

# 2021

EDITION

## MICHIGAN ENERGY AUDIT GUIDE

### WEATHERIZATION ASSISTANCE PROGRAM

The Energy Auditor role is extremely crucial to the success of Michigan's Weatherization Assistance Program (WAP). Success in Michigan's WAP occurs when our clients receive the highest degree of energy savings and safety measures within their homes as possible. A high-quality work scope developed from a high-quality energy audit process allows us to reach that desired success.



## INTRODUCTION

The Energy Auditor role is extremely crucial to the success of Michigan's Weatherization Assistance Program (WAP). Success in Michigan's WAP occurs when our clients receive the highest degree of energy savings and safety measures within their homes as possible. A high-quality work scope developed from a high-quality energy audit process allows us to reach that desired success.

During 2018 the BCAEO developed a Weatherization Change Vision. The purpose of the Change Vision was to take Michigan's WAP to the next level of performance and service delivery. That Change Vision is alive and well. While Michigan's WAP Network has made great strides, our pursuit of excellence continues.

The Michigan Energy Audit Guide is intended to help lead Michigan's WAP to that next level of performance. The information within the Guide lays out a step-by-step approach to performing energy audits within Michigan's WAP. The BCAEO and MiTEC continue to work closely together to provide the resources and training necessary to ensure Michigan's energy auditors can perform their work at a high level of performance.

Following this Guide should ensure that each household served by Michigan's WAP receives the greatest potential of energy savings possible. From the development of high-quality work orders to a Network wide consistent approach to performing energy audits, our success will rise to a new level.

As an Energy Auditor, we hope you will add this Guide to your arsenal of tools used to produce the most comprehensive and effective work orders possible.

### **Weatherization Assistance Program:**

There is some benefit in being familiar with the history of the Weatherization Assistance Program (WAP). Without a knowledge of how the WAP began, we can lose sight of how far the WAP has come. The WAP, being a federally funded program, depends upon Congress to exist. We currently enjoy strong bipartisan support for Weatherization. Looking at the program's history is one way of seeing why that strong support exists. More importantly, we can learn how we keep that support in place.

### **Mission:**

The U.S. Department of Energy's (DOE) Weatherization Assistance Program (Weatherization or the Program) reduces energy costs for low-income households by increasing the energy efficiency of their homes, while ensuring their health and safety.

Weatherization has operated for over 40 years and is the nation's largest single "whole house" energy efficiency program. Its primary purpose, established by law, is:

"...to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, the disabled, and children."

The Program provides energy efficiency services to an average of 35,000 homes annually with congressional appropriated funds while reducing annual energy costs by an average of \$283 or more per household. Through the American Recovery and Reinvestment Act of 2009 (the Recovery Act) (Public Law 111-5), the Program weatherized over 1,000,000 homes during three years of the Act.

These low-income households are often on fixed incomes or rely on income assistance programs and are most vulnerable to volatile changes in the economy or energy markets. High energy users or households with a high energy burden also receive priority for weatherization services.

### **Eligible Households:**

As of 2014, more than 39.5 million households are eligible for Weatherization services, though not all of these homes are appropriate candidates for weatherization.

Any household at or below 200% of the poverty guidelines is considered eligible.

- Low-income households typically spend 16.3% of their total annual income on energy, compared to 3.5% for other households.
- Low-income families must often cut back on other necessities, such as groceries or medicine, to pay their energy bills.

Some income eligible clients may live in dwellings that require repairs, rehabilitation, or services that are beyond the scope of the Weatherization Assistance Program.

### **Weatherization in Action:**

The national Weatherization network offers a streamlined delivery system to provide high quality, energy efficiency services and improvements in single family homes, manufactured or mobile homes, and multifamily buildings.

Weatherization professionals utilize the most advanced technologies to address energy use and improvements. These professionals use computerized energy audits and advanced diagnostic equipment, such as blower doors, pressure pans and infrared cameras, to determine the most cost-effective measures appropriate for each home.

Once a customized work order is created, trained crews install the identified energy efficiency and health and safety measures. When the work is completed, a certified Quality Control Inspector (QCI) ensures all work was installed correctly to the Standard Work Specifications (SWS) and the home is safe for the occupants.

### **Household and Community Impacts**

Weatherization helps to alleviate the heavy energy burden on low-income households and helps them become self-sufficient. Weatherization measures:

- Result in an average energy savings of \$283 per year per weatherized household. Savings can be higher if electric baseload measures (e.g. - lighting, refrigerators) are upgraded.
- Will continue to save money and energy every year.
- Improve health and safety by eliminating energy-related hazards.
- Returns \$2.78 in non-energy benefits for every \$1.00 invested in the Program.

The Weatherization Assistance Program helps low-income households while contributing to revitalizing communities by spurring economic growth and reducing environmental impacts. After weatherization, families' homes are more livable, resulting in fewer missed days of work (i.e., sick days, doctor visits) and a decrease in out-of-pocket medical expenses by an average of \$514. The total health and household-related benefits for each unit is \$14,148.

### **Program History:**

The Weatherization Assistance Program was created in 1976 under Title IV of the Energy Conservation and Production Act to assist low-income families at a time when most Americans were dramatically affected by the 1973 oil crisis. Escalating home heating bills were a heavy burden on household budgets, sinking many families into debt. Low-income families in cold-climate states suffered the most severe consequences.

In Maine, state officials and community action agencies worked with homeowners and renters to seal air leaks in homes. These measures cut energy bills and saved oil. Out of this effort, the nation's first Weatherization Program was developed.

In this early phase, volunteers and job trainees installed low-cost conservation measures, such as covering windows with plastic sheeting, caulking and weatherstripping, to reduce home heating bills. By the 1980s, the Program focused on more permanent and cost-effective measures, such as adding insulation (with its long track record of effectiveness) and improving efficiency in heating systems. Today's home performance industry, made up of for-profit companies, is based on the techniques and technologies developed by the Weatherization Assistance Program.

In the 1990s, the trend toward emphasizing more cost-effective measures continued with the widespread adoption of advanced energy audits and diagnostic equipment. The use of computerized energy audits improved the cost effectiveness of the Program. Blower door-directed air sealing has enabled agencies to diagnose and solve infiltration problems more accurately. The integration of advanced diagnostic equipment has also improved the identification of energy-related health and safety problems, such as carbon monoxide leaks caused by faulty furnaces and inoperable vent flues.

Cooling efficiency measures were integrated in the Program in 1994, including air conditioner replacement, ventilation equipment, and screening and shading devices. These measures have made a big impact in warm climates, where cooling costs are often higher than heating costs.

By 1996, the Program's performance improved significantly due to implementation of many of the recommendations resulting from a National Evaluation conducted by Oak Ridge National Laboratory and other DOE supported research projects. Despite funding reductions during this period, technical

advances produced almost 70% higher energy savings per dwelling. This was achieved through improved training, auditing tools, and management practices.

Additional regulatory and legislative changes in the late 1990s increased flexibility for states. The average amount of spending per home was raised and the requirement that 40% of Program funds be spent on materials was removed in response to the nationwide integration of advanced energy audits. Electric baseload measures were approved and incorporated in 2000.

Also, in 2000, DOE increased flexibility for providers to ease budget constraints related to health and safety expenditures. To help Grantees weatherize more multifamily dwelling units, the eligibility criteria was changed to allow the weatherization of units where low-income tenants account for half of the building's residents in certain situations.

In a 2006 rulemaking, DOE allowed the eligibility of certain renewable energy systems for funding and installation under the Energy Policy Act of 2005 and established criteria for their performance and quality standards.

The Energy Independence and Security Act of 2007, which reauthorized the Program, was expanded by DOE during the rulemaking to include any territory or possession of the U.S. in the definition of "states" as an eligible grantee of the Program.

As part of the Recovery Act that was signed into law on February 17, 2009, the Program was provided \$5 billion in additional funding to support jobs, spur economic growth, and expedite the weatherization of more low-income homes.

Today, DOE's Weatherization Assistance Program has evolved into a sophisticated residential program that addresses whole-house energy efficiency and promotes a whole-community approach.

Now, with that perspective in mind, take a look at the significant program updates during 2020.

- The WAP was reauthorized through FY 2025
- Authority to "reweatherize" a home if 15 years have passed since the original services were completed

What the above history and recent updates represent is an ongoing commitment by Congress to support the WAP. Congress continues to recognize the worth of the WAP and the long-lasting benefits it provides to low-income households. Michigan's WAP Network will continue to do our part to earn their support and confidence.

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## 1.0 Client Interview

Subgrantee auditors are required to conduct on-site interviews with weatherization clients before any assessments or work is performed. This interview process should provide the auditor with enough background information to **properly identify hazards that exist, health and safety (H&S) issues, and energy conservation opportunities.**

- 1.1 Problem identification, such as dwelling use, heating and cooling habits, and comfort issues. Discuss energy conservation opportunities and H&S issues with the client. Make the client aware of the methods and processes associated with installing certain measures such as insulating and patching walls from the interior of the home. The client should be informed that the audit needs to run its course before any of the discussed work can be approved to move forward.
- 1.2 Information about the Weatherization Assistance Program (WAP), services provided by the program and strategies that the client could employ to reduce their energy use.
- 1.3 Discuss any medical concerns the client may have and any possible alternatives to accommodate them.
- 1.4 Inform the client and/or owner about any hazards.
- 1.5 All proper and required paperwork per [CSPM 612](#).
  - [Client plan of action](#)
  - DHS-4285, [Pre-Renovation Form](#) Confirmation of Receipt of Lead Pamphlet (or certificate of mailing) per [CSPM 615](#)
  - [Michigan Weatherization Program Health & Safety Assessment Findings](#), DHS-552
  - [Release of Liability and Waiver of Claims](#), DHS-552-A (per [CSPM 617](#))
  - [Signed radon informed consent form](#)
  - Any other forms that require client signature (e.g., [asbestos notice](#), [unsafe condition](#), [infrared scan](#), etc.)
  - A completed IWC

## 1.0 Client Interview

- A completed work order from Facspro
- A completed DOE-approved audit
- Multi-Family File Documentation:

For multi-family weatherization jobs, the file must include a completed and approved field audit for each building. The audit must include all work including weatherization work performed in common areas like hallways, attics, basements, etc. The client/building files should clearly indicate the structure is a multi-family building and must be cross-referenced with all other units weatherized in the building. Additionally, all client files must be clearly cross-referenced so that any reviewer can easily determine building eligibility under the 66 percent (50 percent for duplexes and four-unit buildings) rule, or any other aspect of the weatherization work to that multi-family building. The files shall clearly indicate weatherization measures to be completed. State of Michigan (SOM) approval shall be obtained to determine if one comprehensive audit or multiple audits are required. ([WPN 16-5](#))

## 2.0 Initial Assessment Summary

The audit is the initial assessment of the home and interaction with the client. The energy audit must include at least the following activities:

- 2.1 Upon entry, ambient carbon monoxide and combustible gases are tested for in the home.
- 2.2 Determinations are made that the building will not be a deferral and weatherization services can be provided per [CSPM 609](#).
- 2.3 Drawing of the house should be done that:
  - Identifies room labeling and corresponds with the work order
  - Shows measurements on the diagram for proper square footage calculations and verification (measurements to the nearest inch)
  - Identifies windows and doors on all sides of the drawing
  - Establishes the thermal and pressure boundary
- 2.4 Required photographs for each weatherization unit should be taken and included in the energy auditors field notes as follows:
  - All sides of the house
  - Mobile home long side with entrance and end, immediately counterclockwise with remaining long side and end, immediately counterclockwise
  - Basement/foundation
  - Furnace, with venting if possible
  - Domestic Water Heater (DWH), with venting if possible
  - Combustion appliance venting if not able to capture in appliance photo
  - Clothes dryer with venting
  - Existing refrigerator

## 2.0 Initial Assessment Summary

- Attic including insulation, air sealing locations when possible, knob & tube wiring, and exhaust fan ducting, when applicable
- Lead Safe Work (LSW) set up if charged to the job
- Photos of exhaust fans and/or controls for ASHRAE compliance, where applicable
- Lead Renovation, Repair and Painting Rule (LRRP) Documentation when applicable
- Photos that show anything out of the ordinary (e.g. large bypasses in an attic, crawlspace clutter, etc.)

