as long as the cumulative cost of the grading and any other general health and safety repair does not exceed the General Health and Safety Repair limit.

2073.03 Gutters and Downspouts *SWS 2.0401.1d; 2.0402.1b; 2.0402.2*

Gutters and downspouts can be an important part of solving a site drainage problem. They collect and drain rain water away from foundations. Agencies should note if the house has an existing effective gutter/downspout system. If the gutter system is in good condition, but is clogged with debris, they may be cleaned by the program if client is physically unable to do the job and all other options (such as family or chore services) have been exhausted. The cleaning can only be done at the time of weatherization services and cannot be repeated as needed.

If gutters/downspouts are missing or are severely damaged, the agency may install or repair existing gutters/downspouts as a General Health and Safety Repair, as long as the cumulative cost of the gutter/downspouts and any other general health and safety repair does not exceed the General Health and Safety Repair limit. Gutters and downspouts should only installed/repaired if it will help solve problems.

Gutters should be pitched to the downspouts. There should be no more than a 40-foot length of gutter without a downspout (i.e., a 70-foot ranch home must have two downspouts). Short gutters may be level. In areas where tree leaves might cause clogging, gutters and downspouts should be oversized so that leaves and debris will be flushed more easily. Gutter hangers should be strong enough to keep gutters from sagging.

Downspouts should be securely fastened to the house. Elbows and straight sections should be fastened together with pop rivets – screws that project into the downspout can lead to clogging.

At the base of the downspout, the water must be directed away from the foundation of the building by six feet. If water is allowed to dump close to the foundation, it might cause moisture problems in the dwelling. The good way to discharge the water away from the house is with downspout extenders (sections of straight downspout) or splash blocks. Both of these are often disturbed when lawns get mowed. A notched section of downspout that is hinged to the elbow at the base of the downspout can solve this problem.

2073.04 Plumbing Repair *SWS 2.0111.2d*

Leaking water pipes and sewer lines may cause moisture problems within the house. Minor repairs may be made to water pipes and sewer lines as a General Health and Safety Repair, as long as the cumulative cost of the plumbing repair and any other general health and safety repair does not exceed the General Health and Safety Repair limit. Cleanup of any unsanitary conditions due to plumbing leaks is the sole responsibility of the client. In some cases weatherization work should be deferred due to unsanitary conditions.

2073.05 Sump Pumps *SWS 2.0111.2h; 2.0402.1d,e*

Sump pumps may be installed to control water in lower levels of the home. Pumps may be installed as a General Health and Safety Repair, as long as the cumulative cost of the pump installation and any other general health and safety repair does not exceed the General Health and Safety Repair limit. Sump pumps must be installed to meet manufacturer's instructions and all local codes. Interior grading will be sloped to the sump pump, if possible.

2073.06 Dehumidifiers *SWS 2.0404.1a-c; 2.0404.3b; 2.0404.4a, b, f*

Dehumidifiers may be installed, with client permission, to help control humidity in basements during summer months in homes with existing mold or moisture problems. All moisture source control methods must have been exhausted before installing a dehumidifier. Explain to the client that the dehumidifier might result in an increase in electric usage. Dehumidifiers must be ENERGY STAR® ® rated and installed to drain properly. If draining to a basement drain, the dehumidifier must be set on blocks to allow for proper drainage.

If a drain does not exist, a dehumidifier may be installed by utilizing a dedicated condensation pump to an existing drain, sump pump, or sewer line. All condensate lines must terminate to a drain; they cannot terminate outside the envelope of the house. Ensure the drain line does not present a trip hazard for the client. Educate the client on proper usage of the dehumidifier including settings and summer/winter use.

Dehumidifiers may be installed as a General Health and Safety Repair, as long as the cumulative cost of the dehumidifier and any other general health and safety repair does not exceed the General Health and Safety Repair limit.

WX Worker

Manufacturer specifications will be followed for size and use.

Occupant will be educated on how and when to change filter and clean condensate drain of the dehumidifier in accordance with manufacturer specifications.

- Equipment will have a minimum efficiency level of ENERGY STAR® or better
- Equipment will have a fan-off option
- Equipment will retain settings after power-off
- Equipment will have features that reduce both peak electric use (e.g., internal and external timers) and absolute energy use
- Equipment will have standby losses of 1 watt or less
- Controls will be labeled so they are understandable, readable, and accurate for occupant needs
- Systems located in a basement or crawl space will be rated for cold temperature operation

2073.07 Attic By-pass Sealing *SWS 2.0401.1a*

Attic by-pass sealing must be done on all homes, even if the house is below the Overall Tightness Limit (OTL). One of the most important benefits of attic by-pass sealing is that it prevents the migration of moisture into the attic where it could cause ice damming, wood rot, and mold-like substance growth. Refer to the Section 4010 for details on attic by-pass sealing.

2073.08 Crawlspace Ground Moisture Barrier *SWS 2.0401.1b;*

Crawlspace moisture can lead to condensation, mold, and rot. Air passing through the soil can contain radon and pesticides. It is important to prevent the moisture (water vapor), radon and pesticides (soil gasses) from entering the house. This can be done by covering the crawlspace ground with an airtight moisture barrier which establishes an air barrier and seals out water vapor and soil gasses. Refer to the Section 5031.01 for details on installing moisture barriers.

2073.09 Incidental Repairs

Incidental repairs are defined as repairs necessary (1) for the installation of weatherization measures and (2) to maintain the integrity of weatherization materials. Certain incidental repairs are allowed by the program but the repair cost is limited to what is allowed by the NEAT/MHEA Audit's Savings to Investment Ratio (SIR). Refer to the Section 7000 for more information about this.

Repair or replacement of missing or deteriorated windows that allow moisture or water to enter the house can be done but the cost is limited as described above. Minor roof and foundation repair may be done to prevent moisture or water from entering the house. The cost of those repairs is limited as described above.

2073.10 Client Education

Agencies should always provide general education to clients about problems that can occur due to high indoor moisture levels or actual moisture penetration and how client practices can lead to moisture problems. It would be beneficial to explain to the client what relative humidity levels should be maintained in the house.

Measures installed to eliminate moisture problems will be fully explained to the client. Instructions on maintaining any installed equipment will be provided to the client.

It is particularly important for agencies to provide moisture education to clients if they identify client practices that have resulted in, or could result in, high moisture levels in the home. Following are client practices that can have an effect on the moisture levels in homes. Agencies should discuss these things with clients.

- Use kitchen exhaust fans when cooking
- Use bathroom exhaust fans when bathing and showering
- Open closet doors and move furniture away from outside walls to allow for more air circulation
- Do not over-use humidifiers
- Do not have too many plants
- Do not have uncovered aquariums
- Do not store firewood indoors
- Do not cover windows with plastic
- Keep gutters clean
- Fix leaky plumbing

2074 If Moisture Problems Cannot Be Resolved

If moisture problems in a house are so severe they cannot be resolved under existing allowable health and safety measures and repair allowances, agencies must explain to the client that weatherization measures that could make the situation worse (e.g., attic and wall insulation and high-efficient furnace installation) cannot be done until the moisture and mold situation is remedied by the client (or landlord). In this case, the Weatherization Deferral form must be completed. Weatherization measures that will not disturb the mold or exacerbate the existing moisture problem will be completed.

2075 Additional Moisture Information

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TABLE 18

Amount of Moisture Produced by Different Sources in the Home	
Source	**Moisture Produced**
One person breathing	3 pints per day
Washing dishes	½ pint
Shower or bath	1 pint / 10 minute shower
Mopping 150 sq. ft. floor	4 ½ pints
Cooking (family of 4)	1.2 pints
Burning kerosene or propane (unvented)	7.6 pints / gallon burned
Wet crawlspace	Up to 80 pints per day
Clothes dryer (vented indoors)	5 pints per load
One pint can increase relative humidity by 8% in a 1500 square foot home	

Water vapor is carried in the air. For any volume of air, the amount of water vapor present depends upon the temperature. Warm air can hold more water vapor than cold air. The amount of moisture that air can hold, relative to the maximum it could possibly hold at a given temperature, is called relative humidity. Relative humidity can be measured in homes with a hygrometer. Humidity should be set between 30 and 40 percent in the winter. When outdoor temperatures drop below 0° F., humidity levels can go to 20 percent humidity and still be comfortable, but special health problems may need higher humidity levels.

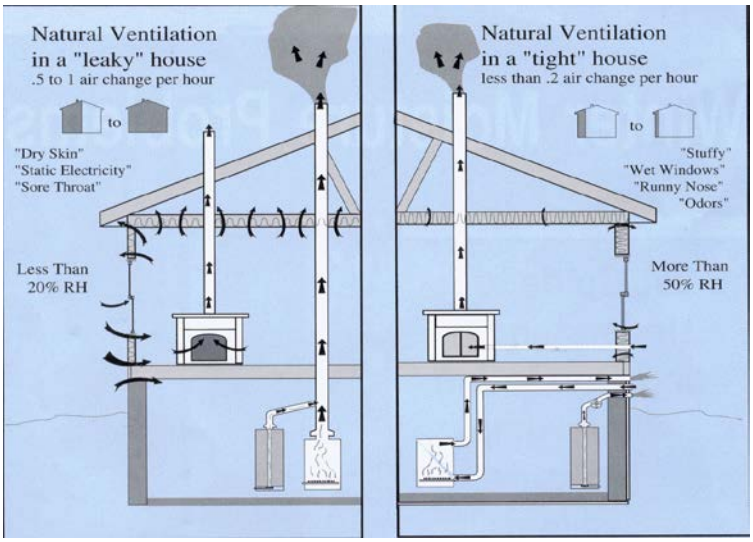
Because air tightening may cause an increase in relative humidity, Energy Auditors should educate the client about moisture problems and possible solutions.

The underlying reason for high humidity is the reduced amount of outside air circulation through the structure. The amount of air moving into and out of a structure is called natural ventilation. The amount of this ventilation is affected by temperature, wind speed, leakage area and open combustion devices, so it is always changing.

Figure 24 shows a comparison of a leaky house and tight house. The leaky house has an air change rate of .5 to 1 air change per hour (ACH). The tight house has an air change rate of less than .2 ACH.

The wintertime humidity level present in a home is the difference between the indoor moisture load and the natural ventilation rate's ability to remove it. Generally, "leaky" homes have higher natural ventilation rates and lower indoor moisture levels. "Tight" homes have lower natural ventilation rates and higher indoor moisture levels. The recommended ACH for a house is .35, or a third of the air change per hour, according to the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). To determine if a house is too tight, see Section 2080 Ventilation Limits.

FIGURE 24

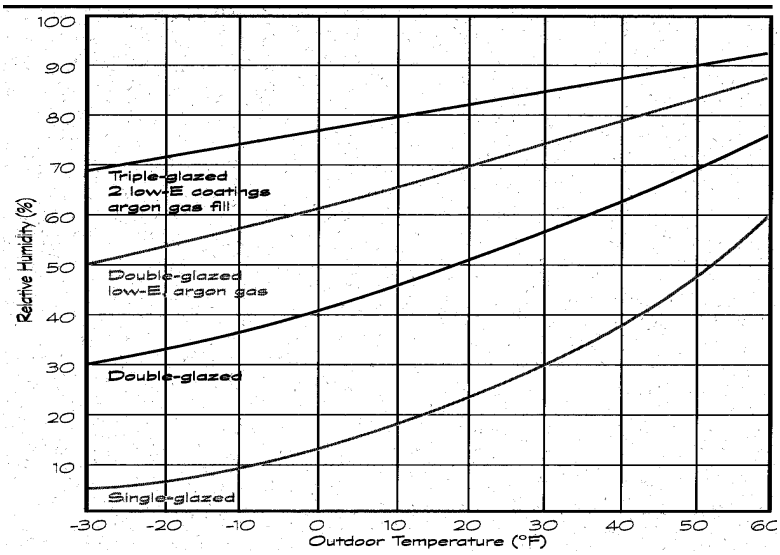


Moisture, staining, or mold often indicates evidence of condensation on windows and walls. This graph shows condensation potential on the center of glass area (the area at least 2.5" from the frame/glass edge) at various outdoor temperature and indoor relative humidity conditions. Condensation can occur at any points that fall on or above the curves. Note that the thermal conductivity at the edge of a window is generally higher than at the center of the glass. For example, insulated glass with a low-e coating and argon gas may tolerate 61 percent humidity at 0º, but the edge may show signs of condensation at only 26 percent humidity.

U-Factors
(Approximates from National Fenestration Rating Council)

Description	Approx. U.-factor
Triple-glazed, 2 low-E coatings, argon gas fill	0.32
Double-glazed, low-E, argon gas	0.37
Double-glazed	0.52

Single-glazed 1.10



Source: Lawrence Berkeley National Laboratory

2076 Existing Mold *SWS 2.0111.2c*

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In some homes, moisture will condense on cold spots of exterior walls and ceilings resulting in mold growth. Molds are a type of fungi. Other fungi include mushrooms and yeasts. Their roles in nature are to biodegrade and recycle dead matter. They secrete digestive enzymes into their surroundings, and then absorb the digested material to fuel further growth. They can live on a wide variety of substances, including organic material, such as leaves, mulch and wood or building materials such as drywall, ceiling tile, vinyl flooring, wood, particleboard, and carpet. The key ingredient for mold growth is moisture.

Mold produces tiny spores that are like small seeds. Spores can be released and carried by air and water to new locations. It is important to realize that mold spores are present everywhere, in outside air as well as indoor air. Every day, people are exposed to airborne mold spores from outdoor sources, sometimes at high concentrations. Mold spores drift through the indoor and outdoor air continually. When spores land on a damp surface that has food and oxygen available, and if the temperature is right, they will start to grow. When excessive moisture or water accumulates indoors, mold growth will often occur, particularly if the moisture problem remains undiscovered or un-addressed. There is no way to eliminate all mold and mold spores in the indoor environment (mold is everywhere). However, the amount of indoor mold can be controlled by controlling indoor moisture.

The presence of mold in a dwelling does not mean workers or the occupants will have any health effects from it. There are no action thresholds established by regulatory agencies. Individuals have different sensitivity to mold exposure. Most people are not affected by exposure to mold unless they are exposed to high concentrations of it. Those who do have an allergic reaction to mold may only have “cold-like” symptoms such as a runny nose, congestion, cough, and itchy eyes. Although there is documentation of severe health effects of mold in humans, most of the problems are derived from ingestion of contaminated foods or in agricultural settings where inhalation exposure was very high. Such high-level exposures are not expected to occur while performing weatherization work.

Exposure to mold will more likely result in severe reactions in persons with the following medical conditions.

- Decreased immune function
- HIV/AIDS
- Respiratory problems

- Asthma
- Emphysema
- Severe allergies
- Persons having undergone recent surgery
- Infants less than 12 months old
- Other serious health conditions

It is very important to document all existing mold/mildew and Red Flags. Good documentation can prove that mold was pre-existing in a home and that weatherization did not cause it.

The Health and Safety Assessment Findings Form should be used to document Red Flags or existing mold/mildew. Agencies must also document existing mold and serious Red Flags with pictures which must be maintained in the house file.

The following Red Flags, used to identify situations that are favorable for mold growth in a home, are items an Energy Auditor should look for and document during the assessment of the home.

Visual:
- Evidence of water penetrating the home (stains, moist areas).
- Evidence of conditions that might allow water in the home (poor grading, bad flashing, bad/missing gutters).
- Actual construction defect or deterioration that allows water into the home (roof, decks, windows, concrete slabs, lack of vapor barriers).
- Plumbing defects (leaking drains, pipes or toilet seals, missing caulk on sinks or tubs).
- HVAC problems (dirty, moist filters, poor condensation drainage).
- Dryer vented indoors, inadequate ventilation for a kitchen, bath, or other high moisture area.
- Any source of condensation.
- Visible mold-like substance growth.

Human senses:
- If the Energy Auditor or the client thinks there is a musty odor, there may be mold present.
- If the Energy Auditor or the client feels a room has a damp atmosphere, there may be conditions for mold-like substance growth.

If the clients complain of allergy-like symptoms in a specific area of the subject property, this could be associated with mold and should be considered a red flag.

The following areas must be checked for mold/mildew: bathrooms, kitchen, laundry area, basement walls, crawlspace, attic, and ceilings next to exterior walls.

Agencies should develop a plan to remedy mold/moisture problems. If existing mold covers more than 30 square feet per affected area, agency management must review and approve the plan. Solutions allowed by the program are described in Section 7000. Spending limits in regard to the above moisture problem solutions are described in the *Iowa Weatherization General Appendix*.

If the Energy Auditor determines that the moisture problem cannot be satisfactorily eliminated, weatherization work will not be started and the house will be deferred.

WX Worker

Clean Up

If the work can be completed without disturbing mold/mildew, cleanup is not required, but may be completed at the discretion of the Energy Auditor within the program cost limits. If cleanup is completed, the following cleanup procedures must be followed. These procedures for the remediation of building materials that contain mold-like substances or will likely contain mold-like substances are from the U. S. Environmental Protection Agency (EPA) and New York City Department of Health Bureau of Environmental and Occupational Disease Epidemiology. The procedures are designed to protect the

health of the occupants and cleanup personnel during remediation. These procedures are based on the area and type of material affected by water damage and/or mold-like substance growth. Visual documentation, such as pictures of the red flag situations, should be taken before and after the remediation process and kept in the client file.

Spending limits for cleanup are described in the *Iowa Weatherization General Appendix*.

Non-porous (e.g., metals, glass, and hard plastics) and semi-porous (e.g., wood and concrete) materials that are structurally sound and visibly moldy can be cleaned and reused. Cleaning can be done using a detergent solution. Porous materials (e.g., ceiling tiles, insulation, and wallboard) that can be cleaned can be reused. Some porous material cannot be cleaned and should be discarded.

<u>Small Isolated Areas (10 sq. ft. or less per affected area)</u>
Recommended personal protection:

- Respiratory protection (e.g., N95 disposable respirator), gloves, and goggles.
- The work area should be unoccupied.
- Containment of the work area is not necessary. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the case of children less than 12 months old, persons recovering from recent surgery, immune suppressed people, and people with chronic lung diseases (e.g., asthma, severe allergies).
- The mold-like substance should be cleaned with a detergent solution.
- Discarded material should be put in a sealed plastic bag. There are no other special requirements for the disposal.

<u>Mid-Sized Isolated Areas (10 – 30 sq. ft. per affected area)</u>
Recommended personal protection:

- Respiratory protection (e.g., N95 disposable respirator), gloves, and goggles.
- The work area should be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the case of children less than 12 months old, persons recovering from recent surgery, immune suppressed people, and people with chronic lung diseases (e.g., asthma, severe allergies).
- The work area should be covered with plastic sheets and sealed with tape before cleaning to contain any dust or debris.
- Misting surfaces (to suppress dust) should be done prior to cleaning.
- The work area should be HEPA vacuumed and the mold-like substance should be cleaned with a detergent solution.
- Discarded material should be put in a sealed plastic bag. There are no other special requirements for the disposal.

<u>Large-Sized Isolated Areas (30 – 100 sq. ft. per affected area)</u>
Recommended personal protection:

- Respiratory protection (e.g., N95 disposable respirator), gloves, and goggles.
- The work area and areas directly adjacent to the work area should be unoccupied.
- The work area should be covered with plastic sheets and sealed with tape before cleaning to contain any dust or debris.
- Heating/cooling system registers in the work area should be sealed with tape or other material.
- Misting surfaces (to suppress dust) should be done prior to cleaning.
- The work area should be HEPA vacuumed and the mold-like substance should be cleaned with a detergent solution.
- Discarded material should be put in a sealed plastic bag. There are no other special requirements for the disposal.

<u>Extensive Areas (greater than 100 sq. ft. per affected area)</u>
Personnel trained in the handling of hazardous materials should do the clean-up.

2080 Ventilation Limits

STANDARD
Two different building tightness limits are required. One is called the minimum ventilation level (MVL) and the other is ASHRAE 62.2. An additional test is the depressurization tightness limits (DTL). The DTL is to test for back drafting appliances. The OTL is a comparison between MVL and DTL to assure the CFM_{50} is not too low.

SWS 2.0299.1a-i;

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Purpose
The MVL is expressed as a CFM_{50} value; making it easy to determine whether the dwelling achieves a minimum ventilation level for infiltration work.

The purpose of DTL is to establish a CFM_{50} minimum, below which the back drafting of conventionally vented combustion appliances is likely to occur.

The purpose of ASHRAE 62.2 is for pollutant source control and defines acceptable ventilation levels.

Documentation
Document results on the Client Home Energy Audit.

When Required
MVL, DTL, and most current ASHRAE 62.2 are required on every home. The most recently adopted ASHRAE 62.2 will be used when determining ventilation requirements**.**

Test Procedure
General Procedure MVL
- Calculate the MVL before weatherization work begins. The MVL is a CFM_{50} estimate that is used as an infiltration guideline. The MVL is 10% of the house volume.

Depressurization Tightness Limit (DTL)
If the dwelling has atmospheric vented combustion appliances, the Depressurization Tightness Limit (DTL) must be calculated before weatherization work begins.

The DTL calculation establishes a CFM_{50} minimum, below which the back drafting of conventionally vented combustion appliances is likely to occur. This limit provides a guideline for air sealing activities.

The use of the DTL should never be used as a substitute for performing the worst-case draft test procedure.

The DTL is independent of the MVL; each must be calculated independently and the greater of the two for a particular dwelling must be used as the Overall Tightness Limit (OTL).

Calculation Procedure
Use the DTL program in the ZipTest Pro 3™ software package loaded in the TI-89 calculator or RED Calc to calculate the dwelling DTL.
- In the ZipTest Pro 3™ software package, select the program “DTL”.
- Select a solution for “CFM_{50}”.
- Measure the actual flow of existing exhaust fans. Then enter the total effective flow for all other appliances that cannot be measured. Include any appliances that are not yet installed, but will be during weatherization work. For example, include the CFM exhaust rate of an electric or gas dryer that

is not vented to the outdoors now, but will be vented as part of weatherization work. Refer to **Error! Reference source not found.**able 19 for guidance.

- Select and enter the appropriate building depressurization limit based on Table 20. If more than one appliance is located in a CAZ, use the lowest magnitude building depressurization limit for the existing CAZ appliances (for example, -5 Pascal is a lower magnitude than -15 Pascal).
- Enter the appropriate flow exponent for the house. If the actual flow exponent is unknown, enter the default value, 0.65.
- The ZipTest Pro 3™ software calculates the CFM_{50} tightening limit for combustion safety, the Depressurization Tightness Limit. Use this as a low limit to house tightening. For example, if the DTL is 1600 CFM_{50}, instruct the crew/contractor not to tighten to below 1600 CFM_{50}.

Remember, the DTL is a pre-weatherization guideline only. It must never be used to replace the worst-case draft test procedure.

TABLE 19

ESTIMATED EXHAUST POTENTIAL			
Devices	Approximate Duct/Flue Size (inches)	Typical Rated Flow CFM	Effective Flow CFM
Bathroom and range hood fans	3 3¼x 10 4 7 8	85 85 106 212 318	53 53 64 127 223
Exterior mounted kitchen fans	10 10	424 636	297 445
Clothes dryer	4	85-127	106
Central vacuum			117
Jenn-Air or similar range or counter-top /ext.vent	5 6 3¼ x 10	800 800 800	300 500 600
Wood-burning Fireplace			300
Open wood stove			65
Airtight wood stove			50
Atmospheric or induced draft, gas, oil, or propane appliances (water heaters, boilers, furnaces)	3 4 5 6		21 38 47 72

TABLE 20

Building Depressurization Limits for Various Appliance Types (Used to calculate the Depressurization Tightness Limit)	
Appliance Type	Building Depressurization Limit, Pascal
Atmospheric water heater (orphaned)	-2

Atmospheric water heater and furnace	-3
Atmospheric furnace or boiler	-3
Oil or gas unit with power burner	-3
Induced draft appliance (fan at point of exit at wall)	-15
Direct-vent appliances	-50

Overall Tightness Limit (OTL)
The Overall Tightness Limit (OTL) is simply the larger of the Minimum Ventilation Level (MVL) or the Depressurization Tightness Limit (DTL). Crews should do their best not to tighten below the OTL.
However, there are circumstances when a crew will tighten below the OTL, either knowingly or unknowingly. This might happen when:

- Adding insulation, especially to walls, lowers the whole house CFM_{50} by a large increment, making the house tighter than either the MVL or the DTL. Walls must always be fully insulated, even if the crew knows that the building will become "too tight".
- Indoor air quality problems warrant the tightening of the building to below one of these limits, for example, air sealing a wall between a house and an attached garage lowers the CFM_{50} to a value less than the MVL or DTL.