**2.5** An inspection of **base-load** use is performed:

- Refrigerators are metered as appropriate
- Lighting Upgrades are investigated
- Hot water consumption efficiency upgrades are investigated

**2.6** A thorough inspection of the **exterior** which includes everything from building components, condition, orientation, measurements, insulation levels, and H&S issues to grading and moisture.

**2.7** A thorough inspection of the **attic** which includes everything from building components, measurements, condition, air leakage areas, insulation levels, and H&S concerns to moisture issues and ventilation requirements.

**2.8** A thorough inspection of the **basement/crawlspace**, which includes everything from building components, measurements, condition, air leakage areas, insulation levels, and H&S concerns to moisture issues.

**2.9** Any H&S issues are documented: Mold/moisture, dryer/exhaust fan terminations, plumbing problems, electrical problems, asbestos, etc.

**2.10** Lead issues are documented and a determination will be made regarding lead and the need to use lead-safe work practices.

## 2.0 Initial Assessment Summary

- 2.11 Inspection of the **combustion appliances** is performed; reference the current version of the BPI 1200 standard. This includes being able to check for gas leaks, electrical safety, combustion air requirements, vent system visual inspection, duct system visual inspection, and visual inspection of cleanliness.
- 2.12 **Combustion appliance zone (CAZ) pressure diagnostics** (Worst-Case depressurization of the CAZ) and operational testing are required (establish flow in the vent under worst-case conditions, spillage, CO, and temperature rise on a forced air system)
- 2.13 Blower door testing is performed - looking for leakage areas (specifically high and low), making sure zones that can be isolated are investigated (sections of the home - basements), making sure additional blower door readings are obtained for pressure diagnostic purposes, if appropriate. An evaluation for asbestos should be done prior to any blower door testing. Upon identification of friable Asbestos Containing Material (ACM) follow section 3.6 under Health and Safety Assessment.
- 2.14 Pressure diagnostics are performed - attics, basements, crawls, building sections where thermal and pressure boundary alignment are questioned (attached porches, bulkheads, etc.), attached garages, pressure pan testing on ducts as appropriate, interior room and main body pressures (done with furnace fan only) - evaluation of the results to assist in work scope development is required.
- 2.15 Infrared camera used as appropriate (specifically for blower door testing).
- 2.16 Existing exhaust fans are measured for flow and other data gathered to calculate ASHRAE ventilation requirements.
- 2.17 Client communication before leaving the initial audit. Give the client specifics on workflow and who will show up next. Finish any client education.

## 3.0 Health and Safety Assessment

Health and Safety (H&S) funds may be used when the elimination of hazards is necessary before, or as a result of, the installation of weatherization material; and Health and Safety spending is limited to 50% of the total job cost, and the limit is reasonable in light of the primary energy conservation purpose of the Weatherization Assistance Program. H&S measures do not require a Savings to Investment Ratio (SIR) and are not included in the Average Cost Per Unit. Health & Safety measures are billed to their own line item. Mandatory H&S Measures include - Installation of smoke detectors shall be placed in accordance with all State Of Michigan and Local Fire/Building Codes; Clothes dryers shall be vented to the exterior; Ventilation to meet ASHRAE 62.2 version 2019 or later; Carbon Monoxide (CO) Alarm/Detector in all residences containing a combustion appliance or an attached garage.

Reporting of Emergency Situation Requirements: Reporting the emergency is not an indication for action to be taken by the State's Weatherization Office, it is just a reporting requirement to track emergency situations. Agencies must submit an email to the MDHHS-BCAEO@michigan.gov within 24 hours to report the Health and Safety issues identified. The email should include the job number, the reason for the issue, and the remedy of the life-threatening situation. In addition, please provide the timeline and people involved in the response taken in the email. Full documentation on the issues identified, response taken with the timeline, results of response action, and a notification email to the BCAEO must be uploaded in FACSPRO.

To safeguard the lives and well-being of both subgrantee employees and weatherization clients, auditors are required to conduct a health and safety (H&S) assessment during the initial home audit, before any weatherization work can begin. Identified H&S issues must be documented and corrected before work proceeds if such repairs are cost-effective and feasible. Where problems are beyond the scope of the program, the homeowner and the client must be notified of the problem(s) in writing and an explanation of the deferral process must be discussed and documented. The following areas must be assessed for H&S issues and addressed if found to be deficient:

**3.1 Indoor Air Quality and Ventilation:** All dwellings weatherized shall be evaluated for ASHRAE 62.2 version 2019 or later ventilation requirements. Compliance requirements (e.g. testing, calculations, fan sizing, fan speed rating, whole-home fan flow verification, continuous vs. intermittent fan specifications, file documentation, etc.) shall be performed by a certified person. SOM IWC venting calculations shall be used to determine mechanical sizing requirements. When calculations indicate 15 CFM or less, goals will be considered met and additional mechanical ventilation shall not be added. Method of compliance shall be documented on the 62.2 tab in FACSPRO.

## 3.0 Health and Safety Assessment

- Identification of sources of indoor air pollutants; chemicals posing a health risk to workers or clients.
- Evaluation of terminations of all exhaust fans and clothes dryer vents.
- Evaluation of existing ventilation systems in the dwelling.
- Inspection of clothes dryer vents for restrictions, lint build-up, and appropriate venting configuration.

**3.2 Moisture Control:** The energy auditor shall include the following but is not limited to: drainage, gutters, downspouts, extensions, flashing, sump pumps, dehumidifiers, landscape, leaking roofs, vapor retarders, moisture barriers, etc. All dwellings shall be checked for previous or existing moisture problems. Audit procedures shall include a mold and moisture assessment. The assessment shall be a visual review that includes these four categories:

- General building envelope
- Outside/Site
- HVAC
- Occupied space

For testing, the home will need a visual assessment including exterior drainage. Diagnostics (such as moisture meters) are recommended for pre-weatherization and at the final inspection. Mold testing is not an allowable cost. Client Education will also need to be provided as follows:

- Visual inspection and issuance of EPA guidelines/pamphlet for remedy.
- Provide client written notification and disclaimer on mold and moisture awareness.
- Provide information on the importance of cleaning and maintaining drainage systems.
- Provide information on proper landscape design and how this impacts site drainage and moisture control.

## 3.0 Health and Safety Assessment

- When deferral is necessary, provide information in writing describing conditions that must be met before weatherization work can begin.

### 3.3 Structural & Other Problems:

DOE funds will be used for incidental repairs of Building Structure and Roofing, see the incidental repair policy [CSPM 607](#).

Projects beyond the scope of weatherization will be deferred until the area of repairs can be corrected through other funding sources. Referral shall be made through the Notice of Potential Hazard and recommendations to seek a building inspection by a licensed building Quality Control Inspector (QCI) or contractor. Some areas to look for these concerns could be:

- Roofing and attic condition
- Siding condition
- Foundation condition
- Interior and exterior wall, floor, and ceiling condition
- Homes under renovation or under construction

### 3.4 Electrical Wiring: An electrical wiring inspection assessment must be conducted.

Electrical fires and shocks are common and serious safety problems. Electrical safety is a basic housing need, requiring attention during weatherization and repair. Observe local codes and the following specifications for electrical safety in weatherizing existing buildings.

- When any weatherization, health, or safety procedure requires working with line voltage power, a licensed electrician, or a qualified technician must do the procedure.
- Whenever working around wiring, use a non-contact voltage tester to determine if circuits are live. Turn circuits off at circuit breakers as appropriate.
- Confirm that all wire splices are enclosed in electrical junction boxes. If you plan to cover a junction box with insulation, attach a flag to mark its location.

## 3.0 Health and Safety Assessment

- Don't allow metal insulation shields to contact wiring.
- Verify the electrical system is grounded to a ground rod or a metallic water pipe with an uninterrupted electrical connection to the ground. If installing insulation, and knob and tube wiring is present, refer to Michigan's Weatherization Field Guide for directions on how to proceed.
- When you doubt the safety of a building's electrical system, use a generator to power insulation blowers and other large power tools.

**3.5** Decommission **knob-and-tube wiring** before or during weatherization if possible. Try to convince your clients or their landlords to replace knob-and-tube wiring with their own funds to avoid a deferral. Use a non-contact voltage tester to determine whether the knob-and-tube wiring is live. If you're unsure about whether the wiring is still live, schedule an inspection by an electrician. If the knob-and-tube wiring in an attic is live, ask an electrician and/or an electrical inspector to determine whether the attic wiring can be decommissioned and replaced with non-metallic (NM) sheathed electrical cable. Depending on the situation, the electrician may choose one of these two options.

1. Terminate the existing attic knob-and-tube wiring, and connect the new NM circuit directly to the main service box.
2. Install a flagged junction box in the attic to connect the knob-and-tube riser to the new NM cable in the attic.

**3.6 Asbestos:** Assess potential asbestos hazards.

When friable Asbestos Containing Material (ACM) is suspected, in the home, the blower door test will not be conducted to avoid disturbing friable ACM particles. When friable ACM is identified in the home, the blower door test will not be conducted to avoid disturbing ACM particles and the work will be deferred until all asbestos materials have been safely removed and disposed of by an authorized agency. The client must provide documentation that a certified professional performed the removal or remediation of asbestos and the client must provide results of the Air Quality Testing (to ensure air quality is safe for workers) in cases where a home was deferred due to ACM and then later approached for weatherization.

## 3.0 Health and Safety Assessment

### 3.7 **Lead Paint:** Lead paint removal is not an allowable activity under the Weatherization Assistance Program.

- Testing to determine the presence of lead in paint that will be disturbed by WAP measure installation is allowed with [Environmental Protection Agency \(EPA\)](#) approved testing methods.
- All weatherization Energy Auditors are to be trained and certified in Environmental Protection Agency's LRRP Rule requirements.
- Issue EPA pamphlet or safe work practices around the home.
- Follow pre-renovation education provisions for LRRP.
- When deferral is necessary, provide information in writing describing conditions that must be met in order for weatherization to commence.

### 3.8 **Fuel Leaks:**

- When a minor gas leak is found on the utility side of service, the utility service must be contacted before work may proceed.
- Fuel leaks that are the responsibility of the client (vs. the utility) must be repaired before weatherization can begin.
- Notify utilities and temporarily halt work when leaks are discovered that are the responsibility of the utility to address.
- Test exposed gas lines for fuel leaks from utility coupling into and throughout the home.
- Conduct sensory inspection on bulk fuels to determine if leaks exist.

### 3.9 **Pests:**

- All work will be deferred until all infestation of pests are eliminated from work site because it poses a H&S concern for workers.
- Inform the client in writing of any observed conditions and associated risks.

## 3.0 Health and Safety Assessment

- When deferral is necessary, provide information in writing describing conditions that must be met in order for weatherization to commence.

### 3.10 Radon:

- Radon mitigation is not an allowable H&S cost. No testing for Radon will be done.
- Clients must sign an informed consent form prior to receiving weatherization services. This form must be kept in the client file.
- Whenever site conditions permit, cover exposed dirt floors within the pressure/thermal boundary with 6 mil (or greater) polyethylene sheeting, lapped at least 12" and sealed with appropriate sealant at all seams, walls and penetrations.
- Other precautions may include but are not limited to, sealing any observed floor and/or foundation penetrations, including open sump pits, isolating the basement from the conditioned space, and ensuring crawl space venting is installed.
- Auditors, assessors and inspectors must have knowledge of radon, what it is and how it occurs, including what factors may make radon worse, and precautionary measures that may be helpful.

## 4.0 Combustion Appliance Assessment

- 4.1** Carbon Monoxide (CO) alarms shall be installed in each dwelling unit in compliance with NFPA 720. CO alarms shall be installed in all residences containing a combustion appliance or an attached garage. Carbon monoxide alarms shall be installed by the Energy Auditor during the audit in a dwelling under the following circumstances:
- Whenever a local agency must defer work and the dwelling unit contains an unsafe combustion appliance
  - A combustion appliance is emitting unsafe levels of CO that cannot be immediately remedied
  - A combustion appliance has minimal draft and/or spillage and no CO is being produced
  - The dwelling contains a fireplace or wood-burning stove that draws combustion air from inside the dwelling.
  - CO alarms must be installed where alarms are not present or are inoperable.
- 4.2** Where solid fuel-burning equipment is present, fire extinguishers may be provided as an allowable health and safety measure.
- 4.3** Ambient Air Monitoring for CO: The Standard Work Specifications (SWS) require CO monitoring during combustion testing to ensure that CO in the combustion appliance zone (CAZ) doesn't exceed dangerous levels.
- If ambient CO levels in the CAZ exceeds 70 ppm, stop testing for your own safety. Communicate the situation clearly to the client, immediately evacuate the home, and contact the appropriate personnel.
  - If ambient CO levels in the CAZ exceeds 35 ppm, but is less than 70 ppm, communicate the issue clearly and immediately to the client and suggest appropriate solutions.
  - Ventilate the CAZ thoroughly before resuming combustion testing.
  - Investigate indoor CO levels (which are greater than outdoor ambient levels) to determine their cause

## 4.0 Combustion Appliance Assessment

- 4.4 Examine appliances for signs of damage, misuse, improper repairs, and lack of maintenance.
- 4.5 Inspection of combustion venting systems for damage, leaks, disconnections, inadequate slope, and other safety hazards.
- 4.6 Place the Combustion Appliance Zone (CAZ) under worst-case depressurization conditions. Then perform a worst-case CAZ test.
- 4.7 Follow the steps below to find the worst-case depressurization level in the combustion appliance zone (CAZ).
  - 1. Turn off or set to pilot all vented combustion appliances.
  - 2. Close all exterior doors, windows, and fireplace damper(s). Open all interior doors, including closet doors.
  - 3. Turn off all operating exhaust appliances including clothes dryers and occupant ventilation fans.
  - 4. Remove furnace filter. Be sure the filter slot is covered for the test.
  - 5. Record the baseline pressure of the CAZ with reference to outdoors.
  - 6. Turn on the clothes dryer and exhaust fans. (Clean clothes dryer filter.)
  - 7. Open interior doors to negative-pressure zones (rooms with exhaust fans) and close the doors to all other rooms off the main body. Use smoke or a manometer to verify room pressures across doors that separate sections of the main body or to a door you are just not sure about. Position doors to create the greatest negative pressure in the CAZ.
  - 8. Open and close the CAZ door. Record the most negative pressure and note CAZ door position.
  - 9. Turn on the furnace air handler. Reposition interior doors as appropriate. Smoke or pressure test doors to rooms with exhaust fans, returns, or doors that you are not sure about. Position doors accordingly.

## 4.0 Combustion Appliance Assessment

10. Open and close the CAZ door. Record the most negative pressure, and note CAZ door position.
11. Calculate the net difference between the worst depressurization found from either #8 or #10 and the baseline pressure from #5. This is the worst-case depressurization.
12. CAZ depressurization levels should be evaluated carefully. Be suspicious if CAZ levels are more negative than -2 and particularly when -3 or greater and the appliances appear to function properly. Make sure wind is not helping the combustion appliances to vent. CAZ testing is best done on calm days.
13. Use the following troubleshooting chart to assist in specifying appropriate improvements when combustion appliances back-draft or do not function properly when tested under worst-case.
14. Auditors - Use the House Depressurization chart to help predict potential post-Wx depressurization levels.

## 4.0 Combustion Appliance Assessment

		<b>CAZ DOOR</b>	
		<b><u>OPEN</u></b>	<b><u>CLOSED</u></b>
<b>F O R C E D  A I R  B L O W E R</b>	<b><u>OFF</u></b>	<b>Negative number</b> (1)	<b>More negative from #1</b> (2)
		Causes: <ul style="list-style-type: none"> <li>Exhaust appliances</li> </ul> Repairs: <ul style="list-style-type: none"> <li>Eliminate/reduce CFM of exhaust</li> <li>Isolate appliances/CAZ from exhaust</li> <li>Replace the combustion appliances</li> <li>Provide make-up air (not realistic)</li> </ul>	Causes: <ul style="list-style-type: none"> <li>Exhaust appliances in the CAZ or affecting the CAZ</li> </ul> Repairs: <ul style="list-style-type: none"> <li>Eliminate/reduce CFM of exhaust</li> <li>Isolate appliances/CAZ from exhaust-interior and exterior connections</li> <li>Replace appliances - sealed combustion furnaces, electric or power vented water heaters, etc.</li> <li>Pressure relieve CAZ to the house</li> <li>Provide make-up air (not realistic)</li> </ul>
	<b><u>ON</u></b>	<b>More negative from #1</b> (3)	<b>More negative from #3</b> (4)
		Causes: <ul style="list-style-type: none"> <li>Supply duct leakage to the exterior of the structure</li> <li>Interior door closure</li> </ul> Repairs: <ul style="list-style-type: none"> <li>Seal supply ducts</li> <li>Pressure relieve interior rooms</li> </ul>	Causes: <ul style="list-style-type: none"> <li>Return duct leakage in the CAZ</li> </ul> Repairs: <ul style="list-style-type: none"> <li>Seal return ducts in the CAZ</li> </ul>
		<b>More positive</b>	<b>More positive</b>
		Causes: <ul style="list-style-type: none"> <li>Return duct leakage to the exterior of the structure</li> <li>Interior door closure</li> </ul> Repairs: <ul style="list-style-type: none"> <li>Seal return ducts</li> <li>Pressure relieve interior rooms</li> </ul>	Causes: <ul style="list-style-type: none"> <li>Supply duct leakage in the CAZ</li> </ul> Repairs: <ul style="list-style-type: none"> <li>Seal supply ducts in the CAZ</li> </ul>

Baseline (Stack Effect) is present in each quadrant - neg or pos

- 4.8** Spillage testing must be completed for all natural-draft appliances. Spillage must first be tested under worst-case conditions and then repeated for natural conditions if the appliance fails under worst-case. If an appliance fails spillage or CO at worst case depressurization, specify measures to correct CAZ depressurization.
- 4.9** With the CAZ in the worst case depressurized state, test spillage on the smallest BTU appliance first. If spillage in a combustion appliance, with a warm vent or domestic water heater exceeds two minutes during pressure testing, measures will be specified to mitigate. Similarly, if spillage in a combustion appliance, with a cold, vent exceeds five minutes during pressure testing, measures will be specified to mitigate

## 4.0 Combustion Appliance Assessment

**4.10** Verify that the combustion gases don't spill or contain excessive CO at worst-case depressurization. Test each appliance in turn for spillage and CO as described below:

- Check for flue-gas flow in the venting system. Feel the vent connector for heat. The vent connector should start warming within 5 seconds if it establishes flue-gas flow. If the vent connector remains cold, stop the test and investigate.
- Detect spillage at the draft diverter of each combustion appliance in one of these ways.
  1. Smoke from a smoke generator is repelled by spillage at the draft diverter.
  2. A mirror fogs from spillage at the draft diverter
  3. If spillage in one or more appliances continues at worst-case depressurization for 2 minutes or more, take action to correct the problem.
  4. Measure and record vent pressure in each category 1 appliance after 5 minutes.
  5. Measure CO in the undiluted flue gases of each vented space heater or water heater after 5 minutes of operation at worst-case depressurization. If CO in undiluted flue gases is more than 100 ppm as measured or 200 ppm air-free measurement, take action to reduce CO level.
  6. Measure CO in the undiluted flue gases of each furnace or boiler after 5 minutes of operation at worst-case depressurization. If CO in undiluted flue gases is more than 100 ppm as measured or 200 ppm air-free measurement, take action to reduce CO level. The maximum allowable CO in undiluted flue gases is 200 PPM as measured or 400 PPM air-free but only after all reasonable attempts have been made to reduce CO production.

## 4.0 Combustion Appliance Assessment

**Table 1: CO Thresholds for Fossil Fuel-Fired Combustion Appliances  
(from ANSI/BPI-1200, Section 7.95)**

CO Thresholds for Fossil-Fuel Fired Combustion Appliances	
Appliance	Threshold Limit
Central Furnace (all categories)	400 ppm air free <sup>4</sup>
Boiler	400 ppm air free
Floor Furnace	400 ppm air free
Gravity Furnace	400 ppm air free
Wall Furnace (BIV)	200 ppm air free
Wall Furnace (Direct Vent)	400 ppm air free
Vented Room Heater	200 ppm air free
Unvented Room Heater	200 ppm air free
Water Heater	200 ppm air free
Oven/Broiler	225 ppm as measured
Clothes Dryer	400 ppm air free
Refrigerator	25 ppm as measured
Gas Log (gas fireplace)	25 ppm as measured in vent
Gas Log (installed in wood burning fireplace)	400 ppm air free in firebox

- 4.11** Gas ovens can release CO, natural gas, or propane into a kitchen. Test the burners for safe combustion with these steps and do the recommended improvements.
1. Test for gas leaks in the gas piping in and around the range and oven and seal the leaks.
  2. Turn the oven burner and then range burners to high one-by-one. Inspect the flames and test them for CO. For the oven burner test at its outlet. For range burners, hold the test probe approximately 8 inches above the flame.
  3. After 10 minutes, if the CO reading for the oven exceeds 225 ppm or any of the range top burners exceeds 100 ppm, recommend the client have the unit serviced.
  4. DOE funds cannot be used to replace ranges.

## 4.0 Combustion Appliance Assessment

5. Burner orifices can clog. Clean dirty orifices with a multi-tool designed for cleaning various sized orifices.
6. Adjust the burner's air shutters to stabilize and harden the flame and reduce yellow-tipping, which should also reduce the CO concentration.