2081 Energy Recovery Ventilation (ERV) *SWS 3.1602.4a; 6.6102.1 6.6102.2; 6.6202.2a-g, i-k*
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The installation of ERV's is new to Iowa Weatherization, therefore, prior to installing an ERV, the agency is to submit a proposal to the DCAA which includes the reason for installation, cost justification, and why it is the most feasible alternative.

ERV's installed must:

- Have a plastic core.
- May not have or need an electric element or a drain for defrosting the unit.
- Be able to transfer both heat and humidity.
- Be rated by the Home Ventilating Institute (HVI).
- Be sized by ASHRAE 62.2.

The units' installation should be necessitated by depressurization/drafting problems caused by exhausting appliances and the cost-effectiveness of the available measures to remedy the problem.

The unit is to be easily accessible to allow the client to perform necessary maintenance on the unit. The ERV should not be installed if it is unlikely to be maintained.

Record the efficiency percentage and CFM flow setting for reporting in WAMS.

Manufacturers' information for installation, maintenance, warranty, and any other pertinent information is to be left with the client. The client is to be educated concerning maintenance and operation of the controls.

The Ventilation and Your Home form must be completed and provided to the client.

WX Worker

Follow manufacturer's installation instructions.

A hole no greater than a 1/4" greater than the fitting will be cut to accommodate intake fitting.

Collar will be at least the same diameter as the duct; if collar is larger than duct, a rigid metal transition will be used.

Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable.

Intake fitting will be labeled "ventilation air intake".

Occupant will be instructed to keep yard debris and other contaminants clear of the intake.

The damper will be installed to open in the direction of the desired flow. A backdraft damper will be installed between the energy recovery ventilator (ERV) and the exterior, unless the system operates continuously. Ensure fasteners do not inhibit intake damper operation.

Outdoor air intakes and exhausts will be equipped with automatic or gravity dampers that close when the ventilation system is not operating.

Damper will close when system is off.

Duct to intake fitting will be connected and sealed as follows:

- Round ducts will be mechanically fastened to maintain alignment.
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes.
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool.
- Flexible duct between tie band and end of metal or PVC duct will be screwed into place.
- PVC-to-PVC materials will be fastened with approved PVC cement.
- Other specialized duct fittings will be fastened in accordance with manufacturer specifications.
- In addition to mechanical fasteners, duct connections will be sealed with UL181B or 181B-M listed material.

Air to be exhausted to the outdoors will not be taken directly from the forced air system.

Gaps between registers or grilles and interior surfaces, that define conditioned space, will be sealed.

Sealants will be compatible with their intended surfaces and will be continuous and meet fire barrier specifications.

Supply ducts attached to the return side of forced air systems will be:

- Attached as close to the HVAC system's fan as possible while remaining in compliance with manufacturer specifications.
- Set up to provide filtration of outdoor ventilation air before reaching the HVAC system with minimum MERV6 filter.
- Connected to the intake fitting.
- Connected and sealed in accordance with the supply duct detail.

Exterior termination fitting will be flashed or weather sealed.

Water will be directed away from penetration Installation will not inhibit damper operation.

Manufacturer specifications will be followed.

Corrosion resistant screen, louver, or grille material no less than ¼" and no greater than ½" hole size in any direction will be used, or as specified by authority having jurisdiction.

Screen will be installed so it does not inhibit intake damper operation.

Air flows will be measured and adjusted to match to the system's intent.

Intake will be installed according to the following:
- A minimum of 6" from grade.
- A minimum of 10' from contaminant sources or exhaust outlets.
- Above local snow or flood line.
- A minimum of 18" above an asphalt based roof.
- Never on a flat roof.
- As required by authority having jurisdiction.
- Air intake and exhaust ducts to and from the ERV are to be insulated to R-8. Rigid metal ducts are preferred with as few elbows as possible.
- Intake and exhaust inlets and outlets must be a minimum of 10' apart.
- If an air intake is located in the kitchen, it must be at least 10' away from the cook top or oven.
- Air intakes are to be located away from driveways, and laundry and furnace vents.
- Grilles installed are to be neat in appearance.

Occupant will be educated on how and when to change filter and clean drain pan, if applicable, according to manufacturer specifications.

2090 Mechanical Ventilation

STANDARD
Effectively move the required volume of air as determined by prescribed testing procedures providing healthy living environment for the client.

SWS 2.0401.1c; 2.0404.3e; 6.6002.1a-e; 6.6003.1a-l; 6.6003.3; 6.6003.3; 6.6202.1;

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2091 Ventilation Systems for Acceptable Indoor Air Quality
The most current ASRHAE 62.2 adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter), Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, shall be used for the installation of ventilation systems, both local ventilation and whole-building ventilation. This ASHRAE standard is for building of three stories or fewer. This standard does not apply for buildings with four or more stories.

New fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are generated.

Existing operable fans that will remain in place and serve as part of the ventilation system shall be measured for CFM airflow. This airflow shall be recorded on the appropriate form.

Inform the client of the importance of using the kitchen exhaust fan while cooking and using the bathroom exhaust fan after showers or baths. A ventilation system guide designed for the occupants (non-professionals) to explain why the system was installed and how to operate and maintain the system is to be distributed. Controls shall be labeled as to their function, unless that function is obvious (such as on-demand bathroom exhaust switches).

Manufactured Homes *SWS 6.6003.3; 6.6003.6; 6.6205.1*
- Mechanical ventilation for manufactured homes should meet the requirements.
- Clearance of the fan based on size and for adequate head clearance must be considered.
- Power source must be determined adequate.

- Consideration will be given to:
  - Adequate head clearance
  - Vent termination location
  - Amount of space for duct run
  - Roof condition
  - Type of roof (e.g., shingle, bow string, flat, etc.)
  - Duct insulation
- Fan must be secured to a structural component.
- Structural integrity of the manufactured home will be maintained.

The client must sign the 2-part NCR Ventilation and Your Home form attesting to the fact that they have been informed about the importance and proper use and maintenance of the installed ventilation devices. This form is supplied by the DCAA.

2091.01 Bathroom Ventilation (ducted and through the wall installation) *SWS 6.6002.1a-e; 6.6002.3b; 6.6003.1a-i*

- Should have on-demand fans that exhaust at least 50 CFM and are controlled by an on/off switch or a time-delay-shutoff switch; or
- Should have continuously operating 20 CFM fan.
  - A continuously operating bathroom fan or a programmed intermittently operating fan may serve as the whole-building ventilation.
- If a bathroom does not have this amount of ventilation stated above, it must be provided, or Appendix A of most current adopted ASHRAE 62.2 must be used for sizing whole-building ventilation.
- Installed fans must have a back-draft damper at the fan and at the duct termination.
- The duct termination must be outdoors.
- Fan flows of existing bathroom fans that are to be left in place must be measured or the flow rate shall be determined by the fan label according to most current adopted ASHRAE 62.2 requirements (see most recent adopted ASHRAE 62.2, Section A4.2).
- Dehumidistats may not be used in bathrooms.

2091.02 Kitchen Ventilation (ducted and through the wall installation) *SWS 6.6002.1a-e; 6.6002.3b 6.6003.1a-I; 6.6005.2*

- On-demand exhaust fan:
  - Should have on-demand fans that exhaust at least 100 CFM and are controlled by an on/off switch.
  - The fan may be located anywhere in the kitchen, but a range hood or a fan location near the range is preferred.
- Continuously-operating exhaust fan:
  - Should have continuously operating fan that exhausts at least 5 ACH based on kitchen volume. A continuously operating kitchen fan or a programmed intermittently operating fan may serve as the whole-building ventilation.
    - A continuously operating kitchen fan or a programmed intermittently operating fan may serve as the whole-building ventilation.
- If a kitchen does not have the amount of ventilation stated, it must be provided, or Appendix A or ASHRAE 62.2 must be used for sizing whole-building ventilation.
- Kitchen fans to be installed must be rated for use in the kitchen or installed to manufacturer's specifications.
- Installed fans must have a back-draft damper at the fan and at the duct termination.
- The duct termination must be outdoors.
- Fan flows of existing kitchen fans that are to be left in place must be measured or the flow rate shall be determined by the fan label according to ASHRAE 62.2 requirements (see ASHRAE 62.2, Section A4.2).
- Outdoor make-up air should be provided for kitchen fans in accordance with most current adopted ASHRAE 62.2 requirements.

NOTE: Most current ASHRAE 62.2 (Section A4.2 Airflow Rating) adopted by authority having jurisdiction or adopted by the State of Iowa (whichever is stricter).

If airflow ratings do not exist or the duct sizing requirements of ASHRAE 62.2, Section 5.4 cannot be verified, the airflow rate shall be measured. The alternative procedure in Section 5.4 (using the airflow rating at 0.25 in. WC (62.5 Pa)) may not be used. But, if airflow ratings for the existing equipment are available at 0.1 in. WC (25 Pa) but not at 0.25 in. WC (62.5 Pa), those values may be used, provided they are reduced by 25%.

Exception: The airflow rating, according to ASHRAE 62.2, Section 7.1, at a pressure of 0.25 in. WC (62.5 Pa) may be used, provided the duct sizing meets the prescriptive requirements of Table 22 (see Section 2091.07) or manufacturer's design criteria.

2091.03 Garage Exhaust Fans *SWS 6.6003.5a-c*
Garage exhaust fans may be installed in certain cases with state approval.

Ventilation for garages will be exhaust only and provide a minimum installed capacity of 100 CFM of ventilation per vehicle bay and will vent directly outdoors.

Garage exhaust fans will be wired for continuous operation or installed with automatic controls that activate the fan whenever the garage is occupied and for at least 15 minutes after the garage has been vacated.

If a ducted fan (not through-the-wall) is used, measure and verify the minimum air flow and adjust as necessary.

Air leakage between the house and garage will be prevented by sealing and weatherstripping.

Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards.

Exhaust fans and other exhausting systems shall be provided with makeup air or other pressure relief in accordance with the most current adopted ASHRAE 62.2 requirements.

2091.04 Whole-Building Ventilation *SWS 6.6002.3a 6.6003.1a-l; 6.6005.2a-g; 6.6201.1a-c; 6.9901.1*
Whole-building ventilation operating continuously shall be determined by the most current adopted ASHRAE 62.2. RED Calc or similar program will be run at time of audit (using target CFM) and again at inspection (using final actual CFM reading). This will determine whole house ventilation needed. A copy of both tests showing ventilation requirements and program inputs must be in the house file. RED Calc will be run at time of audit to consider what effect estimated tightness will have on the house.

This ventilation may operate intermittently, but
- The CFM airflow must be increased accordingly while the fan is operating. For example, a flow rate of 25 CFM for continuous operation would be increased to 50 CFM for 30 minutes-on/30-minutes-off operation.
- The fan must operate at least once every 3 hours.
- The fan must be controlled automatically.
- The fan control must be appropriately labeled.

- If the bathroom and/or kitchen fans do not satisfy the requirement of 50 CFM and 100 CFM airflow rates, respectively, the most current adopted ASHRAE 62.2 (Alternative Compliance Supplement) must be used when sizing the minimum whole-building airflow rate.
- The whole-building ventilation may be a single exhaust fan; multiple exhaust fans controlled appropriately; a balanced system, such as a energy recovery ventilator; or part of the furnace air-handling system.
  - Local bathroom and/or kitchen exhaust fans are permitted to be part of the whole-building ventilation system.

- The system must be designed to operate during all occupied hours.
- A readily available override control must be provided to the occupant.
- The infiltration credit shall be calculated as part of the inputs in RED Calc or similar program.

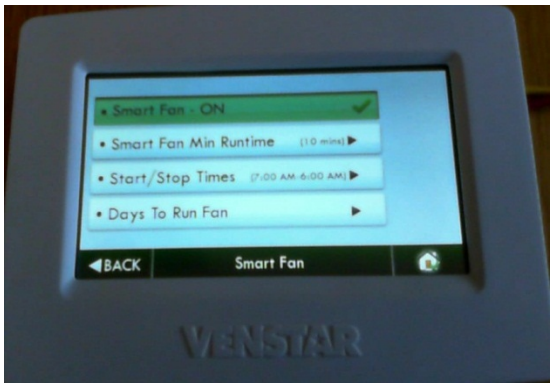
One example of how to utilize the furnace air handling system follows:

ASHRAE 62.2, Section 4.2 allows for outdoor air connected to the return ducts side of the mechanical heating or cooling system for makeup air as long as the manufacturers' air temperature requirements are met (temp. rise).

- Air flow measurements may be done by measuring of the return duct in the location where the outside air duct connection will be installed.
- Air flow then can be estimated using the Table 2 in Section 2022 of the *Iowa Weatherization Work Standards Manual* or using an air flow hood, or other airflow measuring device.
- The supply duct to the return must be a minimum of six feet away from the heat exchanger in the heating system.
- The operating control for the system shall be the heating and air conditioning thermostat. The thermostat must have a smart fan control timer that will turn the blower fan on the heating and cooling system when there is no call for heating or cooling. The Energy Auditor must determine if the client is capable of programming the thermostat.
- This method may be useful for homes that don't require a lot of continuous ventilation. Caution should be taken with homes that have high moisture content with high positive pressures.
- An example of a thermostat with a smart fan control is VENSTAR T5800. Figure 25 shows the thermostat in program mode. Figure 26 shows the thermostat ready to have the Smart Fan programmed.

Figure 25

Figure 26



2091.05 Whole-Building Ventilation, Discretionary Threshold

- If the whole-building minimum ventilation requirement is 15 CFM or less, the Energy Auditor may decide to install a whole-building ventilation system or not. The reasons for not installing a ventilation system when the minimum CFM requirement is between 1 and 15 shall be documented in the client file. This decision shall be based on:
  - The moisture assessment of the dwelling,
  - The indoor air quality assessment of the dwelling,
  - The health of the occupants, and
  - Other factors deemed significant by the Energy Auditor.
- If the whole building minimum ventilation requirement is greater than 15 CFM, a system supplying the minimum ventilation airflow must be installed.

2091.06 Fan Sound Ratings *SWS 6.6288.1a, b*

Fan sound ratings shall be equal to or less than the ratings in Table 21.

TABLE 21

Maximum Fan Sound Ratings	
New Replacement Fans	**Maximum Sound Rating for New Replacement Fans**
Local bath, on-demand	1.0 sone
Local bath, continuous	1.0 sone
Local kitchen, on-demand	1.0 sones Range hoods are exempt
Local kitchen, continuous	1.0 sone
Whole-building (site built and manufactured home)	1.0 sone
Manufactured home kitchen and bath fans	3.0 sones

2091.07 Exhaust Fan Venting *SWS 3.1601.1b; 6.6002.1a-e; 6.6002.2a-g; 6.6102.1; 6.6003.1; 6.6003.3d; 6.6003.5a-c; 6.6002.4*

Energy Auditor/Inspector

Any existing operational kitchen or bathroom exhaust fans must be vented to the outside using proper termination.

If not vented to outside, install rigid (galvanized, PVC, or aluminum) or metal flexible vent duct to a proper termination on outside of the house. Ensure the vent duct is properly sized (see Table 21), insulated with at least an R-8 material and, if possible, covered with the insulation blown into the attic, and is pitched to the outside. The size of the duct must not be reduced from the outlet of the fan. All flex ducts must be installed with minimal sagging.

Do not insulate over an existing fan with a light or heat source that is not Type-IC rated, install damming material around it in the manner described in Section 5014.04.

WX Worker

Ducts outside of the thermal envelope shall be insulated to a minimum of R-8.

Rigid ductwork with a smooth interior surface is recommended over flexible ductwork. Rigid PVC may be used for ventilation ductwork unless local code will not allow.

The radius of turns in ductwork will not be less than the diameter of duct.

Duct support:

- Flexible ducts are to be installed with minimal sag and supported at intervals of 2 feet or less.
- The maximum amount of drop between supports shall be ½ inch per foot of horizontal run or less.
- Supports shall have a width of at least 1 ½ inches.

Duct diameter will be equal to or greater than the exhaust fan outlet. For example, a 4” exhaust can be vented out with a 6” diameter duct and can be reduced back down to 4” diameter duct at termination.

Duct runs shall be as short as possible.

Kitchen fan ductwork shall be rigid, smooth metal of at least 30-guage wall thickness.

Rigid duct requirements:

- Round ducts will be mechanically fastened to maintain alignment.
- PVC-to-PVC joints shall be joined with approved PVC cement.
- Rigid ductwork shall be sized according to Table 22.

Insulated flexible or metal flexible duct requirements:

- Shall not be bent around framing members of other objects.
- Flex duct will be UL 181 listed or Air Diffusion Council approved.
- When flex duct is run through confined spaces, do not reduce the diameter of the flex duct in order to fit it within the space.
- Attach sections of flex duct according to the manufacturer’s recommendations.
- Flex-to-metal or flex-to-PVC joints shall be fastened with tie bands.
- Flexible ductwork shall be sized according to Table 22.

TABLE 22

Prescriptive Duct Sizing

Duct Type	Flex Duct				Smooth Duct			
Fan Rating	50	80	100	125	50	80	100	125
CFM @ 0.25 in. w.g. (L/s @ 62.5 Pa)	(25)	(40)	(50)	(65)	(25)	(40)	(50)	(65)
Diameter, in. (mm)	**Maximum Length, ft (m)**							
3 (75)	X	X	X	X	5 (2)	X	X	X
4 (100)	70 (27)	3 (1)	X	X	105 (35)	35 (12)	5 (2)	X
5 (125)	NL	70 (27)	35 (12)	20 (7)	NL	135 (45)	85 (28)	55 (18)
6 (150)	NL	NL	125 (42)	95 (32)	NL	NL	NL	145 (48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 ft (5 m) of allowable duct length for each elbow.
NL = No Limit on duct length of this size
X = Not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop

2091.08 Duct terminations, exhaust *SWS 3.1601.1b*

- The termination collar shall be at least the same equivalent size as the exhaust fan outlet.
- Termination fasteners shall not inhibit damper operation.
- Exterior termination will be flashed or weather sealed.
- Terminations shall be at least three feet from any property line.
- Terminations shall be at least three feet from any operable opening to a house.
- Terminations shall be at least 10 feet from any mechanical inlet.
- All existing mechanical exhaust ventilation systems should terminate outside the building shell by extending the ventilation duct through the roof, sidewall, foundation, or skirting.
- Installed fans must have a back-draft damper at the fan and at the duct termination.
- Exterior termination fitting will be flashed or weather sealed.
- Water will be directed away from penetration.
- Termination fitting installation will not inhibit damper operation.
- Manufacturer specifications will be followed.

2091.09 Exhaust grille location

- For local bathroom or kitchen exhaust, the fan and/or grille shall be installed in the space where contaminants are generated.
- For whole-building ventilation when other local bathroom and/or kitchen ventilation is present, the grille should be located central location within the main body of the dwelling, or in high moisture areas.

WX Worker

Exhaust fans will be installed and ducted as required by work orders.

A hole no greater than a 1/4" greater than the assembly will be cut to accommodate fan assembly.

Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes.

Fan outlet will be oriented toward the final termination location. Fan will be oriented so the equivalent length of the duct run is as short as possible.

Kitchen exhaust fans will be ducted using smooth wall metal duct.

Fan will be mounted securely in accordance with manufacturer specifications.

A backdraft damper will be installed between the outlet side of the fan and the exterior.

Duct-to-fan outlet will be connected and sealed as follows:

- Round ducts will be mechanically fastened to maintain alignment.
- Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes.
- Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie-band tensioning tool.
- PVC-to-PVC materials will be fastened with approved PVC cement.
- Other specialized duct fittings will be fastened according to manufacturer specifications.
- In addition to mechanical fasteners, duct connections will be sealed with UL Underwriters Laboratories 181B or 181B-M listed material.

Gaps and holes in fan housing will be sealed with caulk or other sealants in accordance with manufacturer recommendations:

- Sealants will be compatible with their intended surfaces.
- Sealants will be continuous and meet fire barrier specifications.
- Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics).

Air flows in cubic feet per minute (CFM) will be measured and adjusted to meet the whole house upgrade design requirements.

Photos or other visual documentation of fans and fan ducting must be available at the agency, preferably in the house file.

2100 Lead Paint *SWS 2.0104.1d; 3.120.1.1a; 3.1201.2a; 3.1201.3a; 3.1201.5b; 3.1202.1a; 3.1202.2a; 3.1202.3b; 3.1203.3b; 3.1302.1b; 3.1203.1a; 3.1203.2a; 4.1001.5; 4.1101.1*

The Iowa Department of Public Health (IDPH) is responsible for applying the notification requirement in Iowa. IDPH has promulgated rules for the application of the EPA notice requirement for Iowa. The IDPH rules are contained in Chapter 69 of the Iowa Administrative Code (IAC). Chapter 69 is titled, “Renovation, Remodeling, and Repainting – Lead Hazard Notification Process.” IDPH officials have told us that the requirements in Chapter 69 of the IAC are at least as stringent as the EPA requirements contained in 40 CFR Part 745. Therefore, the weatherization program only needs to be concerned with compliance with Chapter 69 of the IAC.

Refer to the *Iowa Weatherization General Appendix*.

2110 Slate Siding

Homes with insul-brick or slate siding which require sidewall insulation may only be completed if the siding can be removed and replaced by a contractor who has a current permit from the Iowa Division of Labor. The work must be completed within the General Health and Safety Repair limit. A list of qualified contractors for Iowa can be found at the Iowa Workforce Development website http://www.iowaworkforce.org/labor/asbestos.htm.

Agency crew members may also complete the siding removal/replacement if: The agency has a current permit issued by Iowa Division of Labor; and the individual crew members (who will be working with the siding) have a current license issued by Iowa Division of Labor. This must also be completed within the General Health and Safety Repair limit. A file with all required permits and licenses must be maintained by the agency.

These costs (crew or contractor) must be reported in sequence number 6758 Minor Asbestos Abatement.

Walls may be insulated from the interior if all work protocols including client permission, lead safe confinement and clean up, wall repair (described in Section 5000), etc., are followed and documented in the files.

Siding may not be removed by the client.

This work must be bid out to qualified contractors and contractor files with all required insurance, licenses, permits and trainings, etc. must be maintained by the agency.

If an insul-brick or slate sided house requires wall insulation and the cost to remove and replace the rows of siding will exceed the limit or the interior walls cannot be drilled, all work on that house must be deferred.

The General Health and Safety Repair limit includes several different measures and is a cumulative limit – not per measure.

2120 Unsanitary Conditions

Any unsanitary conditions, including insect pests, animal or bird feces/carcasses or sewage leakage in the work area must be recorded on the Health & Safety Assessment Findings Form.

FIELD GUIDE
Energy Auditor/Inspector

Animal Feces or Raw Sewage
If animal feces or raw sewage are in the way of doing work or pose a health threat to workers, the feces/sewage must be removed by the client before work is begun or continued. If the client refuses to do this, the agency must defer work on the job. This must be documented on the Health and Safety Assessment Form Part 1.