- 4.12** Assess solid fuel-fired appliances to ensure safe installation before weatherization activities take place. Repair or removal is an allowed H&S measure for primary and secondary solid fuel-fired heating appliances. Replacement is allowed for primary solid fuel heating appliances but replacement is not allowed for secondary heating appliances. Repair of flues and proper installation (e.g. protection of combustibles), is required for both primary and secondary solid fuel heating appliances. Install replacement primary heaters and/or flues according to applicable codes, standards and manufacturer's instructions. Provide adequate combustion air.

Inspection/Evaluation: Assessing solid fuel-fired appliances involves inspecting the venting/chimney and the overall installation to ensure it adheres to the applicable code: NFPA 211 or other as determined by the authority having jurisdiction. Appliances should be inspected pre- and post-weatherization.

- 4.13** Smoke detectors are required as a health and safety measure. Smoke detectors shall be battery powered, installed in accordance with the manufacturer's recommendations, following state and local code requirements. New batteries may be installed in existing-working smoke detectors. (Alkaline are recommended).

When installing hardwired smoke alarms, it will be listed and labeled in accordance with UL 217 and installed in accordance with the IRC or as required by the authority having jurisdiction.

Smoke alarms may be installed where alarms are not present/ inoperable.

- New installation of hard-wired devices (smoke detectors) as long as it does not include significant spaces (entrances/entry halls/lobbies, areas for public gathering and circulation, primary rooms). If work occurs in a significant space, work shall not damage historic materials or finishes. New wiring/piping/ductwork, etc. shall be concealed.

## 5.0 Unvented Space Heaters

Unvented space heaters include ventless gas fireplaces and gas logs installed in fireplaces previously designed for wood-burning or coal-burning. The unvented space heaters and fireplaces create indoor air pollution because they deliver all their combustion byproducts to the indoors. Unvented space heaters aren't safe. Replace them with vented space heaters or electric space heaters if at all possible. DOE forbids unvented space heaters as primary heating units in weatherized homes. However, unvented space heaters may be used as secondary heaters, under these requirements and the requirements outlined in the Michigan State Plan:

- The heater must conform to the safety standards of ANSI Z21.11.2.
- The heater must have an input rating of less than 40,000 BTUH.
- The heater must be equipped with an oxygen-depletion sensing shut-off system.
- The room containing the heater must have adequate combustion air.
- CO production from unvented space heaters shall not exceed 200 PPM when measured on an air-free basis.
- The home must have adequate ventilation: See "[ASHRAE Standard 62.2–2016 Ventilation](#)".

## 6.0 Energy Conservation Measures Assessment

All weatherization materials utilized in conjunction with work performed as a part of this program shall, at minimum, meet the NREL Standard Work Specifications and the Standards for Weatherization Materials contained in “Appendix A”, or variances approved by DOE for the State of Michigan, as published in the 10 CFR 440 and DOE WPN 19-4.

Subgrantees must evaluate ECMs in order to establish which measures are cost-effective. The following criteria will be used to establish which ECMs are appropriate for each dwelling:

**6.1 Insulation:** The following insulation must be evaluated for in WA 10 or the latest version.

**NEAT:** Attic R-11, Attic R-19, Attic R-30, Attic R-38, Attic R-49, Filling Ceiling Cavity, Sillbox insulation, Floor R-11, Floor R-19, Floor R-30, Floor R-38, Wall Insulation, Kneewall Insulation, Duct Insulation, Foundation Wall Insulation

**MHEA:** Wall Fiberglass batt insulation, Wall cellulose loose insulation in Addition, Wall fiberglass loose insulation, Wall fiberglass loose insulation in Addition, Wall Fiberglass batt in Addition, Floor cellulose loose insulation in Addition, Floor fiberglass loose insulation, Floor Fiberglass loose insulation in Addition, Roof cellulose loose insulation in Addition, Roof fiberglass loose insulation, Roof fiberglass loose insulation in Addition, Insulation for Belly Repairs.

- Measuring the dimensions of the building.
- Documenting the net wall and attic square footage.
- Determining and documenting the thermal boundary; defined as the separation between the interior and exterior environments of a building that slows heat flow and is typically the alignment of the air and insulation boundary.
- Locate and document crawl space/basement entrance.
- Additions to the dwelling.
- Inspect the attic for the presence, depth, and type of insulation.
- Check exterior walls for insulation, cavity depth, and batt thickness.
- Calculate the estimated number of insulation bags, rolls of insulation, or other materials needed to complete the job.

## 6.0 Energy Conservation Measures Assessment

- Check remodeled areas and additions separately.
- Check the crawlspace, exposed floors, belly, or basement box sills for insulation.
- Note evidence of moisture transport, condition, and amount exposed above exterior grade at the perimeter foundation and basement walls.
- Document the existing inches of insulation for building components that comprise the thermal boundary and determine the capacity of an insulating material to resist heat flow ( R-value).

**6.2 Windows:** The following window/door measures must be evaluated for in WA 10 or the latest version.

**NEAT:** Window sealing, Storm Windows, Window Replacement, Low E windows, Door Replacement

**MHEA:** Replace marked doors (mandatory), Replace wooden doors in Addition, Storm Doors, Storm Doors in Addition, Window Sealing, Window Sealing in Addition, Replace single-paned windows, Rpl single pane windows in Addition, Plastic storm windows, Plastic storm windows in Addition, Glass Storm Windows, Glass Storm Windows in Addition

**6.3 Baseload:** The following measures must be evaluated for in WA 10 or the latest version: Water Heaters, Refrigerators, Faucet Aerators, and Compact Fluorescent Light bulbs or LED bulbs.

Baseload assessment must include:

- Evaluation of refrigerator energy consumption via a database or metering (for a minimum of 2 hours). Refrigerators must be assessed for replacement. The refrigerator being replaced must be surrendered without exception.
- Evaluation of water heater manufacturer, model, fuel type, location, size, rated input, input unit, energy factor, efficiency. Checking for H&S concerns including backdrafting, proper pitch for venting, and clearance from combustibles. The pressure-and-temperature relief valve needs a discharge line that terminates less than 6 inches from the floor into a floor drain or drain pan.

## 6.0 Energy Conservation Measures Assessment

- LED's will utilize the baseload tab in Weatherization Assistant 10 or the latest version for NEAT and MHEA. Agencies must fill out the existing lighting system information. Agencies must change the Replacement Compact Fluorescent Light size (watts) box to the comparable LED wattage. If not, NEAT/MHEA will automatically provide a default entry. Remember to change the costs in your setup library to reflect your LED lighting costs. LED bulbs shall have a minimum 15-year life span and minimum 25000-hour average life. All bulbs, fixtures, and controls will be ENERGY STAR® rated. All bulbs, fixtures, and controls will be Underwriters Laboratories (UL) approved and installed in accordance with local code(s) and National Fire Protection Association (NFPA), [www.nfpa.org](http://www.nfpa.org) 70 National Electric Code. LED Bulbs shall be used to replace existing incandescent light bulbs only. Annual energy savings will be based on a three-hour usage per day.
  - » LED bulbs must be omnidirectional
  - » LED bulbs must be soft- or warm-white to provide the hue similar to incandescent bulbs (unless the client requests brighter light)
  - » All LED bulbs installed must be ENERGY STAR® (version 2.0) rated
  - » LED bulbs installed in a dimmable socket must be designed to work with traditional dimmer switches
  - » LED bulbs installed in an enclosed housing must be approved for recessed or enclosed spaces
  - » LED bulbs will be installed with client permission in each house.
  - » LED bulbs must be installed where instructed in the work order.
  - » Weatherization workers may not leave the bulbs with the client to install.

## 6.0 Energy Conservation Measures Assessment

### 6.4 Air Sealing:

- The blower door shall be used at the audit and inspection as a diagnostic tool to measure the air tightness of buildings and to help locate air leakage sites.
- Air Leakage Rate- A before weatherization blower door number must be achieved at house a house pressure difference of 50 (Pa).
- After-Weatherization Target- This number is what the energy auditor believes the blower door number can be reduced to after air sealing is complete.
- Zone pressure diagnostic testing is required for attics and for attached garages. It is encouraged for other areas of the home as a diagnostic tool. Room pressures during air handler operation must be tested. For details on the process of testing room pressures or performing zone pressure diagnostics, refer to the Michigan Weatherization Field Guide.
- Pressure pan testing is required in any homes where ducts are outside of the conditioned space, including all manufactured homes. If the pressure pan reading is above 1 PA on any duct outside the conditioned space for site-built or for manufactured housing, sealing must be performed. For details on the process of pressure pan testing, and sealing ducts, refer to the Michigan Weatherization Field Guide.
- Document major air leakage holes and bypasses.
- Any ductwork outside the conditioned space needs to be evaluated and insulated to R-8.

### 6.5 Heating System: The following heating measures must be evaluated for in WA 10 or the latest version.

**NEAT:** Electric vent damper IID, Furnace Tune-ups, Replace Heating System, High Eff Furnace, High Eff Boiler, Smart thermostat, Install/Replace heat pump

**MHEA:** Setback Thermostat, Tune heating system, Replace Heating System

- Evaluation of heating appliance(s) operation, condition, and efficiency.

## 6.0 Energy Conservation Measures Assessment

- Evaluation of heating and cooling distribution system/s operation, condition, and efficiency. Include R-value of duct system.
- Assess and evaluate existing thermostat for ECM replacement with Smart or programmable thermostat.
- Assess and evaluate the heating system for ECM replacement.

**6.6 Faucet aerators:** Faucet aerators must be evaluated on every dwelling. Faucet Aerators are to be added as a User Defined Measure.

## 7.0 Optional Energy Conservation Measures

Grantees may install the identified General Heat Waste reduction measures listed below, known as Optional Weatherization Measures, on one to four-unit dwellings, without a need for justification in a site-specific energy audit. Optional Measures are intended to be relatively low-cost items that can be quickly and easily installed. Measure costs, including labor, must not exceed \$250.00 total. These measures must provide additional benefit to the client/customer and are not able to be tied to another measure.

An Optional Measure may be skipped for any documented reason (including declined by the client). Optional Measures are not prioritized by the energy audit tool and are not turned on inside the audit.

Optional Measures include: Water heater tank wrap, Water heater pipe insulation, and Low-flow showerheads.

Optional measures must be turned off in each agency's setup library. Optional measures will utilize the Itemized Cost/User Defined Measures tab of NEAT and MHEA. Optional Measures are not to be included in the SIR. Optional Measures will appear as itemized costs on the Work Order, and as OP- Optional Weatherization Costs in your cost center material list.

## 8.0 Work Order Determination and Development

- 8.1 Energy Conservation Measure:** A procedure, including weatherization materials and installation, which is considered or performed for its anticipated energy savings. Ancillary Items: Items necessary for the proper installation of weatherization (energy conservation) materials are included in the cost of the ECM.
- 8.2 Incidental Repair Measure:** An Incidental Repair Measure (IRM) is defined as a repair necessary for the effective performance or preservation of newly installed weatherization materials, but not part of a standard installation. IRM installations must be associated with a specific Energy Conservation Measure (ECM) or group of ECMs. IRMs must be justified by written and photo documentation in the client file. IRM costs must be included in the SIR calculation of the total package of weatherization measures. The total costs of all IRMs are added to the cost of the package of weatherization measures to calculate the whole unit SIR (CSIR). See [CSPM 607](#) for further details.
- Incidental repairs must be justified by written and photo documentation in the client file. All incidental repairs must be documented in the itemized cost section of WA 10 or the latest version with the measure name starting with IR.
- 8.3 Health and Safety Repair:** Allowable health and safety measures are those measures that are necessary to maintain the physical well-being of both the occupants and/or weatherization workers where the actions must be taken in order to effectively perform weatherization work or are necessary because of weatherization activities. Reasonable Costs are those which do not cause a subgrantee to exceed their annual per-unit average allowance.
- Determine from the site-specific audit recommended measure report which measures are cost-effective. Only ECM's that have a SIR of 1.0 or greater may be installed with the exception of air sealing.
  - H&S items must be installed prior to ECM's being installed.
  - Select energy related health and safety problems to correct. All health and safety repairs will be listed on NEAT/MHEA recommended measure report.
  - There are some instances where, depending on circumstances, the measure can be considered either a health and safety measure OR an energy conservation measure (e.g., furnaces). In those instances where the measure has a cost-effective savings-to-investment ratio (SIR) of one (1.0) or greater, the measure should be treated as an ECM. See WPN 17-7.