Bird/Bat Droppings
There are some fungal diseases associated with bird and bat droppings. Those are histoplasmosis and cryptococcosis. Histoplasmosis is caused by a fungus that is transmitted to humans by airborne fungus spores from soil contaminated with bird droppings. The fungus is not in the bird droppings but in the soil. The bird droppings just provide a nutrient source for the growth of the fungi. Most infections are mild and produce either no symptoms or minor flu-like symptoms. Fresh bird droppings have not been shown to present a health risk for histoplasmosis.

Cryptococcosis is found in debris around pigeon roosts and soil contaminated with pigeon or chicken droppings. Cryptococcosis infections are mild and usually occur without symptoms.

Unlike birds, bats can become infected with the organism that can cause histoplasmosis. They can excrete the organism in their droppings. However, the incidence of histoplasmosis being transmitted to humans from bat droppings occurs infrequently.

Exposure to bat droppings only pose a risk if the droppings are dry and are disturbed so the spores become airborne and are inhaled. As a precautionary measure, Energy Auditors should wear an NIOSH-certified respirator (an N95 respirator is sufficient) when entering attics until they have had a chance to determine whether bat droppings are present.

If bat droppings are present but will not prevent attic by-pass sealing and attic insulation from being done, work may proceed. However, protective clothing including an NIOSH-certified respirator that can filter particles as small as 0.3 microns, disposable gloves, overalls and boots must be worn. The bat droppings should be misted with water to prevent the spores from becoming airborne.

If the bat feces will prevent attic by-pass sealing and attic insulation from being done, do not do those measures. Do a one-point pressurization test and conduct a pressure test in the attic. With the blower door @ 50 Pascal, if the house to zone (attic) pressure is 45 Pascal or more, other work on the house may be done. If the house to zone (attic) pressure is less than 45 Pascal, defer any work on the house. (A pressure reading of 45-50 Pascal would indicate very little by-pass leakage, thus other work could be done to the home without concern about the by-passes not being sealed. A reading of less than 45 Pascal indicates there is enough by-pass leakage to possibly be a problem. Therefore, all work on the house should be deferred.)

2130 Electrical Safety

Correcting electrical wiring problems is generally not an allowable weatherization measure. Wires are inspected to ensure they are not bare or frayed. Service boxes are inspected to ensure they have secure covers.

FIELD GUIDE
Energy Auditor/Inspector

Fuses and breakers are inspected to ensure they are properly sized. If it is determined a hazardous situation exists, the problem must be corrected before weatherization work is started. Program funds may be used to correct minor electrical problems but spending must be within the General Health and Safety Repair cost limits. A Department of Public Safety appropriately licensed electrical contractor will be used to perform electrical work needed to correct a problem.

Electrical hazards will be eliminated and inspected in accordance with NFPA 70 National Electric Code.

Knob & Tube Wiring
Unless prohibited by local codes, S-type fuses must be installed in homes having knob and tube wiring, to provide over-current protection. If S-type fuses will not work because of overloaded circuits, a new service panel must be installed and the house brought up to code. Agencies may use either General Health and Safety Repair funds (within limits) or the pilot project described below to complete this work.

Pilot Project
Program funds may be used up to $5,000 to either replace the service panel and bring the house up to code OR replace the knob & tube wiring. The $5,000 must include the cost of the permit and inspection fees. If the work will be more than $5,000, another source of funds must be used. These other funds may include client contribution, HUD, USDA, Habitat for Humanity, local housing trust funds, etc.

Agencies will be required to submit a plan to DCAA indicating total cost of the project, amount covered by other funds if necessary, source of other funds, and amount of program funds required to complete the job. If approved by DCAA, HEAP funds will be allocated for that job.

Manufactured Homes
Known electrical problems may be corrected within the General Health and Safety Repair program spending limit.

- If manufactured home has aluminum wiring, it must be inspected and determined to be safe by a licensed electrician. Aluminum wiring can be a fire hazard if it is corroded, lose or exposed. Take special care when working in a manufactured home with this type of wiring.
- Frames of home sections will be bonded with copper wire.
- Bonding lug will be selected to prevent corrosion due to dissimilar metals.
- Homes will have a four-wire service entrance to the panel box to ensure a wiring system that is nominally rated at 120/240 volts and allows for proper grounding.
- Grounding at the service entrance will be checked to determine proper grounding of the home.

- In units that are receiving insulation measures, electrical wiring and the electrical circuit breaker/fuse box must be assessed for adequacy as follows: #12 aluminum or #14 copper wiring must be protected with 15 amp fusing or breakers.
- Care must be taken to ensure the electrical wiring was not damaged during insulation work. This can be done by testing electrical outlets and switches following completion of work.

2140 Section reserved

2150 Suspected Asbestos

2151 Friable Asbestos

STANDARD
Weatherization measures will not be installed if they will disturb suspected friable asbestos.
SWS 7.8102.2a

FIELD GUIDE
Energy Auditor/Inspector
Clients will be provided with the Asbestos in Homes handout anytime materials with presumed asbestos are present in the house. The handout can be found on the Members Only page of www.weatherization.iowa.gov . Minor asbestos removal, such as asbestos tape on furnace ductwork and on boiler pipes, is allowable under the General Health and Safety Repair limits described in the *Iowa Weatherization General Appendix* and must be performed by a licensed asbestos abatement contractor. Minor asbestos removal is the minimum amount necessary in order to perform weatherization work.

2152 Slate-Sided Dwellings see Section 2110

2153 Vermiculite

STANDARD
If vermiculite is found in a home, there is no way to tell if it contains asbestos without testing it. If an agency is not willing to collect a sample to test for asbestos, the agency may hire an outside contractor to collect the sample.

FIELD GUIDE
Energy Auditor/Inspector
Vermiculite has been used as an insulating material in some homes. Much of the world's supply of vermiculite came from one mine in Montana. Because this mine had a natural deposit of asbestos, the vermiculite collected from the mine may be contaminated with asbestos.
EPA and OSHA regulations define asbestos containing materials as material containing more that 1% asbestos. Therefore, if the test results show the vermiculite sample contains 1% or less asbestos, the vermiculite is considered to be non-asbestos containing material and the attic or walls can be insulated.

Vermiculite testing may be completed at laboratories that are accredited by either the National Voluntary Laboratory Accreditation Program (NVLAP) or by the American Industrial Hygiene Association (AIHA) Laboratory Accreditation Industrial Hygiene Program (IHLAP) for the Field Testing (FOT) of polarized Light Microscopy.

If vermiculite is in the walls:
- If vermiculite is present in the house, operate the blower door in pressurization mode.
- If test results show there is asbestos in the vermiculite, do not insulate the walls. Operate the blower door in the pressurization mode. Other work may be done on the home.

If vermiculite is in the attic:

- If vermiculite is present in the house, operate the blower door in pressurization mode.
- If the test results indicate there is no asbestos in the vermiculite, do attic air sealing and insulate over the existing vermiculite.
- If the test results indicate there is asbestos in the vermiculite:
  - Operate the blower door in the pressurization mode.
  - Attic by-pass sealing should not be completed nor should the attic be insulated.
  - To reduce the risk of moisture problems in the attic, the attic must be properly ventilated. If needed, add ventilation to ensure one (1) square foot of venting for every 300 square feet of attic. This is necessary because the by-passes are not sealed.
  - Other energy efficiency measures and health and safety measures may be done.

2160 Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) are widely used as ingredients in many household products, such as paints, varnishes, fuels, and many cleaning, disinfecting, cosmetic, and hobby products. These products can release the organic compounds as vapor when they are used and, to some extent, when they are stored. Formaldehyde is a volatile organic compound found in many building materials and household products, such as new carpets and plywood. These products release the organic compounds over time. Organic compounds sometimes have adverse health effects on people. Because of the potential for adverse health effects, local agencies must take this into consideration when determining air tightness limits of dwellings and whether installing ventilation may be needed.

2170 Radon

STANDARD
To complete all measures without increasing occupant exposure to radon and possibly reduce occupant potential exposure to radon.

FIELD GUIDE
Energy Auditor/Inspector
Radon abatement is not an allowable activity under the program. Where there is a previously identified radon problem in a home, work that may exacerbate the problem should be limited.

Houses with previously identified radon problems should not be left with an increased negative pressure in the contaminated area than existed before weatherization work began. This is determined by setting the house up in worst-case. Section 2041 describes worst-case testing methods. Major radon problems should be referred to the appropriate local environmental agency

2180 Building Structure

STANDARD
Provide a safe and stable work environment that will support and sustain work to be performed by ensuring the work area and associated building assemblies are suitable for the proposed work.

FIELD GUIDE
Energy Auditor/Inspector
Weatherization services should not be performed on dwellings whose structural integrity is in question, which could pose a safety hazard to workers, or are in such a state of disrepair that failure is imminent and the conditions cannot be resolved in a cost-effective manner. Minor repairs to stairs, steps, railings, etc., are allowed if necessary to complete weatherization work. For example, broken steps to the basement where the furnace is located may be repaired in order to complete furnace work. Broken boards on the front porch away from the door may not be repaired because it will not interfere with

weatherization work. Minor repairs made to remedy the issues are allowed within the Incidental Repair expenditure limits.

2190 Animals

STANDARD
Provide a safe and stable work environment.

FIELD GUIDE

Energy Auditor/Inspector

If there is an animal in the house or on the house grounds that is menacing, or if a worker is uncomfortable being around the animal, require the client to restrain the animal before proceeding with any work. If the client refuses to do this, defer work on the house. Document this on the Deferral Documentation Form.

Any bite from an animal, particularly a wild animal, should always be considered a potential for rabies exposure. If a worker is bitten by an animal, the worker should immediately and thoroughly wash the bite wound and then seek medical care. If a worker is bitten by a bat, an attempt should be made to kill the bat without destroying the head. The bat should be placed in a cloth or plastic bag and then shipped under refrigeration to the nearest health laboratory for examination for rabies. Any animal bite should be reported to the appropriate local agency personnel.

WX Worker

If there is an animal in the house or on the house grounds that is menacing, or if a worker is uncomfortable being around the animal, require the client to restrain the animal before proceeding with any work. If the client refuses to do this, contact the agency.

Any bite from an animal, particularly a wild animal, should always be considered a potential for rabies exposure. If a worker is bitten by an animal, the worker should immediately and thoroughly wash the bite wound and then seek medical care. If a worker is bitten by a bat, an attempt should be made to kill the bat without destroying the head. The bat should be placed in a cloth or plastic bag and then shipped under refrigeration to the nearest health laboratory for examination for rabies. Any animal bite should be reported to the appropriate local agency personnel.

2200 Refrigerants

STANDARD
To prevent reuse of inefficient equipment and components and to protect the environment from hazardous waste.

SWS 7.8001.1c

FIELD GUIDE

Energy Auditor/Inspector

Refrigeration appliances that are replaced must be disposed of according to the environmental standards in the Clean Air Act (1990), Section 608, as amended by the Final Rule, 40 CFR 82, May 14, 1993. The party recovering the refrigerant must possess an EPA-approved Section 608 Type II license or an approved universal certification.

WX Worker

Appliances replaced by new units will be recycled or disposed of in accordance with federal, state, or local regulations.

SECTION 3000 FIELD EVALUATION

3010 OVERALL BUILDING SHELL

The energy audit and inspection of a home involves several equally important activities. The first activity involves the health and safety assessment where existing or potential health and safety problems are identified. A second activity involves the energy efficiency assessment, where energy savings opportunities are identified, with the help of a computerized energy audit. The third activity, and one that should be done throughout the entire energy audit process, involves communicating with the client. Good communication with the client can help the Energy Auditor identify existing or potential health and safety problems, comfort issues, and weatherization opportunities. It is also a good opportunity to provide energy education to the client.

It is highly recommended that pictures are taken of existing furnaces, water heaters, refrigeration appliances before and after weatherization. It is strongly recommended that photo documentation is taken of problem areas before, during, and after weatherization measures are installed.

All on-site weatherization workers, including Energy Auditors, crews, contractors and Inspectors are expected to follow OSHA safe work practices as well as any practices spelled out in these standards.
SWS 2.0100.1

3011 Recommended Energy Audit Procedures
The following is a summary of procedures Energy Auditors should follow when evaluating homes. Section 2000, 4000, 5000, and 6000 provide more detailed information on required tests, documentation, etc.

These procedures are NOT to be considered all inclusive. Every house is different and Energy Auditors might find unusual situations not addressed here. When auditing a house, it should be emphasized to new Energy Auditors, to take one step at a time. Solve each task or problem as you get to them and don't try to do them all at one time.

1. Upon arriving at the house and property, while walking to the door, scan the house and surrounding area for anything that may cause a deferral situation such as "For Sale" signs, extensive remodeling, etc.

2. Introduce yourself and briefly discuss the energy audit procedure and approximate length of time procedure will take.

3. Throughout the energy audit process, be aware of existing or potential health and safety problems (electrical, CO, drafting problems, leaks in gas lines, unsanitary conditions, etc.) and Red Flag situations (mold, moisture problems, plumbing defects, evidence of water penetrating the home, etc.). The Health & Safety Assessment Forms Part 1 & 2 and the Client Home Energy Audit are to be completed throughout the energy audit process documenting health and safety problems and red flags. Take pictures of the problems/red flags to document that they were pre-existing conditions. (Section 2010)

4. Walk through the house to review the arrangement of rooms (makes it easier to draw the house from the outside). Also check for any problem areas that will need to be dealt with or possibly cause a deferral situation. (Section 1027)

5. Obtain client signature on the Release of Liability Form: Release of Liability and Waiver of Claims and any other forms required by the agency. (Section 2010)

6. Ask about number and location of refrigerators and freezers. Plug in the meters to the refrigerators and freezers. Write down make, model number, etc. of each appliance.

7. Outside the house
   - Proceed outside and draw each side of the house. Start at the front, far left of the house (side facing the street or road) and continue to the right each time (counter-clockwise).
   - Move to the right around the house to look at the windows (also measure them for NEAT) and number each one (this will help keep track of the windows), as well as each door; foundation (look for cracks and drainage problems); measure the length of the walls; check for any roof, gable & soffit vents; note siding type; and look at the gutters for any problems. Record size, type, glazing type and existing storm windows. Also record type and condition of all exterior doors. If there are grade entrance doors, one must be made airtight, preferable the lower door. Do this on all four sides. Note any Red Flags according to the health and safety forms, such as drainage problems, gutters, or lack thereof.
   - Go back around the house with a digital camera and take pictures of the house and any particular problems the crews/contractors need to address. Looking at everything again may bring something to your attention that was missed the first time around.
   - Check sidewalls for insulation by either drilling a pilot hole on the outside of the house or by removing an outlet cover on the interior of the house.
   - Document any incline in the yard or obstructions which would require special ladders or other safety equipment. Determine appropriate measures needed to assure worker safety.
   - **MANUFACTURED HOMES**
     - If the home has an installation deficiency that may affect worker safety, corrections must be made before beginning work.
     - Structural problems affecting insulation measures must be corrected prior to installing insulation.
     - Belly rodent barrier must be repaired if insulation will be installed or if significant air leakage is occurring.

8. Inside the house
   - Go back in the house and start with the very first window and go the same direction as on the outside. While looking at the windows and doors, also look for any other concerns, such as, holes in the walls, lowered or suspended ceilings that may need to be looked above (missing plaster, holes in lath, leaking areas, etc.), and any other problems that may need attention.
   - Look in the attic or attics for amounts and kinds of existing insulation for required work to be done. Measure any kneewall, slants, and attic areas to calculate required insulation. Check for by-passes in both the kneewall and attic areas (such as floor joists, rafter runs and open stud runs). Note all attic accesses and required treatment. Obtain a sample of vermiculite if existing.
   - Note any exhaust fans and dryers and whether they are adequately vented outside.
   - Note the location and condition of the main service entry box. Note if it is properly mounted in the appropriate location. Determine the type and amp rating of the main service box. This information should be available on the main service box. If the Energy Auditor determines that a hazardous situation exists, the client must correct the problem before weatherization work is started.

9. Proceed to the basement and/or crawlspaces. Check band joists and crawlspaces for needed insulation and vapor barrier. Also check outside basement doors and basement windows. While doing this, look for any problem moisture areas caused by outside water or inside plumbing problems. Measure the basement and crawlspaces for area and height for the NEAT audit.

10. Check the water heater and furnace.

11. Take pictures of the furnace and water heater and all problem areas that may need attention.

12. Document the type and size of combustion appliances. Record model number, serial number, Btu's, type of furnace (forced-air, boiler, etc.), etc.

13. Document the volume of the CAZ and whether there is adequate combustion air. (Section 2022)

14. While downstairs, count the number of supply air registers. Proceed upstairs and look for all of the supply and return registers, ensuring they are open and unobstructed. Note any supplies and returns in the CAZ.

15. Set up the house in worst case scenario. (Section 2041)

16. Test furnace for CO, draft, static air pressures, fan on/off, and temperature rise. Test the water heater for CO, draft and spillage. The order of testing the water heater and furnace will be determined on-site based on whether the appliances are induced-draft or atmospheric burning. (Section 2042)

17. While the furnace is on and running, check all the supply registers for airflow. Perform room-to-room air pressure testing if needed. (Section 2048.01)

18. Check all gas lines for leaks, drip legs, proper flex lines, and shut off for each appliance.

19. Check oven for CO. (Section 2043)

20. Set up the blower door in the exterior door that is easily accessible and has the fewest restrictions in front of it (restrictions, such as, basement doors, small entry hallways, etc.) and outside of it (restrictions, such as, enclosed porches, etc.).

21. Run hoses to any attics, kneewalls, garages, etc. to be tested.

22. Test supply runs or returns that may be run through an area outside of the thermal boundary.

23. Calculate the MVL and DTL to determine the Overall Tightness Limits (OTL) using procedures in Section 2080.

24. Install or note any required lighting and water heating measures.

25. Document the meter readings and duration of readings (minimum 2 hours) for the refrigerators and freezers. Run the readings through the TI-89 or utilize the look-up chart. If any appliances need to be replaced, complete the Client Refrigeration Appliance Agreement. (Section 6011)

26. Finish completing the Health & Safety Assessment Findings Forms Part 1 & 2 and the Client Home Energy Audit Form.

27. Install CO and smoke alarms if required. (Section 2060)

28. Collect all gauges and equipment. Ensure the water heater and furnace is returned to normal operating condition.

29. Review the energy audit with the client. Explain what the program can do and tell the client why the program cannot do the other things the client wants done.

30. Give the Lead Poisoning Pamphlet to the client and obtain their signature on the sheet showing they received it (if the agency distributes the pamphlet).

31. Obtain client signatures on all state and agency forms. State forms include: Client Home Energy Audit, Lead Paint Notification, Health & Safety Assessment Forms, Part 1 & 2, Release of Liability Form, Deferral Documentation Form if necessary, and the Client Refrigeration Appliance Agreement if necessary.

32. Answer any further questions the clients may have and give them a business card. If possible, give the client an approximate time when the work may be completed. Explain that an inspection of the work will be done and to call with any questions.

3012 Recommended Inspection Procedures

1. Look at the house from the exterior as approaching the door to get an idea of attic locations, sidewall insulation, chimney locations and general layout of the house (porches, overhangs, potential kneewall locations, foundation types, etc.).

2. After introduction to the client, ask about materials installed, furnace work done, and if the client had any problems with the work done or not done. Also ask if any insulation came in anywhere. If there are suspended ceilings, ask the condition of the ceiling above and if any repairs were done to it. The upper ceiling should be visually checked.

3. Determine the thermal or air boundary of the home. If different from the Energy Auditor's determination, try to ascertain why, giving benefit of the doubt to the Energy Auditor. If the thermal boundary is not air-sealed and insulated it must be corrected. If the Energy Auditor clearly made the wrong choices, it must be corrected. If the Energy Auditor extended the thermal boundary beyond what is necessary (i.e., heating a porch for plants or animals, or a double ceiling) it should be noted and corrected if possible.

4. During the inspection process, always be looking for any hazardous situation as well as health and safety problems. This would include wiring, plumbing, mold, ventilation, and other issues. Determine whether a smoke alarm or CO alarm should be installed. The dryer needs to be checked to ensure it is properly vented to the outside. Confirm that all exhaust fans, both new and existing, are in working order. New exhaust fans must meet the sone requirement.

5. Inside the home
   - All measures installed must be according to standards.
   - Verify materials installed including light bulbs and appliances.
   - If new appliances were installed, verify they are working properly and the client is satisfied.
   - All areas of the house must be visually checked for holes in ceilings and walls. Leakage of any holes can be checked at the time of the blower door test.
   - The client's comments about any insulation coming into the home should be taken into consideration at this time and any other comments about air coming into the house should also be checked.
   - While walking around the home with the blower door operating, you should feel the registers for air movement. Pan pressures should be checked whenever there is a possibility that they are over 1 Pascal.
   - Verify that registers are open to the house and not covered. Check rooms for returns. Check baseboards to see if exterior walls were used as return ducts. If the house has a central return, room pressures must be checked.
   - Make note of construction details that might be linked to attic by-passes to be checked when the attic.
   - The windows and doors of the home should be checked for major leakage or safety problems.

6. In the attic
   - Check the attic for insulation. Note depth, level and consistency throughout the attic with all heated areas being insulated.
   - Insulation barrier is to be around all potential heat sources with a two inch clearance.
   - Recessed lights are to be boxed around with drywall and a lid installed. If the box cannot be built, metal insulation shielding or damming material should be used around the recessed light.
   - Existing exhaust fans should be shielded unless they are Type-IC rated.
   - Ducts from exhaust fans need to be checked to make sure they go to the outside and are installed and insulated to standards.
   - If there is ductwork in the attic, it should be sealed and insulated.
   - Slopes of attics are to be dense packed. If they cannot be dense packed, they need to be hard sealed at the top and bottom or at least from either the top or bottom if both cannot be done.

- Check the by-passes noted on the audit and during inspection walk through. All by-passes must be sealed or dense packed.
- Any chimney that passes through the attic must be inspected to make sure it is intact. If the brick around a liner terminates in the attic, the opening between the liner and brick must be sealed with proper materials.
- In attics that have been insulated, the insulation certificate from the bag must be filled out by the installer and attached to a rafter or the box of the attic access so it is clearly visible from the attic access. An empty bag must also be left in the attic, where it is clearly visible from the attic access. One certificate for each differently treated attic (left in individual attic). Cantilever floors and walls do not require certificates.
- A barrier is to be installed securely around the attic access door unless the slope of the roof does not allow it. This barrier must remain secure and solid as the Inspector goes in and out of the attic.
- Most attic doors need weatherstrip. Caulking the access door shut is only permitted if there is another entrance.

7. In the basement
   - Fiberglass insulation must be applied according to standards (snug fit in bandjoist box, proper size and complete).
   - Crawlspace insulation must be complete and meet standards (snug fit in the box, secured in place and at least 2 feet on the ground).
   - Vapor barrier must be installed according to standards.
   - Crawlspace vents are to be sealed, closeable or have removable covers.
   - If the floor is insulated, the batts must be unfaced fiberglass, secured in place or dense-packed cellulose.
   - Any heat ducts in unheated areas must be sealed and insulated.
   - Grade doors or exterior basement doors are to be built according to standards.
   - Foundations are to be as tight as possible to minimize the need for duct sealing and to eliminate infiltration.
   - Check for allowable repairs for moisture problems.