## 8.0 Work Order Determination and Development

- Determine if incidental repairs are necessary and cost-effective for the home. Incidental repairs must be listed on NEAT/MHEA recommended measure report and a cumulative SIR (total project) of 1.0 maintained.
- Provide a work order with detailed specifications for crews or contractors, as necessary, to understand the materials and procedures necessary to complete the job. Inform crews or contractors of any hazards, pending repairs, and important procedures related to their part of the work order.
- Modular homes are typically constructed using a similar design to site-built homes. Report them as Site Built “NEAT”. If the sub-floor area more closely resembles a mobile home, treat it as you would a mobile home.

## 9.0 Technical Weatherization Install Requirements

### 9.1 PURPOSE:

The purpose of this policy is to identify and define technical weatherization installation requirements on homes to ensure worker safety and client safety.

### 9.2 POLICY:

All measures installed in the Michigan WAP must meet the following requirements to ensure the safety of the home and to ensure proper weatherization of each home weatherized.

### 9.3 Allowable Measures:

All weatherization materials utilized in conjunction with work performed as a part of this program shall, at minimum, meet the NREL Standard Work Specifications and the Standards for Weatherization Materials contained in "Appendix A", or variances approved by DOE for the State of Michigan, as published in the 10 CFR 440 and DOE WPN 19-4. In cases where additional requirements apply, the specific requirement(s) will be listed in the appropriate section of this document.

All measures shall be completed so as to successfully perform the intended function on a continuing basis (a quality of product and installation to provide a minimum 10-year life under normal conditions or WA10 lifespan generated SIR).

Work shall be completed in a manner so as not to detract from the general appearance and structural integrity of the home and shall be in compliance with governing codes, the requirements of this document, and manufacturer's recommendations.

Weatherization measures are for the purpose of rendering the heated portions of dwellings energy efficient and to ensure the safety and protection of such measures, whether new or existing (e.g., any wood or other product which the manufacturer recommends to be sealed, that is used to complete weatherization and which is exposed to moisture, shall receive a minimum of prime painting or other recommended sealer). For the purpose of this program, if necessary client usage of areas requires heat to those areas, they shall be treated as heated and weatherized accordingly. Unheated utility rooms, porches, etc., are not eligible for weatherization.

Health and safety measures shall be addressed as required to eliminate hazards as defined in the Michigan Weatherization Field Guide, and in accordance with the State of Michigan, U.S. DOE Weatherization Assistance Program State Plan, and state and local codes.

## 9.0 Technical Weatherization Install Requirements

If energy savings cannot be realized under this program due to the condition of a home, these conditions shall be documented in the electronic file (i.e. FACSPRO deferred queue or ineligible queue, whichever is applicable) and the home shall not be weatherized. Such conditions shall be brought to the attention of the client with referrals to other resources, if available.

Measures must be installed properly utilizing the Standard Work Specifications outlined in the Michigan Weatherization Field Guide.

### 9.4 Mandatory Health & Safety Measures:

- Installation of smoke detectors
- Client education on appropriate test procedures and intervals to replace the batteries shall be documented.
- Carbon Monoxide (CO) Alarm/Detector are required to comply with ASHRAE 62.2 version 2016 or the latest version in all residences. CO Alarms/Detectors must be tested to verify the operation of installed alarms.
  - » Carbon monoxide alarms shall be installed by the Energy Auditor during the audit in a dwelling under the following circumstances:
    - \* Whenever a local agency must defer work and the dwelling unit contains an unsafe combustion appliance
    - \* A combustion appliance is emitting unsafe levels of CO that cannot be immediately remedied
    - \* A combustion appliance has a minimal draft and/or spillage and no CO is being produced
    - \* The dwelling contains a fireplace or wood-burning stove that draws combustion air from inside the dwelling.
- Implementation of ASHRAE 62.2 ventilation standard is required.
- Clothes dryers shall be vented to the exterior.

## 9.0 Technical Weatherization Install Requirements

### 9.5 Installation of Energy Conservation Measures:

Energy Conservation Measures (ECMs) must be installed in the order of decreasing Savings to Investment Ratio (SIR), starting with the highest and ending with the lowest SIR of 1.0 or greater. “Measure skipping” is defined as follows: Not installing, in order of decreasing SIR, the cost-justified ECMs and related Incidental Repairs Measures (IRM) included in the work scope produced by the Department of Energy (DOE) approved energy audit tool (NEAT/MHEA). Measure skipping is generally not allowed in the WAP. For further details on Measure Skipping, see Measure Skipping Clarification section of this CSPM.

### 9.6 Order of Measure Installation

Measures installation shall be completed in the following sequence:

1. Health and Safety measures to correct hazards identified on the audit that directly affect the health and safety of occupants (WAP staff and workers included).
2. Air sealing.
3. Remaining audit measures in order of decreasing SIR.

### 9.7 Measure Skipping Clarification

- **Measure Skipping**

“Measure skipping” is defined as follows: Not installing, in order of decreasing Savings to Investment Ratio (SIR), the cost-justified Energy Conservation Measures (ECMs) and related Incidental Repairs Measures (IRM) included in the work scope produced by the Department of Energy (DOE) approved energy audit tool (NEAT/MHEA).

- **Major Measure**

“Major Measure” is defined as follows: A high priority measure, which if skipped, would result in “partial” weatherization of a unit. Major measures are as follows: air sealing, duct sealing of ducts outside the thermal boundary, attic insulation, wall insulation, and floor or belly insulation.

- Measure Skipping of cost-justified major measures is not permitted at any time.
- Alteration of the cost-justified work order must be addressed in the following ways for the following situations:

## 9.0 Technical Weatherization Install Requirements

### » **Funding Limitations:**

If all funds available to be spent on the job will not cover the entire work scope, then measures may be removed from the work order starting with the lowest SIR measure and working up the list from there. The work order must remain overall cost-effective or the job must be deferred. Necessary Health and Safety (H&S) measures may NOT be removed from the work order; however, ECMs can be removed.

### » **Prior to work beginning:**

- \* Client education is important to inform a client of planned measures and material use. Resistance from a client to install any measures and/or materials planned as a result of NEAT/ MHEA created work order should be addressed with either additional education and/or re-running the energy audit with a different but acceptable material to determine if the substitute material is cost-effective. If no cost-effective option for the material can be identified, the auditor should again explain and discuss the situation with the building owner or occupant.
- \* If the building owner or occupant still declines a measure, not defined as a major measure, the auditor must include in the client file a comprehensive justification, including background/source documents that support the decision to skip a specific measure. All other weatherization measures must be installed.
- \* If the auditor cannot access background/source documents that justify the building owner/occupant's decision to decline a measure or the measure is defined as a "major measure", the situation must be fully documented in the client file and the job must be deferred due to client refusal.

### » **Inadequate training:**

A lack of training for Grantees is not an allowable reason to skip measures. The standard procedure should be to postpone job(s) requiring priority measures that cannot be installed due to lack of trained staff until adequate training is acquired.

## 9.0 Technical Weatherization Install Requirements

- » **After a job has begun:**

Due to scheduling, measures are sometimes installed with a lower priority first. If during the installation process, the client declines a higher priority measure, work must stop at the time the client declined the higher priority measure. No further installation is allowed and the job must be inspected by a Quality Control Inspector (QCI) and closed out as a completed unit. This should be clearly explained in client file documentation. Some agencies include a statement for client signature that states the client is aware and accepts all WAP rules, including the specific services and measures determined by an energy audit.

- » **Optional Measures:**

The Optional Measures may be skipped for any documented reason (including declined by the client). Optional measures are not prioritized by the energy audit tool. The Optional Measures are listed in the “Optional Measures” section of [CSPM 606.1](#).

- **Fuel Switching:**

The Weatherization Assistance Program (WAP) does not permit the general practice of non-renewable fuel switching when replacing furnaces/appliances. However, DOE does allow the changing or converting of a furnace/appliance using one fuel source to another on a limited, case-by-case basis. These approvals will only be granted when all related costs demonstrate the effectiveness of the fuel switch over the life of the measure.

BCAEO reviews and approves the case-by-case fuel switch requests. Grantees must submit each request to [MDHHS-BCAEO@Michigan.gov](mailto:MDHHS-BCAEO@Michigan.gov) with required submission support and BCAEO will review the submitted information and determine the approval. See [CSPM 610](#) for details on fuel switch submissions to BCAEO.

References: [10 CFR 440](#), [WPN 17-1](#), [WPN 19-4](#), DOE State Plan, [Michigan Weatherization Field Guide](#), [CSPM 606.3](#)

## 10.0 NEAT/MHEA Assessment

Subgrantees are required to use the NEAT/MHEA, for each dwelling. The assessment of all energy conservation measures for both site-built and mobile homes within the NEAT/MHEA software will be run to establish if the measures meet the Savings to Investment Ratio (SIR) of 1:0 or greater.

- For any job completed using DOE funding, the cumulative SIR of the total DOE investment must be 1.0 or greater. Health and Safety, including Lead Safe Work costs, are not included in the calculation of the cumulative SIR.
- Only the qualified Energy Auditor who conducted the site visit shall enter data onto the “Inspection” document generated in FACSPRO and into the initial NEAT/MHEA audit. Audits must include completion of all applicable data of the Inspection document. Inspection approval of each installed measure is mandatory for a dwelling to be considered a completion.
- Grantees shall create and maintain an annual master file, updating the agency’s file most recently approved by BCAEO. Identify the file with the agency acronym and the program year as the title.

## 11.0 NEAT/MHEA Data Collection

The following data must be collected during the energy audit:

### 11.1 Walls :

Energy Auditor must collect the following information on wall types:

- Wall type - platform framing, balloon framing, concrete block, masonry, or stone.
- Structure type - Site-built, Modular, Manufactured.
- Interior finish - drywall, lath and plaster, wood paneling, wallpaper, paint.
- Exterior finish - wood, metal, vinyl, brick/stone (specify if multiple layers)
- Stud size - 2x2, 2x3, 2x4, 2x6, 2x8
- Gross Area (sq ft) - Enter the total gross area of the exterior wall, including the windows and doors. The entry must be in square feet and be greater than zero.
- Orientation- Select the closest cardinal compass direction the wall component faces: (N) - North, (S) - South, (E) - East, (W) - West

### 11.2 Doors and Windows:

Energy Auditor must collect the following data for doors:

- Door type - Identify the type of door. Options are- hollow core wood, solid core wood, insulated steel, single pane sliding glass, double pane sliding glass.
- Door measurements - The energy auditor will need the width and height of each door.
- Storm Door Condition - Options are- adequate, deteriorated, none.