8. Combustion appliances
   - The furnace must be visually inspected to ensure the blower and burners are clean.
   - Other work performed by the furnace contractor must be verified and inspected.
   - Check for signs of carbon in the flue opening.
   - Backdraft and CO tests must be completed on all combustion appliances in accordance to the standards under worst case conditions.
   - All required tests must be run (temperature rise, static pressure, spillage, etc.).
   - Any client comments about furnace problems should also be checked.
   - Check for gas leaks.
   - Check for adequate volume of combustion air.
   - New furnaces must meet the same standards as existing and meet code requirements (local codes or the United Mechanical Code). All replacements must meet Iowa Weatherization Standards as well. There are a few standards that are unique to Iowa Weatherization: The unit must be installed ¾" off the floor; there must be a fused switch on or within 24" of the furnace; a filter rack must be outside of the furnace cabinet with a cover; and, the old unit must be removed. The new furnace must be properly sized. The same tests performed on existing units, must also be run on new units.
   - Visually inspect the duct system for large openings and disconnected ductwork. Large openings, holes and open return registers must be sealed. The cold air drop should not have any sign of insulation in it. If it does, ascertain the origin of the insulation.
   - Duct pressure testing must be completed with the blower door at 50 Pascal and no pan pressure on the supply and return duct should be greater than one with the basement closed to the outside and interior door to the basement open (unless there are ducts that are totally inaccessible).

- Whenever possible, ducts are to be in the heated thermal boundary. Ducts in unheated areas are to be insulated (i.e., garages, attics or unheated crawlspace).
- With the furnace air handler running, the basement WRT outside should not exceed +/- 5 Pascal with baseline subtracted. When there is a central return or a suspicion of high room pressures, the room pressures must be checked with reference to the main body with the air handler running. The room pressures WRT main body must be less than 3 Pascal.
- Pipe wrap is to be proper size and secured. It must be 3" away from flue and draft hood unless the unit is power-vented.
- New installation of water heaters must meet all codes and standards.
- While inspecting the furnace and water, the flue must be checked to make sure they are connected, in good condition and secure. The chimney must be inspected to make sure it has no opening into the basement.

9. Blower door testing is required, including garage leakage tests if there is an attached or tuck-under garage. The target house to zone leakage is 200 CFM for attached or tuck-under garage. The garage leakage test results must be reported in the database. When the blower door is used, zone leakage testing can be done to ascertain the by-pass leakage or tightness in the basement and/or attics. The standard for leakage in these areas is 200 CFM for the total leakage path. If the leakage in the attic is high, by-passes should be checked again. It could create a moisture concern in the attic if the air barrier is the roof rather than the ceiling. If moisture problems exist and by-pass leakage is significant, more by-pass sealing should be done.

10. A CO alarm must be installed in houses with combustion appliances or attached or tuck-under garages. This includes houses with a buffer zone (such as a breeze way) between the house and garage.

11. Outside the house
    - Wall insulation should be checked to make sure it is dense packed and complete. The infrared camera should be used to check wall insulation. Use the infrared prior to using the blower door as air currents around windows and doors can be misleading concerning the insulation. Using the blower door with the infrared will help find air leakage sites and by-passes. If there are questions about what you are seeing with the camera, test holes should be drilled to make certain there are problems with the insulation. Pressure points are to be dense packed. There should be no lifting of carpet or other flooring caused by air coming into the rooms. If holes are drilled in the siding, they should be neat in appearance and in a level line with a minimum of three (3) holes per 8' stud cavity. Drilling the siding should be a last resort. Removing siding to insulate is preferable. Removed siding needs to be properly reinstalled and neat in appearance. There should be no structural damage that will allow moisture into the walls.
    - Check the exhaust terminations, dryer vent termination, furnace and water heater venting.
    - Check attic ventilation.
    - Check structural condition of the exterior wall.
    - Check for cracks in the foundation.
    - Check any newly installed wood. New wood is to be painted or varnished, unless it is pressure-treated wood.

12. Client needs to be informed about any new appliances in the home. The operation of the new furnace, water heater and/or refrigerator might require some explanation to the client. The thermostat may also need to be explained. The reasons for using the exhaust vent may need to be explained. When possible the furnace filter should be looked at with the client. They should know how to replace the filter and the size that is needed.

13. The client final inspection sign off needs to be completed. If available leave information concerning agency contacts. Also leave any printed energy savings tips.

14. Remember – we are to leave the house in better condition than when the job was started.

3020 NEAT/MEHA AUDITS

- The computerized National Energy Audit (NEAT) must be completed for all homes and multi-unit dwellings of less than 5 units.
- The computerized Manufactured Homes Energy Audit (MHEA) must be completed for all manufactured/mobile homes.
- The agency must use the NEAT/MHEA Audit version authorized by the State.
- The agency must have copies of the Input and Recommended Measures Reports in the client file.
- Instructions for installation and navigation of the audit are contained in the National Energy Audit Manual developed by the Oak Ridge National Laboratory.
- Refer to the *Iowa Weatherization General Appendix* for NEAT/MHEA Audit procedures.

3030 INFRARED CAMERA PROCEDURES

- The infrared camera should be used as a tool like pressure diagnostics. It may be used to show contractors/crews areas where they may have missed insulation. When the camera indicates an area is missing insulation, the Energy Auditor/Inspector should visually verify the empty cavity prior to sending a crew or contractor back to the job.
- The camera should be used to troubleshoot problem jobs and look for missed key junctures. The camera should also be used in conjunction with an infrared thermometer and a blower door.

Using a Blower Door with the Infrared Camera

- The ideal technique for finding hidden air leaks in a building is to use a blower door along with the infrared camera. This procedure usually involves performing two infrared scans from the interior of the building; one before turning on the blower door and one after the blower door has been depressurizing the building for 5 to 10 minutes and drawing air in through the leaks. As long as the air being sucked in through the leaks is either warmer or colder than the interior of the building, the area surrounding the leakage path will change temperature and show up on the infrared video display screen.
- Even if there is little temperature difference between the inside and outside of the building, an infrared scan may still be possible if the attic space has been warmed from solar radiation on the roof or the crawlspace has been cooled from the ground. A temperature difference of about 5 to 10 degrees is sufficient to expose the important leaks. Significant leaks are often found without having to enter the attic or crawlspace by using this technique.
- Note: Pressurizing the building and inspecting from the outside can also be useful.

SECTION 4000 GENERAL HEAT WASTE

4010 AIR SEALING / INFILTRATION

In order to prevent air leakage and moisture movement between the conditioned and unconditioned space in chases and open stud runs air sealing is required. The air leaks at the building's high and low points are the more important leaks, because they are larger or because they are under a greater pressure by being located in attics and basements. Infiltration is generally smaller leaks around windows and doors. By separating the leaks into different categories, air sealing and infiltration, a higher priority is given to air sealing than infiltration. Materials used for air sealing and infiltration must conform to Appendix A standards.

SWS 2.0401.1a; 3.1001.1b-d; 3.1001.2a-f; 3.1001.3a-e; 3.1001.4; 3.1002.1a-f; 3.1002.2a-f; 3.1202.3; 3.1005.1; 3.1201.2b; 3.1201.3c; 3.1402.1c; 3.1488.1a-c; 3.1701.1; 4.1001.3a; 4.1001.5; 4.1004.1-5; 4.1006.3; 4.1301.1a; 4.1301.3; 4.1301.4; 4.1301.9;

FIELD GUIDE
Air Sealing
Energy Auditor/Inspector
Document the existence of any penetrations through the attic floor, including:

- Open interior or exterior walls
- Utility penetrations
- Recessed light fixtures
- Exhaust fan housings
- Chase ways
- Chimney chase way

Document any chimneys which do not go through the roof. They must be sealed at the top.

Document the existence and location of kneewall floor cavities, ceiling height changes, stairwells, etc. Figure 1 shows split level air leaks. Figure 2 shows by-passes in the floor, and roof rafter connections.

Document the existence of any tongue and groove ceilings. These ceilings must be backed with a continuous air barrier and permanently sealed.

Document the existence of any whole house fans. The fan must either be disconnected with client permission or removed with client permission and the ceiling area finished matching surrounding area or an insulated box must be built as a cover for these fans during winter weather.

Document existing fiberglass insulation or loose-filled cellulose in sloped areas or rafter runs. These must be sealed at the top and bottom of each cavity, if possible, instead of re-insulating. If both the top and bottom of each cavity cannot be sealed, one or the other must be sealed to prevent convective looping in the cavity. (See Section 5014)

Attic thermal by-passes result in heat loss and must be sealed. Recessed lights may be changed to regular lighting by a qualified electrician to reduce air leakage into the attic. The cost of this would be an electrical repair under the General Health and Safety Repair limit.

Attic by-pass sealing must be verified in the client file by use of photographs taken either by the crew/contractor or other agency staff. Whenever possible, attic by-pass sealing should be checked by the agency prior to the installation of insulation.

FIGURE 1

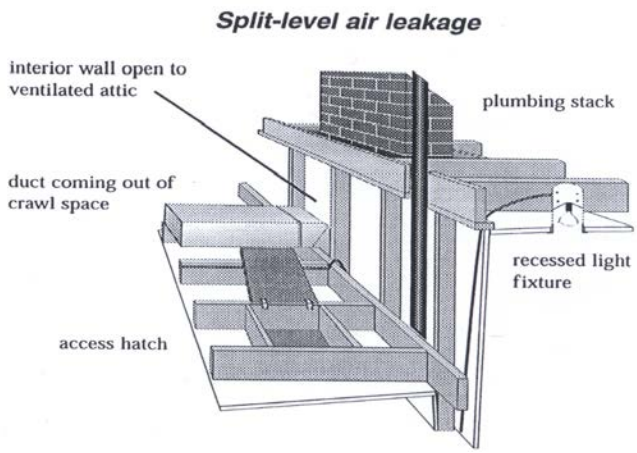


FIGURE 2

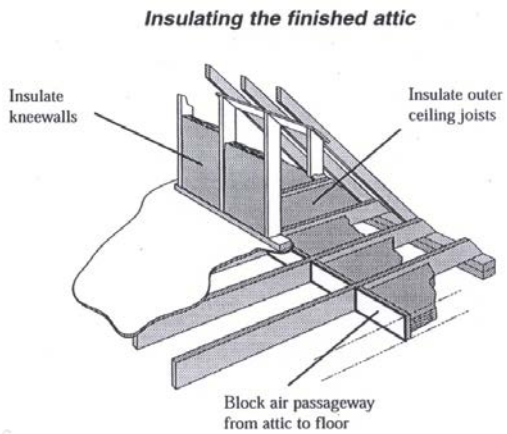


Figure 1 & 2 provided by Saturn Resources

WX Worker

Unfloored kneewalls (outer ceiling joist) shall have at least 36” of dense-packed cellulose insulation in the floor joist area under the heated portion of the floor. An alternative is to seal between each joist at the wall joint with a rigid air impermeable material and seal. The remainder or exposed portion of the kneewall floor shall be insulated as if it were an attic floor according to NEAT. (See Section 5014)

Material used for attic air sealing includes, but is not limited to, rigid foam, liquid foam, sheet metal, dry wall, and caulk. Material used to seal around heat sources include: sheet metal, fire rated liquid foam, and caulk that will withstand at least 400º.

Seal all major attic by-passes such as vent pipes, open interior and exterior wall stud runs, wire penetrations, chimney chase ways, area between brick chimney and flue liner, etc. (check local building codes on chimney chase ways).

Open stud cavities and holes smaller than 6" in diameter shall be sealed with a moisture resistant air impermeable board and caulked or foamed. Fiberglass is not to be used as an air sealing material, but may be used to stuff the top of wall cavities which will be dense-pack insulated. Plastic bags, stuffed with fiberglass, are not an acceptable air sealing material.

Holes larger than 6" in diameter in the attic floor, such as those above bulkheads or open stairwells, must be covered with a material strong enough to support the installed attic insulation; such as plywood, ½" double foil-faced foam board or ¾" or thicker foam board (not bead board). Support materials will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation)

Air sealing materials, such as rigid foam board, must be sealed in place with caulk or non-expanding foam to make them air tight.

When required, an insulated box must be built to cover (during winter weather) an existing whole house fan.

- The box must be built of ¾" plywood deep enough to protect the fan housing and motor from insulation. The box will be continuously weatherstripped to ensure a tight fit.
- Non-compressible insulation equal in R-value to surrounding attic floor will be permanently attached to the top and sides of the box.

Any opening that has a heat source in it must be sealed with caulk that will withstand at least 400º or if the hole is larger than ¼", sheet metal and high temperature caulk or fire rated liquid foam must be used.

Infiltration

Energy Auditor/Inspector

General infiltration measures may be done only if found to be cost effective as determined by the NEAT/MHEA Audit. General infiltration will not be done if the house is below the Overall Tightness Limits (OTL).

Primarily, infiltration materials include weatherstrip, caulking, glazing, mortar mix, and thresholds. The estimated cost for infiltration reduction must be entered in the NEAT/MHEA Audit in the Duct & Infiltration Screen and included in the SIR.

The blower door should be used to assess the problem areas and determine where the greatest need for infiltration reduction exists. The following should be a guide for energy audit.

- Weatherstrip is to be installed on all house-to-garage doors (if none existing) or when there is significant air leakage around the exterior door.
- Thresholds are to be installed when there is significant air leakage at the bottom of a door and a sweep will not work properly or when the exterior door rubs the floor.
- When air leaks are found in walls, ceilings, foundation cracks and attic door casing they must be sealed.
- Skirting should be used when there are many large foundation holes or pieces of foundation are missing.
- Sweeps are to be installed on all house-to-garage doors (if none existing) or when there is significant air leakage at the bottom of a door and a threshold already exists.
- All light fixtures, wiring, plumbing, venting, ducting and gas piping penetrations in an attached or tuck-under garage must be sealed.
- All cracks in house and garage separations wall will be sealed.

Client will be educated on the need to keep door from garage to house closed and not to warm up vehicles or use any gas engine or grills in the garage.

WX Worker

<u>Weatherstrip and Sweeps</u>

- Door weatherstrip
  - All existing weatherstrip is to be removed from the door if installing new.
  - Door trimming and adjustments, including hinge tightening and strike plate adjustments, may be necessary and must be done before installing weatherstrip.

- If available, the color of the weatherstrip should match the color of the jamb.
- Installation is to be in accordance with the manufacturer's instructions.
- Weatherstrip is to consist of a semi-rigid strip with vinyl or neoprene flap. A bulb-type weatherstrip is also acceptable if the bulb is made of siliconized rubber and a minimum of ¼" diameter. A third type that can be used is a tough vinyl tear-resistant skinned material enclosing cellular foam.
- New weatherstrip must form a tight seal, be neat in appearance, and be fastened in such a way as to prevent buckling or gaps.
- A small bead of caulk is to be applied to make the weatherstrip and the door stop airtight.
- Nails or other fasteners are to be made of a non-rust material.
- Staples used for fastening weatherstrip must be at least 9/16" long, 1/8" crown and galvanized.

- Sweeps
  - Sweeps are to be a metal strip with a vinyl or neoprene insert, or a brush type installed with screws on the interior side of the door.
  - Sweeps are to be cut to the same width as the door.
  - Sweeps shall be secured within 2" of the door edge on each end.
  - Sweeps shall have a threshold or carpet bar to seal against.
  - Installation is to be neat in appearance, form an airtight seal and not interfere with the operation of the door.

<u>Thresholds</u>

- Except for lower grade and attic access doors, half thresholds (bumper type) are not to be installed.
- Thresholds are to fit snugly between the jambs and fasten to the sill and the floor with screws.
- All thresholds are to be wood with metal and vinyl insert, unless the work order lists otherwise.
- Thresholds are to be caulked on both the interior and exterior to form a tight seal with the doorsill.
- Thresholds are to be set entirely on the sill or a continuous shim from end to end so no gap exists between the threshold and doorsill.
- All unfinished wood installed is to be painted or varnished to a smooth finish, unless the wood is pressure-treated.

<u>Caulk</u>

- Caulk shall be applied according to the manufacturer's instructions.
- Caulk shall be applied to a smooth, clean, dry surface. Caulk shall be applied in a continuous bead and free of voids, with a smooth and neat appearance.
- All openings 3/8" to 7/8" wide shall be filled to within ½" of the surface with an appropriate packing material specifically manufactured as a packing material, such as closed cell polyethylene rod prior to caulking. All packing material shall be compatible with the type of caulk used.
- Excess caulk shall be removed before it cures.
- Caulk to be used on metal joints or two different materials shall have an elongation rating of at least 200%.
- For interior application:
  - Caulk shall be non-toxic, clear, paintable, or a color complimentary to the surface to which it is to be applied.
- For exterior applications:
  - All exterior cracks or openings wider than ¼" must be packed with a material (flexible polyurethane, oakum, neoprene, butyl rope, or sponge rubber) specifically manufactured as packing or stuffing material. The crack is to be sealed with caulk to make it air and water tight. Any existing loose or brittle material must be removed before caulking.
- Caulking compound conformance
  - Acrylic F.S. TT-S-00230C(ASTM834)
  - Latex ASTM 834-76(1986)
  - Butyl Rubber F. S. TT-S-001657
  - Chlorosulfonated Polyethylene F. S. TT-S-00230C
  - Polyurethane or Polysulfide F. S. TT-S-227E
  - Elastomeric joint sealants (including polysulfide, polyurethane and silicone) ASTM C920-87
  - Oil and Resin Base caulks are not acceptable.

- All caulking compounds must meet 15-year warranty minimum.

Skirting *SWS 3.1488.1a-c*

- 90 lb. Mineral surfaced rolled roofing, or 45-mil. rubber roofing material must be used when skirting the foundation on site-built homes. Other material designed for this purpose may be used when specified by the Energy Auditor.
- The skirting is to be neat and constitute an air-tight seal around the foundation.
- The color of the skirting material is to be white, unless the color of the siding can be matched or complimenting color can be found.
- Where possible, the top of the skirting is to be placed under the siding and nailed. If not, the top of the rolled roofing is to be held in place with 1x2 furring strips and all joints in the roofing are to overlap by a minimum of 6", and be covered with furring strips and sealed.
- All wood installed is to be painted to match the house prior to its installation, unless the wood is pressure-treated.
- The bottom of the skirting is to be dug 4" into the ground or banked with earth to hold it in place.

Glass *SWS 3.1202.1b–d; 3.1202.2b-d*

- Glass shall not be less than "B" grade single strength.
- Glass will be sized 1/8" – 3/16" smaller than opening to allow for movement of frame.
- Glass over twenty-five (25) inches in either dimension shall not be less than "B" grade double strength.
- Glass shall be secured with glazing points (2" from each corner and not more than 8" apart) and puttied with latex or oil-based glazing compound, or sealed with plastic or vinyl glazing strips.
- Glass set in metal frames is to have metal-glazing clips no more than 12" apart and within 4" of each corner and the joint between the two surfaces puttied.
- Safety glass is required in windows located within 12" of a door when the bottom edge is less than 60" above the floor or if panes are larger than 9 sq. ft. when the bottom edge is less than 18" above the floor.
- Safety glass is not required for windows protected with 1½" mullion or guard rail located 2 to 3 feet above the door. It is required in all windows located in entrance doors, in fixed and sliding panels of sliding doors and in panels in swinging doors other than wardrobe doors.
- Safety glass must be permanently labeled.
- Plexiglass may also be used in lieu of safety glass on doors and windows; however, discoloration may occur.

Drywall (may also be a repair cost iN some cases - Energy Auditor decision)

- Only ½" drywall shall be used when installing on entire wall or ceiling (if ceiling joist is on 16" center). If ceiling joist is on 24" center, 5/8" drywall will be used.
- 5/8" Fire-rated drywall must be used over or between a garage and the house.
- Drywall installed on ceilings must be installed perpendicular to the ceiling joist.
- Whenever possible, drywall installed on walls should also be installed perpendicular to the studs.
- Drywall is to be installed using 1¼" drywall screws.
- Screws shall be placed no more than 12" apart on each stud or ceiling joist. Screws shall be countersunk into the drywall without breaking through the paper.
- Metal corner bead is to be installed to all outside corners. Inside corners must be taped with perforated paper tape. If fiberglass tape is used for other seams, be sure to use the proper joint compound to ensure against cracking.
- All gaps wider than ¼" must be filled with a non-shrinking compound manufactured for that purpose prior to taping.
- If installing drywall in order to ready it for wall insulation, one (1) coat of joint compound is to be applied and made ready for a second coat.
- Drywall repairs shall be made with the same thickness material as existing.
- The hole should be squared and a properly sized patch nailed or screwed in place.
- The drywall patch shall receive tape and joint compound and be applied to make a neat patch.

- If repairing drywall due to damage caused by the weatherization crew or contractor, the drywall shall receive three (3) coats of joint compound, textured and painted to return it to its original appearance.
- All work is to be neat in appearance.

Manufactured Homes Infiltration, Air Sealing, Air Leakage Reduction Requirements *SWS 3.1001.4; 3.1101.1a,c; 3.1101.2; 3.1101.3; 3.1202.3; 3.1301.1; 3.1301.2; 3.1701.1; 2.0103.1; 2.0204.1*
Air sealing activities should comply with the mechanical ventilation limit procedures and calculations in Section 2080.

Additional manufactured home specific guidelines are listed here.

- Intentionally ventilated walls will not be sealed at vent locations (weep holes).
- Openings in the ceiling need to be sealed with appropriate materials. Sealing holes and cracks in the ceiling should be considered by-pass sealing and completed even if the blower door is less than the OTL.
- In visible areas sealing material should be similar to the existing material, especially for a large area.
- When accessible, all holes and penetrations in top and bottom plates will be sealed.
- When accessible, sewer and drain vents need to be sealed where they penetrate the ceiling.
- Furnace and/or water heater vents need to be sealed with metal where it penetrates the ceiling.
- Caulk or other sealants should be used for small cracks and blend with surface applied to.
- Air leakage (infiltration) reduction measures shall not be installed when the starting CFM_{50} measurement is below the calculated building tightness limit, except for the following:
  - Ductwork sealing
  - Insulation preparation work
  - Air sealing work that is necessary to block moisture migration into ceilings and walls
- Air Sealing through Bottom Board (underbelly)
  - Patching material will be provided as needed to meet the specific characteristics of the bottom board material and the characteristics of the hole
  - Patch will have a service life of a minimum of 20 years
  - Patching will be provided as needed to meet both the specific characteristics of the bottom board material and the characteristics of the hole
  - Patch will not bend, sag, or move once installed
  - Combustion air supplies will be labeled for identification and will not be blocked or sealed
  - Penetrations will be sealed to meet both the specific characteristics of the bottom board material and the characteristics (hole size and type) of the penetrations (e.g.,, electrical, PVC, gas line, dryer vent)
- Air Sealing through the floor
  - Floor repair material will meet or exceed strength of existing floor
  - Repair will span from joist to joist and blocking added as needed to support floor (patches smaller than 144 sq. inches will not require joist to joist).

Manufactured home skirting installation and/or repair is not an allowable program cost.

4020 Section reserved

4030 WATER HEATER MEASURES

In order to achieve safe and reliable hot water delivery system that meets the needs of the occupant/building management/building operations staff at the lowest possible life-cycle cost, the domestic water heater and pipes will be inspected for possible upgrade. *SWS 7.8101*

4031 Water Heater Turn-Down

Energy Auditor/Inspector

Examine the temperature setting on the gas valve or thermostat. Savings can be achieved by reducing the temperature setting. Consult with the client to determine if the temperature can be lowered to 120°F

without affecting the client's life style. If there is a dishwasher in the home, the temperature should be set at 140ºF. Provide consumer energy education to the client regarding the management of hot water usage.

4032 Water Pipe Insulation *SWS 7.8102.2i*

Energy Auditor/Inspector

Pipe Insulation

Determine if there is insulation present on the hot and cold water lines leading to the water heater. If pipe insulation is not present on the first six feet (6') of the hot and cold water lines, it should be installed (6' on the hot water line and 6' on the cold water line). Do not insulate leaky pipes.