## 11.0 NEAT/MHEA Data Collection

- Door Leakiness - Identify the leakiness category that best describes the fit of the door. Tight-fitting doors will be structurally sound, having fully functional weather stripping, including a tight-fitting door sweep. Loose doors will be ill-fitted, have noticeable leakage sites surrounding them with no or non-functioning weather stripping, and possible structural problems. Options are - tight, medium, loose.

Energy Auditors must collect the following data for windows:

- Window type - Identify the type of windows on the dwelling. Options are fixed, jalousie, awning, slider, door window, skylight.
- Frame type - Identify the correct window frame and sash construction materials. "Improved" metal frames have a thermal break between the inside and outside framing members. Options are- wood or vinyl, metal, improved metal.
- Glazing type - Identify the window glazing type, depending on the number of panes of glass in the primary window and the characteristics of any storm window that may cover the primary window. Options are - double pane, single pane, single with wood storm, single with metal storm, single with bad storm, double pane lowE.
- Interior shading - blinds or shades, drapes, drapes with blinds or shades, none
- Exterior shading % - Enter the approximate percentage of window area frequently shaded by eaves (typically 20%), porches (typically 100%), or other physical exterior barriers.
- Leakiness - Identify the windows as very tight, tight, medium, loose, very loose.
- Measurements of each window - width, height.

### 11.3 Attics:

If the attic is Unfinished Identify the following data:

- Attic type - Identify as floored, unfloored, cathedral, or flat.
- Joist spacing - determine joist spacing in inches.

## 11.0 NEAT/MHEA Data Collection

- Area (sq ft) - Calculate the area in square feet of the ceiling or attic floor that borders the conditioned space.
- Existing insulation - Identify the existing insulation type. Options are - none, blown cellulose, blown fiberglass, rockwool, fiberglass batts, other.
- Depth of existing insulation- Identify the average depth of insulation found in the attic. If applies, identify the total depth in inches insulation may attain.

If the attic is finished identify the following data:

- Attic Area Type - collar beam, outer ceiling joists, knee walls, roof rafters.

For each attic area the following information will also need to be collected:

- Area of the attic type, existing insulation type, and existing depth of insulation in the attic type.

### 11.4 Foundations:

Identify the foundation type:

- Conditioned: Space has thermostat control.
- Non conditioned: No sources of heat.
- Vented: Vented directly to outdoors.
- Unintentionally conditioned: By waste heat from equipment.
- Uninsulated/Insulated Slab: On grade.
- Exposed: Overhang or house on stilts.

Foundation floors require the following data:

- Area (sq ft)- Determine the area in square feet of the floor directly above the foundation space

## 11.0 NEAT/MHEA Data Collection

- Existing Insulation R Value- Determine the R-Value of the existing insulation in the floor over the basement or crawl space.

Foundation sills require the following data:

- Floor Joist Size- Measure the width of the floor joist in inches.
- Perimeter to Insulate- Measure the length, in feet, of the floor perimeter bordering the outdoors.

Foundation walls require the following data:

- Height- Measure the height, in feet, of the basement or crawl space wall. Estimate an average if the height is not uniform
- Perimeter- Measure the length, in feet, of the wall perimeter bordering the outdoors
- Height Exposed- Measure the height, in feet, of the basement or crawl space wall above ground. Estimate an average if the height is not uniform.
- Existing Insulation R Value- Identify the R-Value of insulation currently on the crawl space or basement wall.

### 11.5 Heating:

- Heating Equipment type - Identify the dwellings heating system as gravity furnace, forced air furnace, steam boiler, hot water boiler, fixed electrical resistance, portable electric resistance, heat pump, vented space heater, unvented space heater, other. If more than one type of system exists, select as the primary heating system the one that supplies the majority of heat and to which the heating retrofits will apply. Additional secondary systems will also be identified and data recorded.
- Fuel - Identify the fuel type consumed by the heating system being described as either natural gas, oil, electricity, propane, wood, coal, kerosene, or other.

Identify one of three locations for the heating system:

- » Intentionally heated (space that is under thermostat control);

## 11.0 NEAT/MHEA Data Collection

- » Unheated (space not heated by a mechanical system;
  - » Unintentionally heated (space which is partially heated by waste heat from a furnace, boiler, or other heat-producing appliances
- Manufacture - Identify the name of the manufacturer of the existing heating system if needed for reference, possibly in establishing an appropriate replacement. The information will most often be found on the name-plate of the equipment.
  - Model - Identify the model name or number of the existing heating system if needed for reference, possibly in establishing an appropriate replacement. The information will most often be found on the name-plate of the equipment.
  - Input Rating - Identify the Input Rating of the heating system. The appropriate value can be measured or taken directly from the nameplate of the heating system. The Input Rating is used only with the Output Capacity to provide a Steady State Efficiency.
  - Output Capacity - Identify the output of the heating system in kBtu/hr. The value can be measured or taken directly from the nameplate of the heating system.
  - Steady State Efficiency - Record the measured steady-state efficiency of the heating system. If Input Rating has been entered, the default value will be derived from it and the value of Output capacity.
  - Condition - Identify one of three choices to describe the current condition of the heating system. This entry for the primary system is used in estimating an efficiency increase resulting from a tune-up. The poorer the condition, the greater will be the estimated efficiency increase.

In the event that an energy auditor is unable to perform proper diagnostic testing, see “NEAT / MHEA Steady State Efficiency (SSE) data input” form for guidance on next page. In the instance this is used, the auditor must document why a mechanical contractor was not able to perform the testing as required by the Weatherization program.

# 11.0 NEAT/MHEA Data Collection

## NEAT/ MHEA Steady State Efficiency (SSE) data input

**Purpose:** For use in modifying the measured or nameplate steady-state efficiency (SSE) of existing gas-fired space heating equipment before entering it into NEAT and MHEA.

Currently, measured or nameplate values are entered in the audit software for older, existing gas furnaces. NEAT/MHEA takes SSE and converts it to estimate Annual Fuel Utilization Efficiency (AFUE), which is how newer equipment is rated. The software uses this to assess the savings potential of a furnace replacement. The current software process does not convert the SSE of older gas-fired furnaces to a realistic estimated AFUE. The following will allow for a more accurate analysis.

**Criteria:**

- In site-built homes -only draft hood equipped gas furnaces
- In mobile homes -only standard low efficiency (no draft inducer fan) gas furnaces
- Must be standing pilot
- No vent damper
- Cannot be used in conjunction with the Part Load Reduction Factor for oversized equipment

**NEAT Formula:**

In NEAT, under the "Heating" tab, there will be a section called "Gas Furnace Details". In the box titled "Steady State Efficiency", input an efficiency for the existing unit based on the following formula:

$$(\text{Measured SSE OR nameplate efficiency} \times .80) / .95 = \text{SSE entered in NEAT}$$

Meas/Calc%	72	73	74	75	76	77	78	79	80
NEAT Input	60.6	61.5	62.3	63.2	64	64.8	65.7	66.5	67.4

**MHEA Formula:**

In MHEA, under the "Heating" tab, there will be a sub-tab labeled "Primary". Select "AFUE" in the box titled "Efficiency Units". In the box titled "Efficiency", input an efficiency for the existing unit based on the following formula:

$$(\text{Measured SSE OR nameplate efficiency} \times .80) = \text{AFUE entered in MHEA}$$

Meas/Calc%	72	73	74	75	76	77	78	79	80
MHEA Input	57.6	58.4	59.2	60	60.8	61.6	62.4	63.2	64

**Examples:**

Existing equipment efficiency can be measured by a combustion analyzer (78% SSE for example) or calculated (nameplate states 90,000 Btuh input and 70,000 Btuh bonnet/output capacity -70K divided by 90K = 78%)

NEAT: 78% measured or calculated on a draft hood furnace -you would input an SSE of 65.7% into NEAT

MHEA: 78% measured or calculated on a standard low-efficiency furnace -you would input an efficiency of 62.4% into MHEA after selecting "AFUE" in the "Efficiency Units" field

## 11.0 NEAT/MHEA Data Collection

- Thermostat - Indicate whether the existing thermostat control allows automatic (“smart”) setback of the heating setpoint.
- IID - Indicate whether the primary heating system uses an IID (intermittent ignition device). This device consists of an electric igniter that eliminates the need for a standing pilot light.
- Vent Damper - Indicate whether the heating system flue is equipped with an electric vent damper.

### 11.6 Cooling:

- Equipment Type - Identify the cooling system as one of the following - central air conditioner, window or room air conditioner, heat pump, evaporator cooler.
- Manufacturer - Identify the name of the existing air-conditioner’s manufacturer if needed for reference, possibly in establishing an appropriate replacement.
- Model - Identify the model number of the existing air-conditioner if needed for reference, possibly in establishing an appropriate replacement.
- Floor Area Cooled - Measure the floor area in square feet of that part of the house cooled by the air-conditioner. The sum of all areas cooled by listed equipment may be less than the total floor area of the house, but should not be greater.
- Capacity (kBtu/hr) - Identify the output capacity of the unit in Kbtu/hr. The value is often printed on the nameplate of the air conditioner.
- SEER- Enter the SEER (Seasonal Energy Efficiency Ratio) of the unit. Window units may be rated with EER. Use the following to convert:

$$\text{SEER} = (1.2 \times \text{EER}) - 0.7 \text{ (fan runs only when cooling)}$$

$$\text{SEER} = (0.9 \times \text{EER}) + 0.1 \text{ (fan runs continually).}$$

## 11.0 NEAT/MHEA Data Collection

### 11.7 Duct Insulation:

- Location - Identify the location of the uninsulated duct as either Attic or Subspace. If the Location is “Subspace,” the duct is assumed to be in the largest unintentionally heated space described by the auditor in the foundation space. If the location is “Attic,” an attic environment is assumed surrounding the duct.

For Round Ducts:

- Length- Measure the length, in feet, of uninsulated duct in unconditioned spaces.
- Diameter- Measure the length, in feet, of uninsulated duct in unconditioned spaces.

For Rectangular Ducts:

- Length- Measure the length, in feet, of uninsulated duct in unconditioned spaces.
- Width- Measure the width, in inches, of uninsulated duct in unconditioned spaces.
- Height- Measure the height, in inches, of uninsulated duct in unconditioned spaces.

### 11.8 Infiltration:

- Air Leakage Rate- A before weatherization blower door number must be achieved at a house pressure difference of 50 (Pa)
- After-Weatherization Target- This number is what the energy auditor believes the blower door number can be reduced to after air sealing is complete.

### 11.9 Lighting:

- Room - Identify the room in which the lights being described are located.
- Location - Identify one of five lamp locations for the existing lamp location: Ceiling, Floor, Table, Wall, or Other.

## 11.0 NEAT/MHEA Data Collection

- Lamp Type - Identify one of three existing incandescent lamp types: Standard, Flood or Reflective (Spotlights) or Other.
- Quantity - Identify the number of lamps having the description given and which are candidates for replacement with LEDs.
- Size (watts) - Identify the wattage of the existing incandescent lamp that is to be replaced. Standard incandescent lamp wattages are 25, 40, 50, 60, 75, 90, 100, and 150.
- Use (hours/day) - Identify the average number of hours per day the lamp is normally on. The value must be 24 or less.
- Replacement Light - Enter the wattage of the LED that is to replace the existing lamp.

### 11.10 Water heater:

- Manufacture - Identify the existing water heater's manufacturer's name.
- Fuel - Identify the fuel used by the existing and replacement water heaters from the three choices: Natural Gas; Electric; or Propane.
- Location - Identify one of three locations for the water heater:
  - » Heated Space (space that utilizes a thermostat to control its temperature)
  - » Unheated Space (space not heated by a mechanical system)
  - » Unintentionally Heated (space which is heated by waste heat from furnace, boiler, or other heat-producing appliance).
- Size (gal) - Identify the standard rated tank capacity in gallons.
- Model- Identify the existing water heater's model number.
- Rated Input- Identify the rated input power, the rate at which the water heater consumes energy while operating. The units can be either kW for electric heaters or kBTU/hr for natural gas or propane units.

## 11.0 NEAT/MHEA Data Collection

- Recovery Efficiency- refers to the amount of water heated to a set temperature, per hour.
- Energy Factor- based on the amount of hot water produced per unit of fuel consumed over a typical day.

### 11.11 Faucet Aerators:

Creation of a User Defined Measure (UDM) for faucet aerators

Currently, there is no mechanism in Wx Assistant to input faucet aerators as an Energy Conservation Measure (ECM) with an SIR in the Measures Report. Use the following DoE approved guidance to create a UDM for faucet aerators in your NEAT and MHEA audit inputs. You will need to create two measures – one for gas and one for electric.

- Open your appropriate Setup Library
- Navigate to the User Defined Measures tab
- At the bottom left click the “new” tab to start creating a new measure
- Give the measure an appropriate name so you can find it from the Itemized Cost tab in the audit
- Check the “Include in SIR” box
- From the dropdown box at the upper right, select “Estimated” energy savings
- From the “Units” dropdown box select “Mbtu”
- In the “Amount” tab, input “.328” for the gas measure creation or enter “.218” for the electric measure creation
- From the “Fuel saved” dropdown box, select “Water heating fuel”
- In the “Life” tab, input 15 years
- Assign a cost to the measure – you can just input one total cost or separate it into materials and labor

## 11.0 NEAT/MHEA Data Collection

NOTE: The “Active” and “Available for use in Site-built and Mobile home” boxes should all be checked by default when the “New” button is activated at the start of this measure creation. Check the boxes if they are not already marked.

From the Audit, aerators can now be selected in the Itemized Cost tab when creating a new item. Once aerators is selected, you MUST multiply the “Cost” and “Annual Energy Savings” by the number of aerators you are going to install. The UDM was created for a single aerator.

### 11.12 Mechanical Ventilation:

- State of Michigan Ashrae 62.2 form must be completed for every dwelling.
- Must identify existing ventilation type(s)
- Must determine the type of fan control
- Must assess the condition of the ventilation ductwork (exhausted to the outdoors, insulated)
- Measure existing flow rate of ventilation fan

## 12.0 MHEA Specific Data Collection

### 12.1 Walls:

- Wall Ventilation - A manufactured home wall may be intentionally or unintentionally ventilated. A ventilated wall has a space for air to flow between the exterior and interior wall materials. One technique to determine if a wall is ventilated is to check if the wall insulation is dirty inside the wall cavity. Pull up slightly on the lower end of an exterior wall panel to check for dirty insulation. If a wall is ventilated, the insulation will be dirty. Identify if the wall is vented or not vented.
- Orientation of long wall - Select the cardinal direction one of the long walls faces. Identify it as either north, south, east, or west.
- Existing wall insulation - Identify the existing insulation type as: Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers, made either of glass or cellulose, blown into the wall section of the addition. Foam core insulation may also exist in the wall section. This type of insulation is a rigid foam typically 1/4" thick found either between the wall studs and the interior wall or the wall studs and the exterior wall.
- Carport/porch roof - Is a shelter that has no walls and extends out from one wall of the manufactured home. Often, the home occupant will park a car under this shelter or use it to shade an outdoor sitting area. Indicate the length (in feet) and width (in feet) of this carport/porch roof. The roof length is the dimension parallel to the manufactured home.

## 12.0 MHEA Specific Data Collection

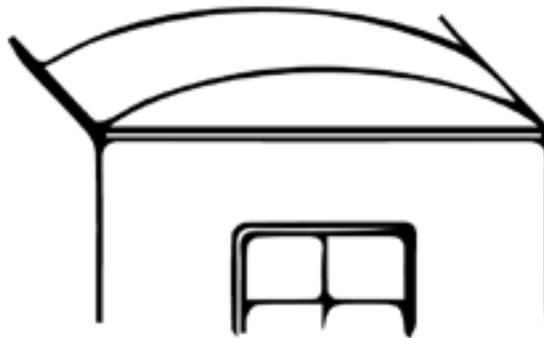
### 12.2 Ceilings:

- Roof Type - Based on the roof type indicate whether the roof is:
  - » **Flat roof** - has an interior surface (interior ceiling) and an exterior surface (exterior roof) attached directly to either side of the wood framing, similar to wall construction.



Flat Roof

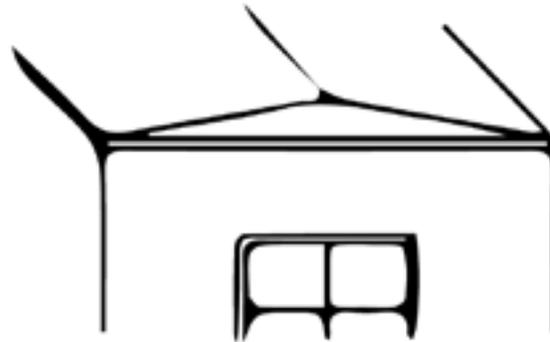
- » **Bowstring roof** - has a lightweight exterior roofing material (usually aluminum) that is stretched over the roof frame structure. The roof has a slight curve with the highest point in the middle of the home width.



Bowstring Roof

## 12.0 MHEA Specific Data Collection

- » **Pitched roof** - are sloped to a higher peak point. When viewing the home width from the outdoors, the roofline creates a triangle. Pitched roofs are also often shingled, unlike flat and bowstring roofs.



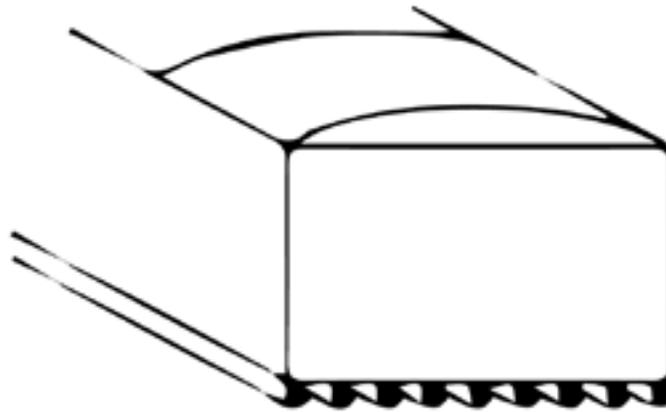
Pitched Roof

- **Roof Color** - The reflectance of the roof affects how solar energy impacts the heating and cooling loads of the home. A White or Reflective roof appears white or shiny metallic, is clean, has little or no discoloration due to weathering, and is often exposed to the sun. The majority of roofs will be classified as Normal. Roofs not exposed to the sun should also be designated as Normal regardless of their finish. Identify the roof from either -white, reflective, or shaded, or as normal or weathered.
- **Existing insulation** - Identify the amount of existing batt/blanket, loose-fill, or rigid insulation in the ceiling.
- **Cathedral Ceiling %** - Identify the approximate percent floor area that lies beneath any portion of the manufactured home having a cathedral ceiling (a sloped ceiling where the roof and ceiling planes are parallel).

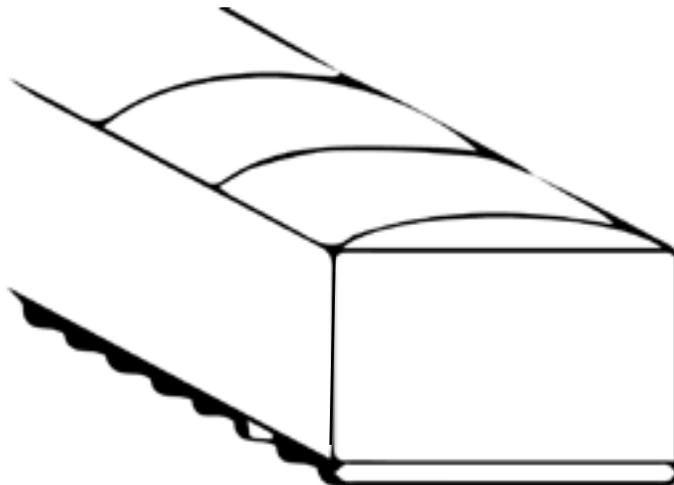
## 12.0 MHEA Specific Data Collection

### 12.3 Floor:

- Floor Joist Direction - the floor joist is the wood framing that supports the interior floor. Enter the direction the floor joists are installed (lengthwise or widthwise).
  - » **Lengthwise** floor joists are installed parallel to the long dimension (length) of the home.



- » **Widthwise** floor joists are installed parallel to the short dimension (width) of the home. The floor joist direction is needed to calculate more accurately the volume of the belly section and indicates where a central air supply duct is located (between joists or below joists), and to calculate more accurately the insulating value (R-value) of the floor.



## 12.0 MHEA Specific Data Collection

### 12.4 Skirting:

- Indicate whether or not a skirt exists around the exterior of the home. Research has shown that skirting only protects the manufactured home belly from exposure to the wind.

### 12.5 Floor Wing Description:

- Floor Joist - Is the wood framing that supports the interior floor. Manufactured homes are typically constructed using standard wood framing. Sometimes, the floor joist size is different in the wing section than in the belly (center) section. Indicate the dimensions of the floor joists in both the wing and belly sections.
- Loose Insulation Thickness - Identify the amount of existing batt\blanket and loose-fill insulation.

### 12.6 Batt/Blanket Insulation Location:

- Indicate where the batt/blanket insulation is located in the wing and belly sections. Also, identify the thickness in inches for both the wing and belly sections.
  - » Attached to Flooring: If the batt/blanket insulation is attached to the underside of the flooring, then select Attached to Flooring.



- » Between Joists: If the insulation lies between but at the bottom of the joists, leaving the potential for an air space between the top of the insulation and the flooring, select Between Joists.



## 12.0 MHEA Specific Data Collection

- » Attached to Joist: If the insulation is attached to the underside of the floor joists, select Attached to Joist.

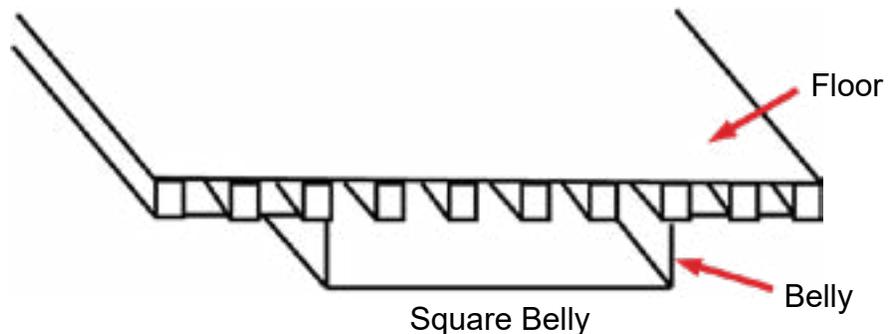


- » Draped Below: Finally, insulation in the belly section that is draped below the underside of the floor joists (attached only around the perimeter of the belly section) is described as Draped Below Floor Joist.