Heat Tape

Heat tape is an allowable program expenditure; it is not however, recommended. If the client does not have heat tape applied or has heat tape that is deteriorated or unsafe, then it is preferable to install new. The agency must obtain the client's permission, in writing, to install the heat tape, an acknowledgement that the heat tape is not permanent, or guaranteed to stop frozen pipes, and the agency is not liable for any damage caused by the heat tape installation. Heat tape is only to be installed outside the structure from the ground to the structure underbelly (under no circumstances should it be installed inside the structure. These general guidelines apply:

- Do not install heat tape on leaking pipes.
- Heat tape should not be used over thermal insulation.
- Instruct the client to check the heat tape at least once a year.
- Check for existing ground fault circuit interrupter receptacle (GFCI). If none, one must be installed.

WX Worker

Pipe Insulation

All material must have a flame spread rating of 150 or less and a smoke density of 50 or less.

All materials used must be capable of withstanding continuous 180° operation.

Pipe insulation must be pre-formed to fit standard pipe diameters and be appropriate for the pipe being insulated. Insulation must be ½" thick.

Insulate the first six (6) feet each of cold and hot water pipe.

Do not cover drain lines, valve handles, or control and safety devices. Water heater pipe wrap that is installed shall not interfere with the temperature pressure relief valve or any other safety devices.

Position slit downward on horizontal pipe.

Insulation must not be compressed or allowed to gap open.

Secure with non-slipping plastic ties. Locate ties 1" from each end and a maximum of 12" between.

Self-adhesive pipe wrap is allowed within set expenditure limits. Non-slipping plastic ties are not required when self-adhesive pipe wrap is installed.

Pipe wrap shall not be installed within 6" of a flue or draft hood, unless the unit is power-vented.

Heat Tape

- In every case follow the manufacturer's installation instructions.
- Install according to instruction. Not all heat tape can be used over plastic pipes.
- Heat tape must be plugged into a ground fault circuit interrupter receptacle (GFCI). Some manufactured homes will have a factory installed GFCI outlet under the home, near the water inlet.
- Start at the plug end, next to the GFCI outlet.

- Use the correct size (length) for the job – do not wrap the heat tape over itself and no 90° bends. Unless the instructions indicate otherwise, the maximum length is 40'.
- Use a laboratory tested heat tape. If installing for a manufactured home, use one authorized for a manufactured home.
- Use only an automatic thermostatically controlled heat tape.
- Run the heat tape along one side of the pipe or wrap the heat tape around the pipe as you go (follow installation instructions for spacing).
- Attach the heat tape according to instructions or if not in the instructions, use electric tape.
- Do not install heat tape on leaking pipes.
- Do not cross the heat tape over itself.
- Try to install the heat tape on all exposed pipe, ending as close to the ground as possible.
- If instructions allow, insulate the pipe and heat tape per instructions.

4033 Low-Flow Showerheads and Faucet Aerators *SWS 7.8101.1a-d*

Energy Auditor/Inspector

Examine plumbing fixtures to determine whether low-flow devices are present. Consult the client to determine whether low-flow devices can be installed in the shower and at sink fixtures. Features will be selected that meet any special needs of the occupant (e.g., shut off, swivel, handheld showers).

WX Worker

Low-flow showerheads shall be rated at a maximum of 2.0 gallons per minute at 80 pounds per square inch. Aerators shall be rated at a maximum of 1.5 gallons of water per minute.

Care must be taken not to mar the finish of the showerhead or any connecting pipe.

Aerators are to be installed finger tight.

Once installed, high-efficiency showerheads or faucet aerators will be tested to determine if equipment is tightened adequately to prevent leakage at the point of connection.

Specific information about proper maintenance of the equipment will be provided to the occupant. Warranty information, operation manuals, and installer contact information will be provided to the occupant.

5000 INSULATION MEASURES

5010 ATTIC

STANDARD
A consistent thermal boundary between conditioned and unconditioned space controls the heat flow. Attic insulation serves to control heat transfer through ceiling. Insulation will be installed to maximum depth allows by NEAT.

5011 Attic Air Sealing
All attic by-passes must be sealed before insulating the attic. (See Section 4010) Photo or other visual documentation must be taken of all work that will be inaccessible or covered over after weatherization measures have been installed (e.g., insulation barrier for heat sources, insulation and by-pass sealing, etc.). Photos must be available in the house file.

5012 Attic/Roof
Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded. For an additional level of protection, the metal coupler on the hose will be connected to a grounding wire. Grounding wire will be connected to the grounding rod.

Energy Auditor/Inspector

EXTERIOR:

- Identify the exterior roofing material type(s) (asphalt shingles, roll roofing, metal, slate, etc.).
- Examine for missing, damaged, or worn surfaces.
- Note obvious damage.
- Examine the building for moisture problems. Note any obvious damage and determine if the weatherization program can repair it or if the damage is beyond the scope of the program.
- Inspect the gutter and downspouts, if present. Determine whether the lack of an effective gutter system is causing moisture damage to the home. This may be remedied using the General Health and Safety Repair funds within program cost limits.
- Note the presence of existing attic ventilation (roof vents, soffit vents, gable vents, ridge vents). Based on minimum venting of one (1) square foot of free airflow for every 600 square feet of attic floor space, determine if additional vents are needed. Natural ventilation may be considered as part of the free airflow.
- Diagram where vents are to be installed and list types. Do not install vents on slate roofs or siding.
- Vents should be installed to allow for high and low ventilation. Soffit vents should be installed as first choice if possible, with gable and roof vents as second choice. Turbine and power vents are not allowed.

HOUSE INTERIOR

- Note any interior plaster or drywall damaged due to moisture from roof leaks. Do not specify insulation where it may come in contact with any moisture until the problem is solved.
- Determine if the circuits are properly fused.
- Note the location and size of any existing attic access, interior or exterior. If there is no access, the Energy Auditor must call for an opening large enough to access. The Energy Auditor must determine where the access needs to be located and get client approval to build it.
- There are two options for insulating walk-up attics. The Energy Auditor will need to make this decision. The first is to install an attic lid at the top of the stairs putting the stairway inside the thermal boundary. The other is to consider the stairway and walls part of the thermal boundary and insulate.
- Note any stored boxes or objects that may obstruct the weatherization work. Consult with the client about removing obstructions. If the client is unable or unwilling to remove the obstructions, determine if it is feasible for the weatherization workers to remove the obstruction and obtain permission from the client.

- Document 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 existence of recessed lighting which will require damming materials or enclosures.

ATTIC INTERIOR

- If attic is not accessible, assume it has no existing insulation and record accordingly.
- Record the type and amount of any existing insulation. If existing insulation is vermiculite, see Section 2153 for procedures.
- Note all voids and areas with incomplete coverage and average the total amount.
- Measure the floor area and enter the area and the amount of existing insulation in the NEAT Audit.
- Note existence and dimensions of any floored attic areas.
- Require additional insulation based on NEAT audit results.
- Note all possible heat sources which will require damming materials. All damming materials must be installed at least 3" from the heat source.
- All damming materials must be higher than the level of the surrounding attic floor insulation.
- Damming material around a heat source must be at least 4" greater than the insulation.
- Note other areas which will require damming materials (e.g., attic access).
- Insulation will not be allowed between the damming and a heat-generating appliance.
- Examine the chimney for soundness. Note all chimney structural problems and inform the client. Minor repairs must be completed by the program.
- All disconnected non-functioning chimneys in the attic must be sealed.
- Examine all metal flues for soundness. Record any loose or disconnected sections for repair. Check stabilizing devices for effectiveness.
- If soffit vents exist, note the presence of existing soffit vent chutes and note how many will need to be installed.
- Note the type of wiring present in the attic.
- Note all exposed electrical junctions and whether they are enclosed in covered junction boxes. Junction boxes must be covered. It is required that a flag protruding from insulation is installed to easily identify the location of a junction box.
- Determine the overall integrity of the wiring and wiring insulation or any other electrical condition which must be corrected before installation of insulation.
- Houses with knob & tube wiring:
  - Must have S-type fuses installed to provide over-current protection. A rule of thumb is to use 15 amp fuses for 14-gauge wire and 20 amp fuses for 12-gauge wire. Explain to the client the importance of properly fused circuits.
  - At agency discretion, a licensed electrical contractor may inspect and certify all K&T wiring to be safe. In those cases, fiberglass and cellulose insulation are acceptable for use in contact with K&T.
  - Live knob and tube, not certified as safe by electrical contractor, will not be covered or surrounded. A dam that does not cover the top will be created using unfaced-fiberglass batt to separate insulation from the wire path.
- Record all electrical devices which will require safety clearance shielding (damming), e.g., recessed lights and vent fans.
- 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 the insulation.
- Inspect the sheathing and rafters for discoloration, mold, or rot. Note the location of any damage.
- Do not specify insulation where it may come in contact with any moisture until the problem is solved.
- If there is existing plumbing running through the attic, it needs to be isolated from the attic as well as possible and insulated.
- Record on the Health & Safety Assessment Form the presence of any animal, insect pests, animal or bird feces that may be in the attic which will pose a health threat. (See Section 2120)

- Determine measures or personal protective equipment necessary to ensure safety of the weatherization workers in the attic. Refer to the Deferral Policy (See Section 1027) if the health threat is severe.
- Do not specify cellulose insulation where it may come in contact with metal roofing. Determine whether fiberglass insulation is appropriate. Blown fiberglass insulation is not to be installed from the interior of the home.
- Document the location of chase ways containing utility runs or ductwork in the sidewalls, if any.
- Document the type of construction, whether it is balloon or platform framing.
- Document with photos problems areas or unusual issues.

Manufactured Homes

- The ceiling and roof condition must be inspected and assessed before installing insulation. Ceilings that appear weak shall be repaired or reinforced within repair cost limits as determined by the MHEA Audit.
- All holes in the ceiling must be sealed.
- Ceiling insulation should be done when determined by the MHEA Audit, unless there are other documented circumstances that won't allow additional insulation.
- Blown fiberglass insulation is not to be installed from the interior of the home.
- Insulation shall be installed only in areas of the manufactured home envelope that separate conditioned from unconditioned space. Insulation measures can only be installed when insulation is included in the MHEA Audit and the cumulative SIR calculation is 1.0 or greater.
- If moisture problems are present in the ceiling, underbelly, or sidewalls, insulation should not be added until the moisture source and/or site of penetration, including leaks, is identified and eliminated.

5013 Attic Access *SWS 3.1002.1a – f; 4.1006.1; 4.1006.2*

WX Worker

5013.01 Pull Down Stairs

Where feasible, pull down stairs shall have a 1"x12" or 3/4" plywood box that is higher than the level of the surrounding attic floor insulation built around them to act as damming for the insulation. The exterior of the damming box must be insulated with 2" rigid insulation or equivalent. The damming box will be covered with a lid made of 1/2" plywood with 1"x2"s on the edges to come down on the outside of the 1"x12" damming. Weatherstrip is to be installed either on the inside of the damming box next to the 1/2" plywood cover or on the outside of the damming box so that the cover box 1"x 2"'s will sit on the weatherstrip. Counterweights should be considered to ease accessibility for excessively heavy hatches.

The back of the lid will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly.

5013.02 Attic Access Hole

Attic hatches rough opening will be surrounded with a durable insulation dam that is higher than the level of the surrounding attic floor insulation. 1"x12's, 3/4" plywood, or particle board shall be used whenever possible for the box of the scuttle hole. The box must be constructed to support the weight of a person entering the attic.

The lid of the attic access hole shall be made of 3/4" plywood, and door stop material with coped or mitered corners used to support the lid.

Access hatch frames will be sealed using caulk, gasket, weatherstrip, or otherwise sealed with an air barrier material, suitable film, or solid material. The access lid will be secured with a latch or lock.

Window casing should be used as trim around the scuttle hole next to the ceiling.

The casing shall be caulked with a small smooth bead of paintable caulking.

The back of the lid will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly.

The insulation must be permanently attached to the scuttle lid. No loose-fill insulation will be installed over an accessible scuttle hole.

New scuttle holes must have a finished opening at least the width of the ceiling joist and be a minimum of 20" long.

5013.03 Kneewall Doors
Kneewall door must be made of ¾" plywood. The back of the lid will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly. The insulation must be permanently attached to the door. The door must be trimmed (including paint or stain) to match the existing window and door trim.

Kneewall door frames will be sealed using caulk, gasket, weatherstrip, or otherwise sealed with an air barrier material, suitable film, or solid material. The access lid will be secured with a latch.

The plywood cover must have the edges rounded, be sanded, finished or painted to match existing trim.

5013.04 Walk-Up Attics Doors *SWS 3.1002.1; 3.1002.2a-f; 3.1002.3a-e*
Door at Bottom of Stairs
There are two options for a walk-up attic access. The Energy Auditor will determine which is to be completed.

- Install an attic lid at the top of the stairs putting the stairway inside the thermal boundary.
- Consider the stairway and walls part of the thermal boundary.
  - Weatherstrip the door and insulate.
  - Dense pack the stairway walls.
  - If back side of stairway is open, finish with ½" drywall and dense pack insulation.

Door at Top of Stairs
- The stairway walls above the level of the conditioned area will be treated as kneewalls and insulated as such.
- Weatherstrip and insulate the door.
- Insulate the ceiling above the stairway as an attic.

5014 Attic Insulation – All types *SWS 4.1001.5; 4.1003.11; 4.1005.2a; 4.1005.3; 4.1005.4; 4.1005.6; 2.0601.1*
Attic Insulation – All types
WX Worker
Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded. For an additional level of protection, the metal coupler on the hose will be connected to a grounding wire. Grounding wire will be connected to the grounding rod.

Photo or other visual documentation must be taken of all work that will be inaccessible or covered over after weatherization measures have been installed (e.g., insulation barrier for heat sources, insulation and by-pass sealing). Photos must be available in the house file.

Insulate attic according to the work order.

Attic insulation is not to be installed in non-repairable attics with water leaks or damaged wiring.

Insulation is to be installed so as to be uniform in depth throughout the attic area and installed in accordance to the R-value of the settle density on the bag. Insulation should be installed to cover the top plate of the outside walls without going into the soffit area. In attics that have been insulated, the insulation certificate from the bag must be filled out by the installer and attached to a rafter or the box of

the attic access so it is clearly visible from the attic access. An empty bag must also be left in the attic, where it is clearly visible from the attic access. One certificate for each differently treated attic (left in individual attic). Cantilever floors and walls do not require certificates.

All ventilation holes are to be cut before the installation of insulation. Whenever possible, the insulation hose should be run through a vent opening rather than through the house.

Screens of existing vents are to be cleaned after the insulation is installed.

Insulation dams and enclosures will be installed as required. See Section 5014.05

Exposed open electrical junctions will have covers installed. All exposed electrical junctions will be marked with a flag to indicate their existence.

Knob & Tube Wiring

Based on work order, attics with active knob and tube wiring may be treated in one of two ways.

- Knob & tube wiring certified safe by a licensed electrician, fiberglass and cellulose insulation are acceptable for use in contact with K&T. The attic may be fully insulated.
- Knob & tube wiring not certified as safe by a licensed electrician will have the wiring isolated. A dam that does not cover the top will be created to separate insulation from the wire path. If the wiring is above the joists, an un-faced fiberglass batt at least 6 inches wide must be installed below the wiring. A dam shall be created using un-faced fiberglass batts at least 14 inches in width and equivalent to an R-38 to prevent attic insulation from covering the wiring. The balance of the attic may be blown to required insulation depth without covering any knob & tube. If the knob and tube wiring goes through the joists, do not insulate below the wiring, just create the dam as described earlier.

Seal all major attic by-passes such as vent pipes, open interior and exterior wall stud runs, wire penetrations, chimney chase ways, area between brick chimney and flue liner, etc. (check local building codes on chimney chase ways). Open stud cavities and holes smaller than 6" in diameter shall be sealed with a moisture resistant air impermeable board and caulked or foamed. See Section 4010 for more information on air sealing.

5014.01 Open Attic *SWS 4.1005.2a – d; 4.1005.3; 4.1005.4*

Cellulose Insulation

Priority is given to cellulose insulation as a recycled material. Cellulose insulation containing ammonia sulfate is not recommended because it will give off an odor if wet. If cellulose cannot be used because of client allergy, weak ceiling, or other reason, fiberglass may be used.

Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier.

All insulation will be installed to the depth indicated on the manufacturer coverage chart for desired R-value.

A signed and dated attic card will be attached to the rafter above the attic access that includes:

- Insulation type
- Installed thickness and settled thickness
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Fiberglass Batt Insulation *SWS 4.1005.2; 4.1005.3a-e*

Fiberglass batt insulation will only be considered in case of a weak ceiling.

If using fiberglass batt insulation, it will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions. Insulation will be installed to the prescribed R-value.

When installing over existing insulation, if the top of the existing insulation is below the top of the framing, new batts will be installed parallel with framing members. If the top of the existing insulation is above the top of the framing, new batts will be installed perpendicular to framing members.

A signed and dated attic card will be attached to the rafter above the attic access that includes:
- Coverage area
- Thickness
- R-value

Client will be informed of type of material and R-value installed.

Blown Fiberglass
Blown fiberglass insulation will only be considered in case of a weak ceiling or manufactured housing.

Blown fiberglass will not be used in site-built homes unless required by the energy audit.

If blown fiberglass is to be installed, the attic access must be closed and hoses run through a vent opening to prevent fibers from getting in the house.
All insulation will be installed to the depth indicated on the manufacturer coverage chart for desired R-value.

A signed and dated attic card will be attached to the rafter above the attic access that includes:
- Insulation type
- Installed thickness and settled thickness
- Coverage area
- R-value
- Number of bags installed in accordance with manufacturer specifications

Blown fiberglass insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier.

5014.02 Floored Attic *SWS 4.1001.5;*
Check for possible heat-producing sources going through the ceiling and the floor. Care should be taken not to insulate over and around heat producing sources when tube insulating attic areas unless using blown fiberglass.

If cellulose is used, it must be dense packed under the floor (3.5 lbs/ft3). Dense-pack insulation must be done by using the tube-fill method if there is existing insulation under the floor. If floorboards are removed they must be reinstalled.

Blown fiberglass will only be installed if required on the work order. Blown fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density of 1.5 to 2 pounds per cubic foot.

The one-inch hole method can be used when there is no insulation under the floor. When using the one-inch hole method, holes are not to be more than 3 ft. apart, and all the holes must be plugged with wood or plastic plugs.

No insulation may be added over the floor of a floored attic.

The first priority with a floored attic is to seal by-passes and dense-pack under the floor. By-passes such as open stud runs must be found and sealed prior to insulating under floored attic. See Section 4010 for more information on air sealing.

If the entire attic is floored, the ends of the joist cavity must be stuffed or sealed to prevent the dense-packed insulation from blowing into soffit area.

5014.03 Kneewall *SWS 4.1001.5; 4.1004.1; 4.1004.2; 4.1004.3; 4.1004.4;*
The un-floored portion (outer ceiling joist) of the kneewall area shall be insulated to the R-value called for by work order. (See Section 5014.01)

Un-floored kneewalls (outer ceiling joist) shall have at least 36" of dense-packed cellulose insulation under the wall and heated portion of the floor. An alternative is to seal between each joist at the wall joint with a rigid air impermeable material and seal. The remainder or exposed portion of the kneewall floor shall be insulated as if it were an attic floor. (See Attic Insulation)

Floored kneewall areas shall be insulated by either removing the necessary number of boards to allow tube-filling or the floor may be drilled with 1" holes every 3' and insulated, using a 1" nozzle, and plugged with wood or plastic plugs. All wood removed for tube-filling, must be reinstalled. (See Section 5014.02)

There are four acceptable methods to insulate wall areas of the kneewall: fiberglass batts, rigid foam or reinforced poly with cellulose, wet spray cellulose or two-part closed cell polyurethane foam. These methods are described below.

Method 1 - Fiberglass Batt
- Wall area shall be insulated with R-11 OR GREATER faced fiberglass batts.
- The batts must be installed so the vapor barrier is toward the winter heated side of the wall.
- Fiberglass batt insulation must be secured using one of two methods to prevent settling or moving.
  - For existing batt insulation: **Strapping or Backing**
    - Wood lath and galvanized nails may be used to hold the insulation in place with a maximum spacing of 18" on center. Twine used to hold the insulation in place must be made of polypropylene, nylon or polyester with a breaking strength of at least 150lbs. and 12" maximum spacing between anchor points.
    - Wire used to hold the insulation must be zinc-coated, stainless or similar corrosive resistant material with a minimum diameter of .035". Wire must be spaced no more than 18" apart. Supports and anchors must be zinc coated, stainless steel or similar corrosion resistant material. Staples for wood lath are to have a ¼" crown. Staples for wire and twine are to have a 3/8" crown and nails are to be galvanized and penetrate the joist at least 5/8".
    - Pre-existing fiberglass batts installed backwards should have the vapor barrier slit if possible.
    - Fiberglass batts may also be backed with moisture permeable materials, such as house wrap, with the label to the outside to allow moisture to escape.
  - For new batt insulation: **Backing**
    - Fiberglass batts must be backed with moisture permeable materials, such as house wrap, with the label to the outside to allow moisture to escape.

Method 2 – Dense Pack Cellulose Using Rigid Foam or Reinforced Poly
- Rigid insulation board material or reinforced poly will be installed to cover 100% of the surface of the knee wall.
- It is then drilled or slit and cellulose is dense-packed into the kneewall stud cavities.
- If foam sheathing is used, sheathing will be listed for uncovered use in attic, or covered with a fire barrier
- Reinforced poly or a material similar to house wrap may be installed to the studs of the kneewall area. The poly will be secured according to manufacturer's specifications or with furring strips on every wall stud before dense packing.

Method 3 - Wet Spray Cellulose Insulation

- When cost effective according to the NEAT Audit and practical, kneewalls may be insulated with wet spray insulation. At the kneewall and floor joist joint and at the kneewall rafter joint, the insulation must form an airtight seal. The insulation must fill the entire kneewall stud cavity. Kneewalls need not be scrubbed.
- Insulation installed must be type 1 (liquid adhesive) and meet ASTM C1149-90 standards.
- Application methods must be CIMA (Cellulose Insulation Manufacturers Assn.) guidelines technical bulletin #3.
- Manufacturer's and supplier's guidelines must be followed.
- Insulation shall not be installed in areas with roof leaks.
- Insulation shall not be installed when it is possible the area insulated will be below freezing within 48 hours.
- Insulation containing only boric acid shall be used. Cellulose insulation containing ammonia sulfate will not be used in wet spray application because when wet, it gives off an ammonia odor.
- Follow the manufacturer's recommendation for water to glue ratio when insulating kneewalls.
- Care must to be taken to avoid getting wet spray insulation on metal surfaces, such as ductwork, gas piping, junction boxes, etc., because of the corrosiveness of the moist insulation. When it does get on metal surfaces, they must be cleaned off.

Method 4 - Two-Part Closed-Cell Polyurethane Foam *SWS 2.0111.4a; 4.1004.5*

Only use if local codes permit

- Manufacturer's guidelines must be followed for recommended use and application, temperature tolerances, shut down procedures and storage.
- Two-part closed-cell polyurethane foam must be rated as Class 1 Fire Retardant.
- Must be installed 2" thick.
- Insulation must be neat in appearance and of a consistent depth.
- When cost effective according to the NEAT Audit, the two-part closed-cell polyurethane foam may be installed at the Energy Auditor's discretion.
- If installed in a confined space, there should be a negative pressure in the area. Follow NIOSH Standards regarding the definition of a confined space.
- Recommend tenants, especially children, vacate the premises while being installed and for one hour after completion.
- Weatherization workers must wear an NIOSH certified respirator as well as eye and skin protection as specified in the product SDS.
- Clean up any overspray or excess of the two-part foam.
- Do not use in areas with knob and tube wiring.