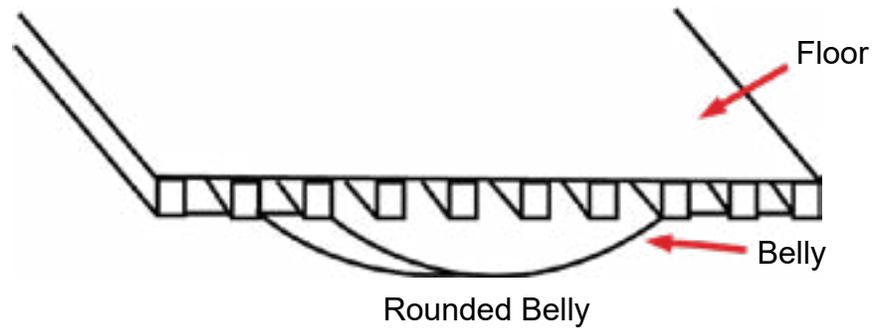
### 12.7 Floor Belly Description:

- Identify the configuration of the belly center cavity. Manufactured home belly cavities are described as being square, rounded, or flat. The belly cavity is the deep section that runs the length of the home and usually houses the main supply air duct.
  - » A square cavity configuration has vertical sides and a horizontal base (Usually, the main iron support beams act as the vertical sides).

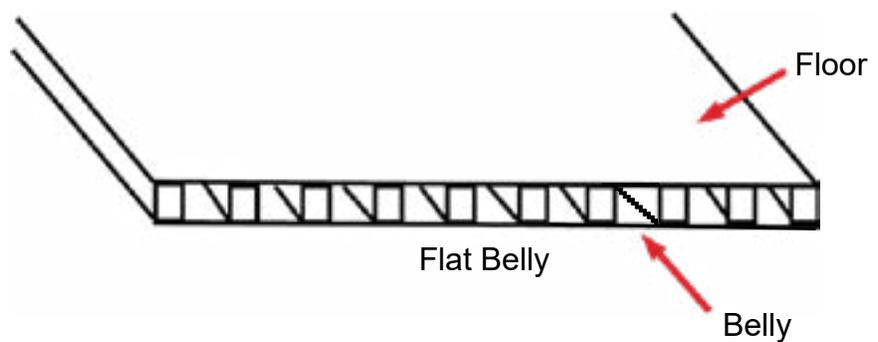


## 12.0 MHEA Specific Data Collection

- » For a rounded belly cavity configuration, the belly wrap is draped in the middle portion of the home. Usually, the wrap is draped between the main iron support beams of the home.



- » A flat belly cavity configuration is one in which there is no center belly section lower than the belly wing section. This type of belly is often found on homes where the main air supply duct is located between lengthwise floor joists or where the main supply air duct is located in the roof section.



## 12.0 MHEA Specific Data Collection

### 12.8 Belly Condition:

- Identify the condition of the belly as good, average, or poor. A belly wrap in good condition does not have any tears, holes, or other opening in the belly wrap and is tightly attached around the entire perimeter of the home. An average belly wrap condition has some small tears, holes, or other openings in the belly wrap or may not be well attached to the perimeter of the home. A belly wrap with large tears, holes, or other openings or is not well attached to the home perimeter is in poor condition.

### 12.9 Maximum Depth of Belly Cavity (in.):

- Enter the maximum depth of the belly (in inches) as measured from the underside of the flooring to the lowest part of the belly

## 12.0 MHEA Specific Data Collection

### Mobile Home Insulation for Belly Repairs

#### Creation of a User Defined Measure per NEAT weather station locations for Michigan

In your Setup Library:

- Navigate to the User-Defined Measures tab
- Select “New” – bottom left to create a new measure
- Name the measure – ex: “Mobile home belly insulation – repairs” – don’t need measure # or type – just the name
- Select “Include in SIR”
- Select “Estimated” in the Energy Savings dropdown menu
- Select “Mbtu” from the Units dropdown menu
- Enter, from the list below, the number in the Amount box that correlates to the weather station you use
- Select “Primary Heating Fuel” from the Fuel Saved dropdown menu
- Enter “20” in the Life box
- Lastly, enter a cost for the insulation. This will be per square foot. You can break it down to materials and labor if needed but it is not necessary. This is for JUST the cost of the insulation/labor needing to be added to the missing section of belly. Belly repair is listed as a General Air Sealing cost. If you think that it will cost you \$200 to slide fiberglass batts up in a belly for a 10x10 repair, it works out to \$2.00 per square foot. You can start there and always adjust the cost in the audit.

#### Using the UDM in Itemized Costs:

You now have a User Defined Measure that can be selected from the Itemized Cost tab in your MHEA audit. Since the information will be based per square foot, once it is selected you must modify the Cost and Annual Energy Savings.

- In the Itemized Cost tab, create a “New” cost – lower left
- Select your created Measure from the dropdown box (upper left) – “Copy from User Defined Measures”
- This will populate the Measure Name and all the savings information – make sure the “Include in SIR” box is checked
- Since the Cost and Annual Energy Savings is based per square foot – multiply the number in each of those boxes by the square feet of insulation needing to be added – this way we can accommodate variations in the amount of belly being repaired
- Make any necessary cost adjustments at this point
- When the audit is run, this should show up as its own measure with its own SIR

#### Summary: (Mbtu/square foot)

Detroit: .0127	Traverse City: .0143
Flint: .0133	Sault Ste Marie: .0176
Grand Rapids: .0131	Duluth, MN: .0188
Alpena: .0151	South Bend or Fort Wayne, IN: .0121

## 12.0 MHEA Specific Data Collection

### 12.10 Pressure Pan Measurements:

- Pre Duct Sealing Supply Pressure -
  - » Identify the duct - house pressure difference under normal conditions with the HVAC fan operating before implementing any duct-sealing measures.
- Post Duct Sealing Supply Pressure -
  - » Identify the duct - house pressure difference under normal conditions with the HVAC fan operating after implementing any duct-sealing measures.
- Sum Of Pressure Pan Measurements (Pa) -
  - » Before Duct Sealing - Add all the duct pressures with the blower door running at 50 Pa prior to any duct sealing.
  - » After Duct Sealing - Add all the duct pressures with the blower door running at 50 Pa after all duct sealing.

## 13.0 Reweatheringization

Re-weatherizing homes: When an auditor approaches a home that is known to have been previously weatherized it is important to understand how past weatherization work will impact more current practices. Despite the knowledge that previous work has been completed the auditor should be prepared to start from scratch and complete a full standard energy audit.

Our understanding of homes working as a system has grown exponentially over the years and the access to tools to assess homes has changed dramatically. Although air sealing was known to be important in the past, we have a much better understanding of just how important it is now. Use of a blower door in conjunction with a good infrared camera allows us to find opportunities that we may have missed in the past. Testing the pressures of attic spaces allows us to have a better understanding of the amount and the size of air sealing opportunities that may be present. These are just a few examples of how new techniques will impact previously weatherized homes, below are a few additional important items to note.

- **Attic Air Sealing:** A thorough inspection of the attic is necessary and will require digging through insulation to identify air sealing opportunities that likely would have been missed in the past. Electrical wires and ceiling light penetrations, wall top plates, plumbing bypasses, dropped soffits/bulkheads are all areas that were likely insulated over in the past. Before entering attic(s), take a mental note of the walls, light fixtures, switches, and bulkheads to have an idea of where you will need to dig through insulation and identify these issues. Good infrared scanning can be done while running the blower door exposing air sealing needs in attics. Check interior walls above light switches, wall tops, and walls with returns or heat ducts for possible air leakage. Bulkheads and lowered ceilings often found in closets, bathrooms, hallways are typically in need of air sealing and will likely show up on good thermal imaging scans.

In general, today's auditors will likely find that past Blower Door target numbers for Wx projects were not as stringent as targets required today. Additionally, changes or alterations to the home over the years will allow for a fresh look for new air sealing opportunities throughout the entire home.

- **Knee walls** that were insulated in the past may need insulation replaced or need an air barrier, such as Tyvek, installed to create the proper thermal and pressure boundary. Also, note locations of electrical outlets in the knee walls and see if these areas could be air sealed (insulation may need to be moved aside to check these areas).

## 13.0 Reweatheringization

- Many **walls** may have cellulose insulation; however a good infrared scan of the walls may show that cellulose may have settled over the years. Check for voids in insulation commonly found at the tops of walls, above and below windows and doors, under or above fire blocks in older balloon framed homes. Homes with balloon framing will likely need air sealing between floors depending on floor joist position. Note locations of missing insulation and/or draw a diagram of the wall with locations of missing insulation. The areas with voids may be best written up as a single wall or walls in NEAT so that these areas can be evaluated to receive the proper insulation.
- Note the condition of **foundation wall and sillbox** insulation, this may be deteriorated, falling down, or have damage from rodents or moisture. Insulation that has been damaged should be disposed of and treated with today's standards in mind. Air sealing of the sillbox may have been missed in the past and proper air sealing should be completed.
- **Vapor barrier** in previously weatherized homes would need to have seams, piers, and perimeter sealed to prevent moisture from rising through those areas. Depending on the condition of the existing vapor barrier a new barrier may need to be installed in order to achieve proper vapor sealing.

## 14.0 Summary of Forms

Follow [CSPM 612](#) for the following document lists and guidelines:

- [Eligibility Documents](#) - must be uploaded to FACSPRO using the document link on the customer intake screen (See [CSPM 601](#) for additional eligibility policy).
- [Application](#) - A signed FACSPRO Customer Report for the applicant household, including the signed Weatherization Disclaimer, must be uploaded to the FACSPRO intake document section.
- [Re-Certification of Application](#) - An applicant must be re-certified when eligibility lapses due to the length of time the applicant was waiting to receive Weatherization services.
- [Applicant Notification](#) - Each applicant for weatherization services must be notified in writing of their eligibility status within 30 calendar days from the eligibility date.
- [Client Signature and Technical Weatherization Documents](#) - these documents must be uploaded to the FACSPRO Weatherization Module under the Weatherization Application Documents tab within 30 days of completion of Final Close Out.
- [Photographs](#) - An agency may choose to keep job photographs on an agency system. The agency is responsible for supplying the photographs to BCAEO staff upon request and in a timely manner (photograph requests must be met within four working days). The agency will be responsible for the storage of the photographs as outlined in the DOE agreement. Agencies that do not wish to store their photographs on an agency system must upload photographs to the FACSPRO Weatherization Module under the Weatherization Application Documents tab (compressed to e-mail 96PPI).
- [Multi-Unit File Documentation](#) - For multi-family weatherization jobs, the file must include a completed and approved field audit for each building. The audit must include all work including weatherization work performed in common areas like hallways, attics, basements, etc. The client/building files should clearly indicate the structure is a multi-family building and must be cross-referenced with all other units weatherized in the building. Additionally, all client files must be clearly cross-referenced so that any reviewer can easily determine building eligibility under the 66 percent (50 percent for duplexes and four-unit buildings) rule, or any other aspect of the weatherization work to that multi-family building. The files shall clearly indicate weatherization measures to be completed. State of Michigan (SOM) approval shall be obtained to determine if one comprehensive audit or multiple audits are required. ([WPN 16-5](#))