5014.04 Sloped Attics/Flat Roofs *SWS 4.1001.5; 4.1003.2; 4.1003.3; 4.1003.4;*

Dense pack ceiling slants by tightly stuffing with fiberglass or some other stuffing material at either the top or the bottom of each run. Each cavity must be insulated with dense-packed cellulose insulation (3.5 lbs./cubic foot) by tube-filling the cavity. Blown fiberglass material may also be installed to a minimum density of 2.2 pounds per cubic foot.

If the sloped areas have existing fiberglass insulation or loose-filled cellulose, the top and the bottom of each cavity must be sealed, if possible, instead of re-insulating. If both top and bottom cannot be sealed, one or the other must be sealed to prevent convective looping in the cavity. See Section 4010 for more information on air sealing.

Small ceiling areas such as over bay windows or flat roof areas are to be insulated with dense packed insulation. This can be done by drilling or removing the fascia board and tube-filling each cavity. Ventilation is not needed when dense packing flat roofs.

Manufactured Homes

All holes in the ceiling should be sealed.

Blown fiberglass is to be used for the insulation. Average insulation densities for loose-fill fiberglass insulation installed in manufactured home ceiling cavities shall be 1.25 to 1.75 pounds per cubic foot. Cellulose must not be used because weight and moisture absorption.

Ventilation fans may be covered with insulation if all holes and penetrations are sealed with a nonflammable sealant.

Recessed lighting fixtures and fan/light combinations that are Type-IC rated by UL may be covered with insulation.

Fiberglass insulation shall not be installed within 3 inches of metal flues, chimneys, heaters, fans, and lights that are not Type-IC rated.

Combustion appliance vent blocking is required when insulation is installed, except where combustion air is pulled through a combustion air pipe that surrounds the combustion appliance vent pipe (concentric pipe system). Follow manufacturer's recommendation for clearances between vent and combustible insulation.

Ceiling insulation must be installed in such a manner that ensures complete coverage over heated areas.

Attic insulation will not be installed if the furnace draws fresh air from the attic.

Manufactured home ceilings shall not be dense packed or over-filled so as to create ceiling structural problems.

Whenever possible, ceiling insulation is to be done from the outside by lifting the roof from the edge and using the tube method. Insulation may also be installed from the ends.

Exterior insulating may also be completed using the tube-fill method through holes opened in the roof, making all areas of the ceiling accessible by the tube-fill method. This is not the preferred method for insulation manufactured home attics.

If an exterior installation method or side-opening method is used, all roof penetrations and areas of potential leakage must be sealed with elastomeric sealant (when compatible with roof materials), or with other equivalent sealant, as necessary. Areas that are to be patched must be cleaned to the metal roof surface.

Blown fiberglass insulation is not to be installed from the interior of the home.

Some manufactured homes might have a gabled roof constructed over the original one. In this roof-over attic area, the following will be followed:

- Attic space created by the roof-over will be accessed in accordance with the single-family attic access.
- If the roof-over does not allow physical access to the roof-over attic, access to the original attic will be gained through roof venting.
- If existing insulation height in the attic is less than the height of the heel plate (original attic), access will be made through the original roof and the original attic cavities will be filled before blowing insulation over the original roof.
- At a minimum, the access holes to the original attic cavities will be sealed to prevent air leakage.
- If existing insulation height is equal to or greater than the height of the heel plate (original attic), the insulation will be installed in the end cavities before blowing on top of the original roof.
- Access to the end cavities will be gained and insulation will be installed.

- Insulation will not be installed on top of the original roof until the end cavities are insulated and air sealed in original attic.
- If insulation is installed on top of the original roof, it will be installed in accordance with the single-family loose-fill blown insulation installation standard.

5014.05 Damming – Heat Sources *SWS 2.0601.1; 4.1001.3; 4.1003.1; 4.1005.2a; 4.1005.4c; 4.1005.6b;*
Insulation dams and enclosures will be installed as required. Damming material must also be around all heat sources in the attic, such as flue pipes, chimneys, mechanical ventilation (unless Type-IC rated), and recessed lights (unless Type-IC rated) whether insulation is being installed or not. All damming materials must be installed at least 3" from the heat source.

Do not insulate over an existing fan with a light or heat source that is not Type-IC rated; damming materials must be installed around the heat source.

A rigid dam having a height at least 4" greater than the insulation to be installed will be constructed to ensure a 3" clearance between combustion flue vent and dam.

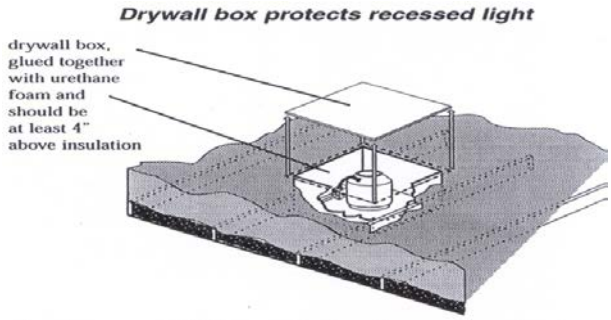
Damming material must be metal that is at least .007" thick, or a nonflammable material meeting local codes.

Damming material is to be permanently attached to the ceiling joist with staples, nails, or screws.

If local codes allow, brick or masonry chimneys that have liners must be sealed, but need not have damming installed around them. If an un-lined chimney goes through the roof and is not in use, damming material is to be installed in case the chimney is later used by the client. Chimneys, which do not go through the roof, must be sealed at the top.
Recessed Lights *SWS 4.1001.1; 4.1003.1; 4.1005.3d;*
A fire-rated air-barrier system (i.e., equivalent to 5/8 fire code gypsum wallboard) will be used to separate recessed lights from insulation. (See Figure 1)
- Provide a minimum 3" clearance between the box and the side of the fixture.
- The box should be constructed to be 4" above the installed insulation and 6" above the fixture.
- Cover the box with drywall lid and seal to sides of box.
- The top of the box is not to be covered with insulation.
- Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only.

If there is insufficient clearance to install the box, use metal material to keep insulation 3" away from fixture. Lay cardboard over damming installed around recessed lights while installing insulation. Be sure to remove it after the insulation is complete.

FIGURE 1



Covering recessed light fixtures with drywall boxes reduces air leakage and allows insulation to be blown around the box. The box should not be covered with insulation.

Figure 1 provided by Saturn Resources

5015 Attic Venting *SWS 4.1001.4; 4.1003.1; 4.1003.3; 4.1088.1*
Although the preferred strategy for attic moisture is prevention through attic by-pass sealing, attic ventilation may be used as a last resort for removing moisture. Relatively dry outdoor air can be used to ventilate attics to remove moisture that accumulates from roof leaks, air leakage from the interior, and vapor diffusion.

All attic ventilation will have screens with non-corroding wire mesh with openings of 1/16" to 1/4" to prevent pest entry (e.g., birds, bats, bees).

Existing vents that are not screened will be covered with non-corroding wire mesh with openings of 1/16" to 1/4".

Gable Vents
New gable vents must be installed with a frame appropriate for the type of siding on the house. Vents must be installed according to manufacturers' recommendations and be neat in appearance.

Gable vents on wood sided houses must be installed with a brick mould frame. The brick mould frame must be installed so the siding butts up to the edge of the frame (the frame does not go over the siding).

The joint between the siding and frame shall be caulked with a paintable caulk and be neat in appearance.

Vents are to be fastened to the frame with screws.

Any siding damaged during vent installation is to be repaired or replaced.
If there is no attic access in the home, a large enough gable vent must be installed with hinges to allow for entrance into the attic.

If there is no sheathing, a 2x4 frame must be built on the attic side of the siding to attach the vent frame.

Roof Vents
Roof vents are to be made of galvanized steel or plastic, with a minimum area of 61 square inches of free airflow.

Roof vent holes are to be cut to close tolerance to ensure the maximum free airflow and water tight fit. Rafters are not to be cut. Roof vents are not to be installed over rafters.

Roof vents are to be installed as high as possible on the roof (bottom edge in line with the 4th course of shingles).

The top edge of the vent must be inserted under the shingles. The sides of the vent should be inserted under the shingles if possible.

Roof vents are to be sealed with tar under the vent and nailed with neoprene washer aluminum nails. Tar should not be visible on installed roof vents or the roofing around them.

Vents are to be evenly spaced and be neat in appearance.

Placement of vents is to be in accordance with the drawings on the work order.

Discarded materials are not to be dropped into the attic area.

The color of the roof vent is to match or compliment the color of the shingles.

Soffit Vents

Soffit vents are to be installed square with the house, evenly spaced and a uniform distance from the house.

Vents are to be screwed to the soffits (staples and nails are not acceptable for installing soffit vents) with the louver opening facing the house.

The hole cut for the vent is to be cut with close tolerance to assure maximum free airflow.

If soffit venting or eave venting is present, soffit vent chutes will be mechanically fastened to block wind entry into insulation or to prevent insulation from blowing back into the attic.

If soffit venting or eave venting is present, chutes will be installed to maintain clearance between the roof deck and baffle in accordance with manufacturer specifications.

Installation will allow for the highest possible R-value above the top plate of the exterior wall.

5020 SIDEWALLS

5021 Sidewall Insulation

STANDARD
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value through dense pack insulation when determined cost effective by the NEAT Audit. Use of cellulose insulation is required unless structural issues are identified. Dense pack insulation is to be installed using a machine with an airlock system and capacity to blow a minimum of 3.5 psi. In order to achieve the required dense pack, cellulose insulation must be blown at 3.5 pounds per cubic foot density (approximately one (1) pound per square foot in a 2x4 wall).

SWS 4.1001.5b; 4.1101.1; 4.1103.1- 3; 4.1101.2; 4.1102.1; 4.1104.1; 4.1104.2

FIELD GUIDE

Energy Auditor/Inspector

Note all types of siding material. Wherever possible, determine the presence and condition of the previous layer of siding or sub-siding. Exterior walls are not to be insulated if they have wood or composition board lap siding with no sheathing. When siding is below-grade, fiberglass insulation must be installed in the wall cavities. Only the below-grade cavities are to be insulated with fiberglass. Note whether siding material contains asbestos or lead paint. If so, determine whether the siding can be safely removed or drilled using Weatherization Safe Work Practices (See the *Iowa Weatherization General Appendix*). It a house has walls which are open (either no plaster/drywall inside or siding outside) the Energy Auditor might consider deferring all work on the house as beyond the scope of the program.

Depending on the application method of installing wall insulation, the Energy Auditor will decide if the siding should be drilled or removed.

Knob & Tube Wiring

Based on work order, walls with active knob and tube wiring may be treated in one of two ways.

- Knob & tube wiring certified safe by a licensed electrician, fiberglass and cellulose insulation are acceptable for use in contact with K&T. The walls may be fully insulated.
- Sidewalls with active knob & tube wiring not certified as safe by a licensed electrician will not be insulated.

Vinyl, steel and aluminum siding which is not under warranty shall be removed. Vinyl, steel or aluminum siding, which is under warranty, may be removed with client written permission. Vinyl, steel, aluminum, etc. siding may only be drilled at the discretion of the client and Energy Auditor.

If siding cannot be removed it may be drilled with written client permission. When using 1" holes, there shall be at least three (3) holes per eight (8') cavity. The upper hole should be drilled at the pressure point in order to ensure good compaction of the insulation in that area. Plugs must be wood or plastic, unless the house is stucco (see below). All plugs used shall be painted to match the siding prior to their installation.

Vertical or Masonite siding may be drilled using either the one-inch method or with a hole large enough to allow the tube-filled dense-pack method.

Stucco siding penetrated from the exterior side of the wall shall be retextured and painted to match the existing stucco on the house.

All insulation installed through the interior side of the wall requires prior written approval by the client. Interior will be masked and dust controlled during drilling when accessing from interior. Shrouds and containment devices are recommended. Blown fiberglass insulation is not to be installed from the interior of the home.

Note any area with exterior moisture damage, including missing or rotted siding or siding with excessive deteriorated paint, or other problems. Note the condition of any exposed structural components for structural integrity. All structural and moisture problems must be corrected prior to insulating the walls.

Document the location of chase ways containing utility runs or ductwork in the sidewalls, interior soffits, wall height changes, pocket doors, drop ceilings, open closets or cabinets, or other construction details.
Wall cavities open to return air supplies are to be sealed so the cavity may be insulated. The upper story returns are to be blocked off. The return air supply is to be routed through the home, and an adequate air supply and a balanced system are required. Return registers in exterior wall cavities on the first floor must be sealed directly above the register.

Determine if the walls are balloon framed. The top of the cavities must be stuffed or sealed if the walls are to be dense-packed. If the walls will not be insulated by the program, the top of the cavities must be sealed. See Section 4010 for more information on air sealing procedures.

Check for the presence of any existing insulation. Look for evidence, such as insulation plugs, of previously installed insulation. Check several test locations. If existing insulation is vermiculite, see Section 2153 for procedures. If there is existing insulation, determine if re-insulating the entire wall or insulating the pressure points would be effective. This is determined by type of existing insulation, the volume of the home and the initial blower door reading.

Note the depth of the stud cavities in order to determine quantity of insulation needed. Calculate the amount of cellulose insulation needed. The calculation should be based on 3.50 lbs./ft^3. Wall cavity depth x .29 = pounds of insulation needed per square ft. of wall space.

Manufactured Homes

The exterior siding and the interior wall materials must be inspected prior to the installation of insulation. Weak or damaged wall materials must be repaired or reinforced prior to installing insulation within program spending limits.

If a manufactured home has aluminum wiring, sidewalls shall not be insulated.

WX Worker

Rigid fill tubes will be made of a material that will not hold an electric charge, such as Schedule 40 PVC Electrical Conduit, or be grounded. For an additional level of protection, the metal coupler on the hose will be connected to a grounding wire. Grounding wire will be connected to the grounding rod.

All sidewall insulation shall be installed through the exterior side of the wall, if possible. The preferred method of wall insulation is tube-fill, dense-pack method. The dense-pack insulation method includes the following steps:

1. Follow lead safe work practices.
2. Lift or temporarily remove the siding to gain access for drilling.
3. Drill 2-to-3-inch diameter holes to access stud cavity.
4. To prevent settling, cellulose insulation must be blown at 3.5 pounds per cubic foot density. This would be approximately one (1) pound per square foot in a 2x4 wall. Blowing cellulose insulation this densely typically requires using a fill tube.
5. Mark the fill tube in one-foot intervals to help the person blowing insulation to verify the correct penetration of the tube into the wall.
6. Starting with several full height, unobstructed wall cavities allows the crew to measure the insulation density. Start with an empty hopper. Fill the hopper with a bag you've weighed. An 8-foot cavity (2x4 on 16-inch centers) should consume a minimum of 10 pounds of cellulose.
7. Plug holes and return siding to original condition. If siding is damaged or destroyed during process, it must be replaced with new siding which matches existing.

If siding must be drilled using 1" holes, there shall be at least three (3) holes per eight foot (8') cavity. The upper hole should be drilled at the pressure point in order to ensure good compaction of the insulation in that area. Plugs must be wood or plastic, unless the house is stucco (see below). All plugs used shall be painted to match the siding prior to their installation.

Vertical or Masonite siding may be drilled using either the one-inch method or with a hole large enough to allow the tube-filled dense-pack method.
Depending on the application method of installing wall insulation, the Energy Auditor will decide if the siding should be drilled or removed.

Vinyl, steel and aluminum siding which is not under warranty shall be removed.

Stucco siding penetrated from the exterior side of the wall shall be retextured and painted to match the existing stucco on the house.

Holes drilled from the interior shall be filled and made ready for the client to paint or finish. Interior will be masked and dust controlled during drilling when accessing from interior. Shrouds and containment devices are recommended. Blown fiberglass insulation is not to be installed from the interior of the home.

When insulating two-story homes with balloon framing, insulation must be dense-packed in second story floors to reduce air leakage.

All cellulose installed in walls must be installed to constitute a dense-packed application. If re-insulating walls, all pressure points must be dense-packed.

If repairing drywall due to damage caused by the weatherization crew or contractor, the drywall shall receive three (3) coats of joint compound, textured, and painted to return it to its original appearance.

If installing drywall in order to ready it for wall insulation, one (1) coat of joint compound is to be applied and made ready for a second coat.

All work is to be neat in appearance.

Slate Siding
Refer to the *Iowa Weatherization General Appendix* for guidelines regarding slate siding.

Manufactured Homes

The exterior siding and the interior wall materials must be inspected prior to the installation of insulation. Weak or damaged wall materials must be repaired or reinforced prior to installing insulation within program spending limits.

Additions to manufactured homes will be treated as site built described above.

Wall areas that are readily accessible should be loosened from the bottom and insulated with 1½" of vinyl faced fiberglass batts using a Plexiglas or equivalent to push batts up into the wall cavity. If a manufactured home has aluminum wiring, sidewalls shall not be insulated.

Use the MHEA Audit to determine whether additional insulation should be added.

- Documentation concerning why the walls were not insulated should be in the client file, if MHEA called for additional insulation.
- Prior to and after insulating walls electrical outlets should be checked to make sure they are in working condition.
- Items hanging on the walls should be removed prior to insulating the walls to avoid breakage.

Installing insulation above windows and doors is usually not feasible or cost-effective and is not required in manufactured homes.

Blown Fiberglass

- If skirting overlaps siding, skirting will be removed.
- Fasteners will be removed from the bottom of the siding, working upward until the siding can be pulled away from the framing approximately 6" without damaging the siding.
- Temporary fasteners will be installed near the bottom of the siding panels at the seams.
- If a sub-sheathing is present under the siding, access through the sub-sheathing will be required.
- Installer pre-work assessment will be conducted to determine:
  - Moisture damage
  - Presence of infestation or pests
  - Location and integrity of wiring
  - Holes to the interior and exterior
  - Loose paneling or siding
  - Location of belt rails
  - Location of wall obstructions (switches, outlets)
  - Existing insulation
  - Wall hangings for removal during work

Problems will be corrected before work begins.

Using fill tube, 100% of each cavity will be filled to a consistent density:

- Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density in accordance with manufacturer specifications.
- The number of bags installed will be confirmed and will match the number to achieve 1.5-1.6 pounds per cubic foot.
- Insulation will be verified to prevent visible air movement using chemical smoke at 50 Pascal of pressure difference.
- Blown fiberglass will not be blown from inside the home.

5022 Cantilever Floor Insulation *SWS 4.1101.1;*

Any cantilever floor, such as under bay windows or rooms over unconditioned areas (except tuck-under garages), must have a ½" treated plywood sheathing to fully cover the bottom of the floor. (See Figure 2)

The cantilever floor shall be insulated using the dense-pack method, a minimum density of 3.5 pounds per cubic foot.

Documentation (insulation certificate) will be posted as required by federal specification 16 CFR 460.

The drilled sheathing is to be plugged and painted.

FIGURE 2

5030 FOUNDATION

STANDARD
To form a consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value.

SWS 2.0404.2a-c; 4.1402.1; 2.0404.3a;

Energy Auditor/Inspector

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

5031 Crawlspace *SWS 2.0111.1a; 2.0111.3a; 2.0111.4a; 2.0401.1b; 2.0404.3f; 2.0701.1a; 3.1401.1a-d; 3.1402.1a-c; 3.1402.3a-b; 3.1402.5a;4.1402.1*

Energy Auditor/Inspector

Measure the crawlspace area including height of foundation walls for the NEAT Audit.

Determine whether the crawlspace is unconditioned or unintentionally conditioned.

- Treat a post foundation as an un-conditioned area.
- Try to align the thermal boundary with the air boundary. If the crawlspace is connected to a basement, decide if isolating it from the basement is appropriate. Determine whether to insulate the walls or ceiling of the crawlspace. Do not call for both. Consider the possibility of water lines freezing and ductwork being put in an unconditioned space. If the floor is to be insulated, the NEAT Audit will determine the R-Value to install. If the foundation walls are to be insulated, the approved methods are listed in Section 5031.03.

Document any plumbing pipes, chase ways, or other by-pass air leakage sites which need to be sealed. If these by-passes lead to the attic, they must be sealed in the attic if possible. Otherwise, they must be sealed in the crawlspace. If the by-passes lead to an exterior wall, they must be sealed in the crawlspace.

Plumbing leaks will be repaired before crawl space upgrade in accordance with the most recently adopted IRC.

Look for exhaust vents that terminate in the crawlspace area. These vents are to be extended to outside the foundation and terminated.

WX Worker

Penetrations will be sealed with a durable material with a minimum expected service life of 10 years.

If penetrations are greater than ¼", a pest proof material (caulking, steel wool, etc.) will be used to fill the opening before sealing.

5031.01 Vapor Retarder *SWS 2.0111.3a, b; 2.0401.1b; 2.0403.1a-e; 2.0403.2b-i; 2.0403.3a-e; 2.0701.2; 2.0403.4*

Energy Auditor/Inspector

Note any existing debris in the crawlspace. Debris that may cause injury or puncture ground covers (e.g., nails, glass, sheet metal screws) must be removed from the crawlspace and disposed of properly. Note whether a vapor retarder is present and inspect for complete coverage and effectiveness. If a vapor retarder is not present and the crawlspace is accessible, a 6-mil, thick polyethylene (poly) vapor retarder must be installed. If clear polyethylene is used, the agency must be prepared to explain to the client why there is moisture visible under the polyethylene. Vapor retarders are not to be installed in crawlspaces where there is a danger of pooling water due to high water table or poor drainage.

Calculate the amount of material necessary to cover the entire floor. When seams exist, they will be overlapped a minimum of 12" with "reverse" or "upslope lapping" technique.
If there is evidence of water leakage or moisture coming through the foundation wall from the exterior, the 6-mil polyethylene vapor retarder must be attached to either the sill plate or just below the sill plate and extend down to the ground in a manner that drains the moisture behind the insulation and covers the insulated section of the crawlspace wall.

The client will be informed of the importance of and cautioned not to damage the vapor barrier in the crawlspace. Clients will also be instructed to not store hazardous and flammable materials in the crawlspace.

Manufactured Homes

- If conditions of the ground and skirting mandates, a moisture barrier that covers the ground will be installed with allowances for structural supports and accessibility.
- Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home.

WX Worker

Debris that may cause injury or puncture ground covers (e.g., nails, glass, sheet metal screws) must be removed from the crawlspace and disposed of properly.

Vapor retarder must be 6-mil thick polyethylene. When seams exist, they will be overlapped a minimum of 12" with "reverse" or "upslope lapping" technique and sealed using caulk, mastic, or house-wrap tape. The sealant must be compatible with the vapor retarder.

A vapor retarder, covering 100% of the exposed crawl space floor, will be installed and sealed to the wall's air and moisture barrier. Ground vapor retarder will be fastened to ground to prevent movement in accordance with ASTM E1643 and manufacturer's recommendations.

The polyethylene should extend a minimum of 6" up the crawlspace wall and secured to the wall. If the work order requires the vapor retarder to extend up the wall, it must be attached to the sill plate or just below the sill plate and extend to the ground.

For wall to floor connection, the wall moisture barrier will be installed under the ground vapor retarder.

Vapor retarders should not extend up the wall if installing wet spray cellulose, rigid foam insulation, or two-part foam.

Care must be taken not to tear the polyethylene.

A minimum expected service life of 10 years will be ensured

5031.02 Crawl Space Venting *SWS 2.0404.2a; 3.1402.2a;*

Energy Auditor/Inspector

Unintentionally conditioned crawlspaces should be treated as a mini-basement. They should be heated during winter and cooled during the summer. A return HVAC system duct or grille is not allowed. A floor grille, acting as transfer grille, can be installed. It should be noted that installation of a transfer grille between crawlspace and the house may be in conflict with some codes unless crawlspace surfaces are also fire rated.

Accidental active depressurization of the conditioned crawlspace via a return duct or return duct leakage that creates recirculation into the house should be avoided. This should not be confused with continuous, active depressurization of the crawlspace via an exhaust fan vented to the exterior that is a proven soil gas control strategy.

During periods of high outdoor relative humidity, when the crawlspace is cooler than the outside air, ventilation may cause condensation in a crawlspace. For this reason, all existing vents must be closeable or a cover made for them. Thermal vents are not allowed.
Vents are not to be added to the foundation. With client permission, all existing crawlspace vents should be permanently sealed shut. If sealing shut from outside, treated plywood should be used. Inside, foam board may be used. *SWS 2.0111.4a*

If drainage problems exist which may create standing water or moisture production, mechanical foundation ventilation or a sump pump may be necessary. *SWS 2.0401.2a* (See Section 2090)

WX Worker

If required by the work order, existing vents in the crawlspace area are to be sealed. If sealing shut from outside, treated plywood should be used. Inside, foam board may be used.

5031.03 Crawlspace Wall Insulation *SWS 4.1402.1a - f*

There are four approved methods of crawlspace wall insulation. The Energy Auditor will determine when to insulate crawlspace walls and which method to use. In all cases a vapor retarder must be installed.

Method 1 – R-11 Fiberglass

- Insulation is to be R-11 or greater fiberglass batts.
- Insulation may be installed either horizontally or vertically along the crawlspace walls. The edges of the insulation must be sealed and it must be attached to eliminate sagging and separation between batts.
- If vapor retarder is installed up the walls to the sill plate, unfaced fiberglass will be used.
- If vapor retarder is not extended to the sill plate, faced fiberglass insulation will be installed with the vapor barrier (paper, foil, etc.) installed to the heated side.
- Insulation is to extend from the top of the foundation wall, down to the floor.
- The top of the batts shall be held in place with lath, 1x2”s, or staples.
- Fiberglass insulation is not to be installed on walls of crawlspaces where there is a danger of pooling water due to high water table or poor drainage.

Method 2 – Rigid Foam

- Three-quarter inch rigid foam may be used to insulate crawlspace walls if local codes permit. Foam board must be foil faced. All joints must be sealed and entire interior exposed foundation covered.
- Insulation is to extend from the top of the foundation wall, down to the floor.
- Vapor barrier must cover the floor of the crawlspace.

Method 3 – Wet Spray Cellulose

- Insulation is to extend from the top of the foundation wall, down to the floor.
- Insulation installed must be type 1 (liquid adhesive) and meet ASTM C1149-90 standards.
- Application methods must meet CIMA (Cellulose Insulation Manufacturers Assn.) guidelines technical bulletin #3.
- Manufacturer's and supplier's guidelines must be followed.
- Vapor retarder must be put on the ground in crawlspaces when insulating the foundation walls.
- Insulation shall not be installed in areas prone to high moisture, flooding, or homes in low-lying areas.
- Insulation shall not be installed when it is possible the area insulated will be below freezing within 48 hours.
- Insulation on crawlspace walls shall be a minimum of R-7.
- Insulation containing only boric acid shall be used. Insulation containing ammonia sulfate will not be used because when wet it gives off an ammonia odor.
- When cost effective according to the NEAT Audit, wet spray insulation may be installed at the Energy Auditor's discretion.
- The box area needs to be insulated to at least an R-7.
- The water to glue ratio needs to be 10 to 1.
- Crawlspace vents are to be sealed prior to installation of wet spray insulation.

Care must be taken to avoid getting wet spray insulation on metal surfaces (ductwork, gas piping, junction boxes, etc.) because of the corrosiveness of the moist insulation. When it does get on metal surfaces, they must be cleaned.

Method 4 – Two-Part Closed-Cell Polyurethane Foam

- Only use if local codes permit.
- According to DOE, two-part foam is used as an air-sealing measure rather than an insulation measure.
- Manufacturer's guidelines must be followed for recommended use and application, temperature tolerances, shut down procedures and storage.
- Two-part closed-cell polyurethane foam must be rated as Class 1 Fire Retardant.
- Vapor retarder must be put on the ground in crawlspaces when insulating the foundation walls.
- Insulation shall not be installed in areas prone to high moisture, flooding, or homes in low-lying areas.
- Must be installed 2" thick.
- Insulation must be neat in appearance and of a consistent depth.
- When cost effective according to the NEAT Audit, the two-part closed-cell polyurethane foam may be installed at the Energy Auditor's discretion.
- The box area also needs to be insulated with 2" thick foam.
- If installed in a confined space, there should be a negative pressure in the area. Follow NIOSH Standard as what is defined as a confined space.
- Recommend tenants, especially children, vacate the premises while being installed and for one hour after completion.
- WX Workers must wear an NIOSH certified respirator as well as eye and skin protection as specified in the product SDS.
- Clean up any overspray or excess of the two-part foam.

Method 5 – Closed-Cell Extruded Polystyrene

- 2" Closed-cell extruded polystyrene may be used to insulate crawlspace walls if local codes permit. All joints must be sealed and entire interior exposed foundation covered.
- Insulation is to extend from the top of the foundation wall, down to the floor.
- Vapor barrier must cover the floor of the crawlspace.

5031.04 Floor over Crawlspace Insulation

Energy Auditor/Inspector

The agency Energy Auditor will decide when and how to insulate floor area over the crawlspace and the NEAT Audit will determine the R-value. If floor over the crawlspace is to be insulated and there are no water lines, then all heat ducts in the crawlspace shall also be insulated.

If the floor is dense packed, the crawlspace must be isolated from the rest of any conditioned or unintentionally conditioned areas.

WX Worker

The two acceptable methods for insulating floors are described below.

Method 1 - Fiberglass Batt *SWS 4.1301.1*

- The foundation wall must be the air barrier when fiberglass is used.
- Wood lath and galvanized nails may be used to hold the insulation in place with a maximum spacing of 18" on center. Twine used to hold the insulation in place must be made of polypropylene, nylon or polyester with a breaking strength of at least 150lbs. and 12" maximum spacing between anchor points.
- Wire used to hold the insulation must be zinc-coated, stainless, or similar corrosive resistant material with a minimum diameter of .035". Wire must be spaced no more than 18" apart. Supports and anchors must be zinc coated, stainless steel, or similar corrosion resistant material. Staples for wood lath are to have a ¼" crown. Staples for wire and twine are to have a 3/8" crown and nails are to be galvanized and penetrate the joist at least 5/8".
- Wire hangers may also be used if spaced no more than 18" on center and have a minimum thickness of .090 inches. The hanger ends must penetrate the joist at least ½".
- The insulation must not be compressed more than 10%.
- Do not insulate water pipes from the heated side. Insulation should be installed between the pipe and the cold side of the crawlspace.
- Any covered water valves shall have a tag with "WATER VALVE" written on it and hung below the valve and insulation.

Method 2 – Dense-Pack Cellulose *SWS 4.1301.2; 4.1301.4; 4.1301.8*

- Any cavities with water lines must be insulated using Method 1.
- Dense-packed equals 3.5 pounds of insulation per cubic feet. To figure the number of pounds of insulation needed per square foot of joist thickness, multiply 0.29 times the cavity thickness.
- Reinforced poly may also be installed on the floor joist. The poly must be installed with staples placed in such a manner to support the weight of the dense-pack insulation. The poly is then slit and cellulose is dense-packed into the cavities. OR
- Floors over unheated spaces such as crawlspaces which do not have water lines may have rigid insulation board applied to the ceiling joist.
  - The insulation board must cover the entire floor assembly. Seams and penetrations must be sealed.
  - The insulation board is then drilled and cellulose is dense-packed into the cavities. The holes must then be plugged.
- Homes without foundations that have exposed floors are to be insulated using the dense pack method.

Manufactured Homes Floor Insulation Requirements *SWS 4.1302.1; 4.1303.1; 4.1303.2*

Energy Auditor/Inspector

Inspect the floors from the interior to determine if there are any holes or penetrations to be repaired before insulating.

Belly cavities must be inspected to determine the location of the plumbing, any existing plumbing leaks, and the R-value of existing insulation. Leaks should be fixed prior to weatherization. Duct leaks should also be sealed before installing insulation.

Belly rodent barriers must be inspected for general condition, structural strength, and major air leakage, prior to installing insulation. Necessary belly rodent barrier repairs must be made if additional insulation will be added or if holes in the belly allow significant air movement between the belly cavity and the outside atmosphere.

Fiberglass insulation is to be used to insulate the manufactured home underbelly. Cellulose is not to be used. Average fiberglass insulation densities for loose-fill insulation installed in manufactured home bellies shall be 1.5 to 1.6 pounds per cubic foot.

Due to some manufactured homes having extended warranties, if the manufactured home is less than 15 years old it will be at the Energy Auditor's discretion whether or not to insulate the underbelly.

If water pipes are located at the bottom of the belly rodent barrier and it is not possible to get at least two inches of insulation between the pipes and the rodent barrier, then the following must be attempted, if cost effective and feasible:

- The pipes must be insulated with additional insulation, either inside the belly or on the exterior of the rodent barrier, or
- The pipes shall be moved closer to the floor above or the insulation above the pipes should be removed.

Belly insulation must be installed in such a manner that ensures complete coverage under heated areas. Bellies shall not be dense packed or over filled so as to create undue stress on the belly rodent barrier. All belly insulation is to be determined by the MHEA Audit.

Holes that have been made in belly rodent barriers for the installation of insulation must be patched and sealed.

Rim joists may not be drilled if they are determined to be a structural component of the foundation support system.

Fiberglass batt insulation may be used if conditions warrant such as under ductwork, small areas requiring insulation, etc.

WX Worker

Underbelly Insulation Methods

METHOD 1 - Belly-Board Penetration

When insulation has to be installed from underneath the belly, the installation of a 6-mil vapor barrier on the ground by the first person to go underneath is preferred, in order to reduce health risks to the weatherization workers from animal feces.

When insulating from underneath, the use of insulation hose or a large diameter fill tube is preferred. Holes shall be spaced and sized to accommodate the directional nozzle or fill tube.

The maximum insulation travel beyond fill tube or nozzle shall be no more than two (2) feet.

Flexible fill tube shall not be more than two (2) feet shorter than the length of the cavity being filled.

The preferred methods of securing belly patches are through the use of adhesives, clinch staples, screws and lath strips whenever possible to provide a lasting patch.

Preferred patching materials for large holes in belly rodent barriers include insulated sheathing board, fiberboard, and nylon reinforced belly bottom material specifically manufactured for manufactured homes.

Ductwork shall be inspected for insulation that might have accidentally entered during insulation work.

METHOD 2 – Rim Joist Penetration
Rim joists may not be drilled if they are determined to be a structural component of the foundation support system.

Rim joist penetration is preferred when the joist size and condition allow for safe and proper installation.

The trim on the bottom of the exterior wall shall be removed to expose the rim joist.

Rim joist access shall not be used if it will weaken or damage the manufactured home.

Care must be taken to avoid damage to plumbing and electrical lines attached or adjacent to the rim joist.

Rigid or flexible fill tube shall not be more than 2' shorter than the length of the cavity being filled.

Upon completion of insulation work, rim joists that have been drilled shall be plugged with a wood plug. The plug shall be sealed in the hole with an adhesive compound.

Ductwork shall be inspected for insulation that might have accidentally entered during insulation work.

5032 Bandjoist Insulation *SWS 4.1401.1; 4.1401.2; 4.1402.1e – f;*

Energy Auditor/Inspector

Measure the bandjoist area and document any existing insulation for the NEAT Audit. Insulation will only be installed in the bandjoist when required by the NEAT Audit.

Where termite pressure exists, removable band joist insulation will be installed.
Agencies are encouraged to use Method 2, Two-Part Closed-Cell Polyurethane Foam.

If the foundation box allows infiltration, seal the box area with caulk or non-expanding foam sealant.

WX Worker

There are four approved methods of bandjoist wall insulation. The Energy Auditor will determine which is to be used.

Method 1 – R-19 Fiberglass

- Box areas are to be insulated to R-19, when called for by NEAT.
- When using insulation with vapor barrier, always install the barrier toward the winter-heated side and form a wrinkle-free appearance.

Method 2 – Two-Part Closed-Cell Polyurethane Foam

- When cost effective according to the NEAT Audit, the two-part closed-cell polyurethane foam may be installed at the Energy Auditor's discretion.
- Only use if local codes permit.
- Manufacturer's guidelines must be followed for recommended use and application, temperature tolerances, shut down procedures and storage.
- Two-part closed-cell polyurethane foam must be rated as Class 1 Fire Retardant.
- Must be installed 2" thick.
- Insulation must be neat in appearance and of a consistent depth.
- If installed in a confined space, there should be a negative pressure in the area. Follow NIOSH Standards to define a confined space.
- Recommend tenants, especially children, vacate the premises while being installed and for one hour after completion.

- Weatherization workers must wear an NIOSH certified respirator as well as eye and skin protection as specified in the product SDS.
- Clean up any overspray or excess of the two-part foam.

Method 3 – Rigid Foam

- ¾" Rigid foam may be used to insulate box areas, when called for by NEAT and local codes permit.

Method 4 – Closed-Cell Extruded Polystyrene

- 2" Closed-cell extruded polystyrene may be used to insulate box areas, when called for by NEAT and local codes permit.

5033 Basement

Energy Auditor/Inspector

Determine whether the basement functions as a conditioned, unintentionally conditioned, or unconditioned area. A tuck-under garage is to be considered unconditioned space.

If the basement area is unconditioned, note the condition of any existing floor insulation. If there is no insulation, enter the area in the NEAT Audit and the audit will determine the amount of R-value needed.

Measure the basement floor and wall area for the NEAT Audit.

Inspect for signs of basement floor moisture and determine if necessary corrective actions can be completed within program spending limits.
Note the presence of water lines and the potential for freezing because of the addition of floor insulation.

Note the presence and location of any direct penetrations. Note any plumbing pipes, chase ways, or other by-pass air leakage sites. If these by-passes lead to the attic, they must be sealed in the attic if possible. Otherwise they must be sealed in the basement. If the by-passes lead to an exterior wall, they need to be sealed in the basement. Document areas to be sealed.

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.

5034 Attached or Tuck-Under Garage *SWS 4.1301.9; 6.6188.1*

Energy Auditor/Inspector

An attached or tuck-under garage is to be considered unconditioned space and should be insulated with fiberglass, dense-pack cellulose, or two-part foam (two-part closed-cell polyurethane foam must be rated as Class 1 Fire Retardant).

If the house to garage leakage is less than 200 CFMs and it is already insulated, additional insulation and air-sealing is not required.

House to garage pressure of 48 Pa or higher does not mean that house to garage leakage is below 200 CFM. It simply means that the test will not be accurate. Air sealing should be completed.

If adding insulation to unfinished ceilings or common walls in attached or tuck-under garages 5/8" fire-rated sheetrock must be installed. The sheetrock may be installed first and the ceiling and wall dense-packed or two-part foam may be installed prior to installing the sheetrock.

Fiberglass must be used in the ceiling cavities with waterlines. Cellulose or two-part foam must be used in cavities with no waterlines.

See Section 4010 for information about infiltration sealing in garages.

WX Worker

If required by work order, ceilings or common walls in tuck-under garages will be finished with 5/8” fire-rated sheetrock.

If required by work order, fiberglass, dense-pack cellulose, or two-part foam insulation will be installed. If dense-pack cellulose is required, the 5/8” sheetrock will be installed first, drilled for insulation, and plugged when complete.

5040 Duct Insulation

STANDARD
To lower thermal conductance of duct system and minimize condensation on the duct system.

SWS 4.1601.1; 4.1601.2; 6.6002.1b; 6.6003.3h; 6.6003.4g; 6.6102.1b 6.6202.2h

Energy Auditor/Inspector

Note any ductwork in an unconditioned area. Also note any that might be put into an unconditioned area as a result of other work being completed. This ductwork must be insulated to a minimum of R-8.

Note any flex duct. All flex ducts must be insulated to R-8 regardless of location.

WX Worker

Ducts are to be insulated whenever supply or return ductwork run through unconditioned areas (this also applies to separate air conditioning systems).
R-8 or greater commercial duct insulation can be used and applied as per manufacturer’s instruction.

Fiberglass batts may be used. It must be secured with straps 12-18 inches apart whenever possible and be at least R-8 or greater.

Insulated ducts in an attic must also be covered with additional cellulose insulation.

All existing flex duct must be insulated to R-8.

6000 ELECTRIC EFFICIENCY MEASURES

6010 Electric Baseload Measures

STANDARD
Clients' electric usage will be reduced by installing more energy efficient appliances. Energy used for lighting will also be reduced while maintaining adequate and safe lighting levels.

Electric baseload usage accounts for over 40 percent of a household's energy use. This includes lights, refrigerators and freezers, and other electrical appliances.

The Iowa Weatherization Program can address lighting by replacing standard incandescent bulbs with compact fluorescent bulbs, which are much more efficient. The program also replaces older, inefficient refrigerators and freezers with higher efficient units.

6011 Refrigeration & Freezer Removal/Replacement *SWS 7.8001.1a-c*
FIELD GUIDE
Energy Auditor/Inspector
Discuss with client the approximate age of the existing refrigerator. Tell the client the usage of their refrigerator will be metered. **Do not promise the client a new refrigerator. The replacement will be done according to the digital line logger.**

Refrigerator and freezer replacement model(s) must be rated as ENERGY STAR® ®. All replacement refrigerators must meet the UL-250 standard.

For situations where a straight one for one replacement is made, the replacement refrigerator must not be larger than the size of the old refrigerator. For situations where two (2) or more refrigerators will be replaced by one (1) new one or where a refrigerator and freezer will be replaced by one (1) refrigerator, the new refrigerator may be larger than the ones being replaced if needed in order to meet capacity needs. Side-by-side refrigerators may be installed as replacements if determined to be cost effective by the BART program. See the *Iowa Weatherization General Appendix* for further information.

The program will not pay extra for any additional features such as ice makers or extended warranties. If an appliance, installed by the agency, fails within the first five years, it may be replaced once. The client is responsible for completing the hook up of any ice maker included with a new appliance.

The color must be white or off-white, unless there is no difference in price for one of a different color. NOTE: Other colors are allowed if client pays the additional cost.

The number of appliances that may be installed is limited to what is allowed by the BART replacement protocol. For example, if a house contains 2 refrigerators and 1 freezer and the replacement protocol allows for the replacement of all three appliances, then all three may be replaced.

If a home has multiple refrigerators, they should be metered. If a refrigerator cannot be metered, the estimated usage for that make and model may be found in the look-up table in the NEAT Audit. If a refrigerator is not metered, the reason should be recorded in WAMS.

All freezers must be metered. If a freezer is not metered, it is not eligible for replacement.

Costs for replacements are limited to what is allowed by the replacement protocol and other limitations described above.

Appliance replacement in rental units is allowed only when the renter owns the old appliance.

All refrigeration appliances located in intentionally or unintentionally conditioned areas must be metered. Appliances in unconditioned areas may be metered and replaced if: (1) the new unit will be installed in an intentionally or unintentionally conditioned area, or (2) a 2-for-1 replacement will occur with the new unit being installed in an intentionally or unintentionally conditioned area. If a refrigerator cannot be metered because it cannot be moved, the estimated usage for that make and model may be found in the look-up in the NEAT/MHEA Audit.

Removal and proper disposal of all replaced appliances is required. The appliances must be disposed of according to the environmental standards in the Clean Air Act (1990), Section 608, as amended by Final Rule, 40 CFR 82, May 14, 1993.

Appliance repair is not allowed.

The replacement policies and guidance cannot cover all possible situations. In some cases, common sense must be used to determine whether an appliance replacement is appropriate. For example, if a household has a second refrigerator that is seldom used or is used to store very little, it would not make sense to replace it with a new appliance. Instead, efforts should be made to encourage the client to allow the straight removal of the appliance.

Install a digital power meter to the refrigerator. Caution: If the refrigerator is running when ready to install the power meter, allow refrigerator to sit for a minimum of five (5) minutes before plugging into the Digital line logger. This will allow compressor pressure to be relieved.

The time the logger is plugged in should be recorded.

The appliance(s) must be metered for a minimum of 120 minutes (2 hours).

Record the kWh usage and the number of minutes from the Digital Line Logger on the Client Home Energy Audit or on the client agreement form. This information is needed because it will be entered later in the WAMS material database.

Use the TI-89 calculator to determine the annual energy consumption by each appliance. The Annual Energy Consumption Conversion Table (Conversion Table) may also be used to convert short-term metering results to an annual energy consumption amount. The short-term metering results are based on the duration of the metering and the meter reading. The annual consumption is shown on the Conversion Table, rounded to the nearest 100 kWh. The table lists short-term kWh readings down the left side and minutes that the appliance was metered on the top.

Example: If a refrigerator is metered for 120 minutes (2 hours) and the Digital Line Logger showed it used .43 kWh, the annual usage from the conversion table would show the annual usage of the refrigerator at 1900 kWh.

Once the annual energy consumption of the existing appliance(s) has been determined using the TI-89 or the Conversion Table, the Energy Auditor can determine if it is cost effective to replace the existing appliance(s). This is done by comparing the annual energy consumption of the existing appliance(s) with the replacement ratings of the “new” appliances.

The replacement ratings of “new” appliances are found on the Replacement Ratings Report, which is produced by the BART program (see BART Manual in the *Iowa Weatherization General Appendix*). The Energy Auditor reviews the replacement ratings for the appliances listed on the Ratings Report to see which appliances have a rating less than the annual energy consumption of the existing appliances. Any appliance or combination of appliances may be installed as long as the replacement rating of an appliance or total replacement rating of any combination of appliances is less than the total energy consumption of the existing unit or combination of existing units.

Example:

Bart Rating Table

ID	*Rating*	*Brand*	*Style*	*Size*
R1	1160	Whirlpool	TF	14
R2	1140	Amana	TF	16
R3	1300	Frigidaire	BF	18
R4	1250	Kenmore	TF	16

The client has two appliances. The two units were metered for 2 hours, and showed consumption of 0.252 and 0.180. We extrapolate these values to annual consumption rates using the TI-89 or the Conversion Table and find the rates of 1,104 kWh and 788 kWh, respectively. The total annual energy consumption of these two units is 1,892 (1,104 + 788).

In this example, the replacement refrigerators cannot be exchanged for either of the existing units since the replacement ratings of the replacement refrigerators exceed the annual energy consumption of each of the existing units (1,104 and 788). However, a replacement refrigerator can be installed if both of the existing units are removed because the replacement rating of any of the refrigerators listed is less than the total annual energy consumption of the existing units (1,892).

When determining which new appliances can be installed, ensure the new appliance will fit into the space available and hinged on the correct side.

Once it is determined whether the replacement appliance or a combination of appliances is cost-effective, discuss the possibility with the client. It may be possible to propose the replacement of multiple appliances for one new appliance. Greater energy savings are realized if multiple appliances can be replaced with one (1) appliance.

If the client agrees to a replacement of an appliance or a combination of appliances, complete the Client Agreement Form and have the client sign the form. The Client Agreement Form lists the existing appliances that will be replaced and the new appliances that will be installed. The form is printed on three-part NCR paper so one (1) copy can be given to the client, one (1) copy kept by the agency, and one (1) given to the appliance vendor.

WX Worker

Removal and proper disposal of all replaced appliances is required. The appliances must be disposed of according to the environmental standards in the Clean Air Act (1990), Section 608, as amended by Final Rule, 40 CFR 82, May 14, 1993.

Appliance will be installed in accordance with manufacturer specifications and local codes.

Any penetrations to the exterior of the home created by the installation of the appliance will be sealed.

Appliance shall be ENERGY STAR® ® rated. Energy-related appliance controls will be demonstrated to the occupant.

Specific information on the proper maintenance of the equipment will be provided to the occupant.

Warranty information, operation manuals, and installer contact information will be provided to the occupant. Appliance will carry a minimum one-year warranty that will provide a replacement appliance if repeated issues relating to health, safety, or performance occur.

Appliance will fit in the available space without blocking access to light switches, cabinets, etc.

6012 Fluorescent Lighting *SWS 7.8003.1b*

FIELD GUIDE

Energy Auditor/Inspector

Incandescent light bulbs can be replaced with compact fluorescent light (CFL) bulbs if they will be used an average of 1.5 hours per day. A maximum of 20 CFLs and a maximum of (2) 3-way CFLs, may be installed in each house. All compact fluorescent bulbs installed must be ENERGY STAR® rated.

Compact fluorescent bulbs may be installed with client permission in each house.

Fluorescent bulbs can have a lower wattage than incandescent bulbs and still provide the same light output. Table 1 shows the bulb wattage that should be selected when replacing incandescent bulbs with compact fluorescent bulbs.

TABLE 1

Incandescent	Compact Fluorescent
100 w	23 w
75 w	18 w
60 w	13 w
40 w	11 w
25 w	9 w

WX Worker

Install bulbs where instructed in work order. Do not leave the bulbs with the client to install.

All compact fluorescent bulbs installed must be ENERGY STAR® rated.

6020 Air Conditioning

STANDARD

Air conditioning, while not a measure considered by the Iowa Weatherization Program, must be identified for client records. Information needed for WAMS and NEAT includes: existing air-conditioning type (window/central) and Btu or tons (12,000 Btu = 1 ton) of each air conditioner for use in NEAT and WAMS.

SWS 5.3003.7f

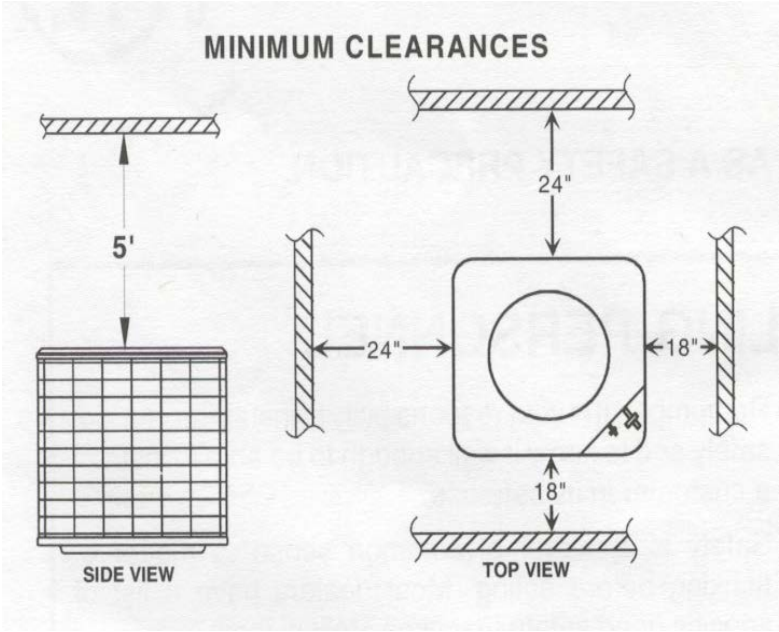
FIELD GUIDE

Energy Auditor/Inspector

Visually inspect the outside unit to ensure clearances meet manufacturer's instructions. See Figure 1 for clearance from the sides and top of unit to walls and other objects. The unit cannot be completely enclosed. One side must be unrestricted. Make sure the cooling fins are not obstructed with leaves or dirt. Explain to the client why this is important, restricting airflow could lead to poor operation and/or severe equipment damage.

FIGURE 1

Outside condensing unit



Visually inspect the inside unit to determine if there is proper condensate drainage. If drainage problems exist, which may cause damage to the furnace, repairs or replacement may be made using program funds within heating system repair limits.

Visually inspect A-coil for dirty or obstructed fins and leaks. If an A-coil is leaking and will result in damage to the furnace, it may be replaced within program expenditure limits, if not repairable.

7000 REPAIRS

7010 Incidental Repairs

STANDARD
Incidental repairs are defined as repairs necessary for the effective performance or preservation of weatherization materials. All repair measures must be installed to meet requirements listed below.

SWS 3.1101.1b; 3.1001.4d; 3.1101.2c; 3.1101.3b; 3.1201.5; 3.1201.6; 3.1203.3; 3.1302.1; 3.1701.1h, j;

FIELD GUIDE

Energy Auditor/Inspector

For single-family dwellings, manufactured homes and multi-unit dwellings that have 4 or fewer units, the amount that can be spent on incidental repair is limited to what is allowed by the NEAT/MHEA Audit's Savings to Investment Ratio (SIR). The cost of these repairs must be input in the NEAT/MHEA Audit and included in the audit's SIR calculation. The repairs may be done if the cumulative SIR (with the repair costs included in the SIR calculation) is 1.0 or greater. For multi-unit dwellings that have 5 or more units, estimated repairs must be included in the prior approval request that is reviewed by the DCAA.

Like material and/or compatible materials will be used for repairs.

Materials for manufactured housing will be selected to comply with manufactured housing rules and regulations (e.g., Manufactured Housing Institute). All manufactured house egress doors and windows will be operable as required by local code.

Manufactured Home Interior Storm Windows
- Fixed interior storm windows will not be installed in egress locations.
- Operable interior storm windows will be installed in accordance with manufacturer specifications.
- Interior storm windows will be operable and egress rated in egress locations.

Manufactured Home Window and Door Replacement
- Replacement windows will be designed for manufactured home use and will be ENERGY STAR® qualified.
- Window and door units will be installed in accordance with manufacturer specifications
- Egress windows will be only replaced with egress windows.
- Replacement doors will be designed for manufactured home use or be pre-hung steel door and ENERGY STAR® rated.

Some measures may be considered as repair OR infiltration. The energy auditor must identify, for reporting purposes, which category is to be charged for these items. Drywall, drywall mud and tape, and plaster may be charged as repair if the measure is necessary in order to prepare for insulation (either attic or wall).

A list of allowed incidental repair measures is shown below. Some measures may require a SHPO review.

WX Worker

Windows

All replacement windows must be thermal pane units, if allowed by SHPO, except in manufactured homes. Individual sash replacements may be ordered to match the existing sash.

<u>Basement</u>
- 2"x8" or other wood is to be used to replace rotting or missing basement window jambs.
- All wood installed for framing is to be CCA (Chromated Copper Arsenate) treated to prevent rot.
- All wood is to be securely fastened to the foundation.

- Basement window replacement shall include sash, hinges, latch, weatherstrip and stops to make the window airtight.
- A small, smooth bead of caulk shall be applied around new window frames.
- All window work is to be neat in appearance.
- Caulking a basement window shut or covering it with plywood is only allowed with written permission from the client. If covering a window, treated plywood must be used.

Channels

- Install window channels following the manufacturer's instructions.
- Channels must be installed when replacing both upper and lower sashes.
- Channels and springs must operate properly. The lower sash must stay in the open position when raised and down when closed. The client should be able to open and close sash easily.
- Vinyl channels shall not have the weatherstripping cut away from the parting stop or any other part of the channel.
- Channels shall have an angle cut on the bottom to match the slope of the window sill.
- Channels are to fit tight to the sill and within 1/8" of the top.
- All installed channels shall be caulked in place with a paintable type caulk or a colored caulk matched to the window.

Glazing *SWS 3.1202.1d*

- Caulk may not be used in lieu of a glazing compound.
- Glazing compound must conform to F.S. TT-P-00791B ASTM C669-75(1989).
- Glazing is not to extend above the rabbet edge of the sash.
- Glazing is to be tooled smooth to form a concave surface and be neat in appearance.
- Glazing compound will be applied in accordance with manufacturer's specifications.

Repair

- Window repair materials shall be of the type and size already existing on the window.
- The finished window shall operate smoothly, form a tight seal, and be neat in appearance.
- All unfinished wood shall be planed or sanded smooth and be painted, stained, or varnished to a smooth finish and match the existing finish as closely as possible.
- Only finishing or casing nails are to be used on the interior and galvanized casing nails on the exterior.
- The check rails (or meeting rails) of the upper and lower sashes are to be flush.

Sash Replacement *SWS 3.1201.1e; 3.1203.1b-d; 3.1203.2b-e*

- Replacement sash may be either wood or vinyl replacement installed as per manufacturer's instructions.
- The wood forming the sash must conform to ASNI/NWWD 1.S. 2-97.
- The lower sash must have the same bevel on the bottom rail as that of the sill.
- The top sash is to be caulked in place if the old top sash was caulked, painted shut or with client permission.
- Sashes are to be painted or varnished to match the existing sashes.
- New sashes are to be installed in a manner as to allow the lower sash to stay in an open position when raised and down when closed. The client should be able to open and close sash easily.
- MANUFACTURED HOME
    - Replacement windows will be designed for manufactured home use and will be ENERGY STAR® qualified.

Sill *SWS 3.1201.1d*

- If replacing the window sill, it must be either a factory made sill or be made from CCA lumber.
- Sill is to be beveled flush with the interior wall.
- Sill shall be the same distance from the house as the rest of the windows.
- Sill shall be installed at the same angle as other windows on the home.
- Only galvanized casement or finish nails are to be used.

- All seams shall be caulked after installation.
- Sills shall be painted to match the rest of the windows on the home.
- Primered coil stock may be used to wrap split sills. When wrapping sills, top, ends and all edges shall be covered.

Stop *SWS 3.1201.1f - g*

- Window stops shall be installed in such a way as to ensure a tight seal between the jamb, sash, and stop.
- Wood installed shall be similar in size and shape to existing stop in the house.
- Installed window stop is to be planed or sanded smooth.
- New stop is to be painted or varnished to blend with current trim.
- Corners of installed materials are to be mitered or coped.
- If matching window stop is not available, then all stop on the window is to be replaced.
- All work to the window shall be neat in appearance.

Doors *SWS 3.1201.3b*

Exterior

- All exterior replacement doors shall have a solid core of wood, wood particle, or foam. Whenever possible, 1¾" thick doors are to be used.
- All new wood doors are to operate smoothly, be sanded, and be painted or varnished to a smooth water repellent finish. Pressure-treated wood is to be left unpainted.
- Doors shall have a 5° bevel cut on the bottom to form an airtight seal between the bottom of the door and the vinyl gasket of the threshold.
- When the inner core of any door (exterior or interior) is exposed during cutting or planing, the door must be re-cored. The newly installed stile or rail must be glued in place, sanded, and the edges of the veneer rounded.
- MANUFACTURED HOME
    - Replacement doors will be designed for manufactured home use or be pre-hung steel door and ENERGY STAR® rated.

Pre-Hung

- If a pre-hung door is needed, either a wood or steel foam-filled door may be used.
- All doorjambs must receive at a minimum, shims behind each hinge and lockset and any other area needed to support the doorjamb and ensure the reveal is the same all around the door.
- New jambs must be trimmed out to match any existing interior and exterior trim.
- Galvanized casement nails must be used, countersunk and filled.
- All doorsills installed must be flush with the floor of the house.

Grade Entrance

- Openings wider than three feet or longer than eight feet shall have two doors installed instead of one large door.
- Grade entrance doors are to be made of shiplap, car siding or 1" x 4" tongue and groove lumber. Doors more than 6 square feet must be framed on the bottom side of the door using a 1" x 4" or 1" x 6" across the entire width of the top and bottom, then the two sides, then the center, forming what looks like two square frames, after which a 1" x 4" or 1" x 6" is placed in each of the two square frames on diagonal from the hinge location to the center of the opposite edge.
- All framing lumber is to be installed with glue and screws. The vertical joints of the car siding are not to be glued.
- Grade doors are to receive three new "T" hinges (minimum of 5") and a handle.
- Where possible, some form of a drip cap should be installed at the top of the door to help shed water.

Lower Grade

- Lower grade entrance doors are to be made of shiplap, car siding or 1" x 4" tongue and groove lumber or ¾ inch treated plywood. Doors more than 6 square feet must be framed on the bottom side of the

door using a 1” x 4” or 1” x 6” across the entire width of the top and bottom, then the two sides, then the center, forming what looks like two square frames, after which a 1” x 4” or 1” x 6” is placed in each of the two square frames on diagonal from the hinge location to the center of the opposite edge. Any door over 6’ in height needs at least 3 hinges equally spaced.

- A flush surface must be touching the weatherstrip.
- All framing lumber is to be installed with glue and screws. The vertical joints of the car siding are not to be glued.
- Steel or solid core slab doors may also be used.
- A lower grade entrance door must have a latching device. Keyed locksets are preferred but barrel bolts or hook & eye are acceptable. If there is an entrance to the basement from the lived-in portion of the house, a keyed lockset must be used.
- All doors are to operate smoothly, be painted or stained to a smooth water-resistant finish, and be neat in appearance. Pressure-treated wood is to be left unpainted.

Hinges

- New 1¾” doors shall receive three (3) new 4”x4” butt hinges. New 1 3/8” doors shall have three (3) new 3½” x 3½” butt hinges that are mortised into the door and jamb.
- When installing a new door and jamb, the hinges are to be placed at 7” from the top of the door, 11” from the bottom of the door, and the third hinge centered between the top and bottom hinge.
- The veneer shall not be removed from the back edge of the hinge gain.

Interior Door

- Hollow core doors may be used only on the interior of the home to close off unheated portions of the house such as walk-up attics.
- Whenever possible, 1¾” thick doors should be used.
- All installed doors shall receive a smooth finish, be painted or varnished to match existing doors, and be neat in appearance.

Jamb Replacement/Repair

- For jamb repair, remove damaged or deteriorated portion of the jamb and replace with matching materials, butting uniformly to near members. Jambs are not to be cut completely through their width.
- All loose sub-members and casing is to be secured and all wood installed is to be finish grade or factory-made jamb material.
- Common stock materials such as #2 or #3 1” x 6” and 2” x 6”’s are not an acceptable jamb material except for CCA lumber for grade door.
- All installed lumber is to be planed or sanded smooth and painted or varnished to a smooth finish to match existing.
- All work is to be neat and form a tight seal.
- WX Worker is to tighten or re-set hinges. Work is to be done in accordance with accepted carpentry standards. New installations require hinges to be mortised.
- Casing used is to match the existing casing on the house. If matching casing is not available, then all of the casing on the door is to be replaced. Wood is to be installed flush with the wall to ensure a tight fit.
- Any damaged interior wall is to be repaired with like materials.
- WX Worker is to tighten or re-set the strike plate to hold the door flush with the doorstop.
- Strike plate is to be mortised into the jamb.
- All doorsills being replaced must be made from CCA lumber or a factory manufactured sill.
- All doorsills installed must be flush with the floor of the house.

Door Lights

- Door lights should only be installed when the client asks for them. Whenever possible peepholes should be used instead of door lights.
- Door lights should be installed to the height of the client. If the glass is more than 100 square inches it must be insulated glass.

- The glass in the door light must be tempered glass.
- Door lights are to be installed so the screws are to the inside of the home.
- WX Worker is to place a small bead of caulk around the frame of the door light to make it air and watertight.
- Door lights are to be installed in accordance with manufacturer's recommendation.

Locksets

- New locksets & passage sets may only be installed on doors that determine the thermal boundary of the house.
- New doors shall have a new lock installed (whenever possible a 2¾" backset should be used unless using a pre-hung door that is pre-drilled for a 2 3/8" lockset). The client is to receive all keys. Minimum of two keys for the lockset.
- Lockset is to be installed between 36" and 39" from the floor.
- A passage set may be used for interior doors being installed.
- The (rose) cover plates are to completely cover the hole drilled for the lockset cylinder.
- Faceplate and strike plates are to be mortised flushed with the wood of the door and jamb. Screws are to be installed straight and be flush with the face and strike plates.
- Strike plates must be installed to allow the door to latch easily but with minimum play between the door and stop.

Repair

- When required, existing doors will be adjusted to properly fit the jamb and allow for ease of operation.
- All repair work must be within accepted carpentry standards.
- Doors may be repaired if possible and if less expensive than replacing the door.
- All replacement materials are to be of the type and size already existing on the door.
- Doors are not to be covered with plywood and all repairs must be permanent in nature.
- All exposed wood (after cutting) is to be planed or sanded smooth and painted or varnished.
- The finished door should make a tight seal and operate smoothly.

Stop

- Wood used for stop is to be manufactured for that purpose.
- If a section of the stop is missing or must be replaced and the stop cannot be matched to the existing stop, replace all stop on that jamb.
- Joints are to be mitered or coped to form a tight corner joint.
- Wood installed is to be sanded smooth and painted or varnished to a smooth finish and approximately match the existing wood.

Drywall (may also be infiltration in some cases – Energy Auditor decision)

Only ½" drywall shall be used when installing on entire wall or ceiling (if ceiling joist is on 16" center). If ceiling joist is on 24" center, 5/8" drywall will be used.

Five-eighths inch fire-rated drywall must be used over or between a garage and the house.

Drywall installed on ceilings must be installed perpendicular to the ceiling joist.

Whenever possible, drywall installed on walls should also be installed perpendicular to the studs.

Drywall is to be installed using 1¼" drywall screws.

Screws shall be placed no more than 12" apart on each stud or ceiling joist. Screws shall be countersunk into the drywall without breaking through the paper.

Metal corner bead is to be installed to all outside corners. Inside corners must be taped with perforated paper tape. If fiberglass tape is used for other seams, be sure to use the proper joint compound to ensure against cracking.

All gaps wider than ¼" must be filled with a non-shrinking compound manufactured for that purpose prior to taping.

If installing drywall in order to ready it for wall insulation, one (1) coat of joint compound is to be applied and made ready for a second coat.

Drywall repairs shall be made with the same thickness material as existing.

The hole should be squared and a properly sized patch nailed or screwed in place.

The drywall patch shall receive tape and joint compound and be applied to make a neat patch.

If repairing drywall due to damage caused by the weatherization crew or contractor, the drywall shall receive three (3) coats of joint compound, textured and painted to return it to its original appearance.

All work is to be neat in appearance.

Foundation Repair
When caulking masonry joints, use siliconized type caulking compounds.

Caulk is to form an air and watertight seal and all work is to be neat in appearance.

If the foundation has loose or missing bricks or holes in the foundation, the area is to have bricks properly re-set with mortar.

If the foundation cracks involve a large area, the area should be back plastered. Back plaster is to be even, neat, and match the existing back plaster.

A pre-mixed fiber bond material should be used or the following formula, or equivalent, may be used:

1	part masonry cement
½	part Portland cement
2	parts masonry sand

Plaster (may also be infiltration in some cases – Energy Auditor decision)
Plaster repairs shall include covering the exposed lath with a plaster mix to the same thickness as the original wall.

Plaster mix or a non-shrinking drywall mix must be used.

Standard drywall compound is not acceptable for plaster repairs.

Large areas of missing plaster may be covered with a drywall patch, provided the edges can be finished flush with the existing plaster surface.

Gaps between the drywall patch and the drywall shall be taped.

7020 General Health & Safety Repairs

STANDARD
General Health and Safety Repairs are defined as "Repairs necessary (1) for installation of weatherization materials; (2) to maintain the integrity of weatherization materials; (3) to eliminate health and safety problems in the home (i.e., moisture problems)." General Health and Safety Repairs is limited to plumbing repairs, sump pumps, ENERGY STAR® dehumidifiers, electrical repairs, gutters and downspouts, banking and grading and mold/mildew cleanup. The cost limit for General Health and Safety Repairs category is described in the Iowa Weatherization General Appendix. There are no waivers allowed.

SWS 2.0111.2b- e; 2.0401.1d; SWS 2.0404.1a-c; 2.0404.3b; 2.0404.4a; 2.0601.1a,b,c,d; 2.0402.1a,b,d,e 2.0402.2

FIELD GUIDE

Energy Auditor/Inspector

Plumbing Repair

Leaking water pipes and sewer lines may cause moisture problems within the house. Minor repairs may be made to water pipes and sewer lines within spending limits, but cleanup of any unsanitary conditions due to plumbing leaks is the sole responsibility of the client.

Sump Pumps *SWS 2.0111.2h*

Sump pumps may be installed to control water in lower levels of the home. Sump pumps must be installed to meet manufacturer's instructions and all local codes. Interior grading will be sloped to sump pump, if possible.

Dehumidifiers *SWS 2.0404.1a – c; 2.0404.4f*

Dehumidifiers may be installed, with client permission, to help control humidity in basements during summer months in homes with existing mold or moisture problems. Explain to the client that the dehumidifier might result in an increase in electric usage. All moisture source control methods must have been exhausted before installing a dehumidifier.

Manufacturer specifications will be followed for size and use.

Dehumidifiers must be ENERGY STAR® rated and installed to drain properly. If a drain does not exist, a dehumidifier may be installed by utilizing a dedicated condensation pump to an existing drain or sewer line. In this case, the dehumidifier must be put up on blocks to allow for proper drainage. If the basement area is divided in separate rooms, drying will be provided to all basement areas.

Educate the client on proper usage of the dehumidifier including settings and summer/winter use. Occupant will be educated on how and when to change filter and clean condensate drain of the dehumidifier in accordance with manufacturer specifications.

Site Drainage

Poor site drainage is often the reason for wet foundations, basements, crawlspaces, and slabs. The ground around the foundation of the house should be sloped away from the house so water runs away from the house and not toward it. Ideally, the ground adjacent to the foundation should have a minimum 5% slope away from the house (six inches of fall in the first 10 feet).

Check for the following site drainage situations:

- Does the site direct rain and snow melt toward the foundation rather than away from it?
- Are there depressions in the ground close to the house where water can collect?
- Are sidewalks or paved driveways sloped so they direct water toward the foundation rather than away from it?
- Does the house have an effective gutter/downspout system that collects and drains rain water away from the foundations?

Gutters and Downspouts
Gutters and downspouts can be an important part of solving a site drainage problem. They collect and drain rain water away from foundations. Agencies should note if the house has an existing effective gutter/downspout system. If the gutter system is in good condition, but is clogged with debris, they may be cleaned by the program if client is physically unable to do the job and all other options (such as family or chore services) have been exhausted. The cleaning can only be done at the time of weatherization services and cannot be repeated as needed. See Section 2073.03 for more information on Gutters and Downspouts.

Electrical Repair
Correcting electrical wiring problems is generally not an allowable weatherization measure. Inspect for bare wires and knob and tube wiring. Inspect service boxes to ensure they have secure covers.

See Section 2130 for information on knob & tube wiring.

Determine the type and amp rating of the main service box. This information should be available on the main service box.

Determine existing wire type and the location and condition of each type present.

Note the size of the existing fuses/breakers and determine if they are properly sized for their circuits.

If the Energy Auditor determines that a hazardous situation (beyond the scope of the program) exists, work must be deferred until the problem is corrected. If using program funds for minor electrical repair (within the General Health and Safety Repair limit), a licensed electrical contractor must be used to perform electrical work needed to correct a problem.

Moisture/Mold Cleanup
If the work can be completed without disturbing mold/mildew, cleanup is not required, but may be completed at the discretion of the Energy Auditor. If cleanup is completed, cleanup procedures described in Section 2070 must be followed. In either case, cleanup must be completed within the program cost limits.

Asbestos
Clients will be provided with the Asbestos in Homes handout anytime materials with presumed asbestos are present in the house. The handout can be found on the Members Only page of www.weatherization.iowa.gov. Minor asbestos removal, such as asbestos tape on furnace ductwork and on boiler pipes, is allowable under the General Health and Safety Repair limits described in the *Iowa Weatherization General Appendix* and must be performed by a licensed asbestos abatement contractor. Minor asbestos removal is the minimum amount necessary in order to perform weatherization work.

Pest Control
Pest removal/extermination is only allowed in cases when weatherization would be deferred otherwise. If pests cannot be reasonably removed, or where removal poses a safety concern for workers, work should be deferred on the house.

If necessary, pest and termite treatment will be completed before crawl space upgrade and inspected in accordance with the most recently adopted IRC.