Maine Home Performance
Efficiency Maine
A Program of the Maine Public Utilities Commission
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Maine Home Performance Technical Standards

Creating a sustainable market throughout the State of Maine for diagnosis and treatment of homes to meke them healthy, comfortable and energy efficient.

Maine Home Performance
Technical Standards

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Introduction

The Maine Home Performance with ENERGY STAR® Standards provide guidelines to service providers for the proper delivery of services for residential buildings. The purpose of the Standards is to ensure that high quality service is given at a reasonable cost and is delivered uniformly throughout Maine. The success of this Program depends upon service providers having a full understanding of these Standards.

The objective of this document is two-fold. First, it serves to define the appropriate application of installation measures for each residence serviced. The Standard delineates material specifications as well as the steps that should be followed to complete each measure. Alternative methods are allowed, but whatever method is used must meet or exceed the standard described in the relevant section of this document.

Second, these Standards set guides for the expectation of quality of the installed product. Procedures are included for evaluating the quality of each installed conservation measure and the overall quality of the completed job.

Additionally, it is anticipated that these Standards will help ensure that customers' resources are used in the most cost-effective manner possible.

This document is intended to represent the best thinking at the time of writing. It is also intended to be a dynamic document, changing as necessary to reflect advances in best practices for home performance work and the health and safety of customers and service providers.

Maine Home Performance (MaineHP) service providers must be certified by the Building Performance Institute (BPI) as Building Analyst 1 (BA1) technicians before they may supervise MaineHP work. The BA1 specification is officially part of this Standard unless otherwise indicated.

All testing procedures, inspections, and safety checks performed by service providers will be done with the attempt to follow the tone and spirit of these Standards. No testing is to be performed by persons not holding appropriate licenses and certifications for doing so. It is understood by MaineHP that energy audit and assessment results constitute an opinion of observable conditions at the time of the assessment. It is also understood that sometimes other conditions or deficiencies may exist beyond those observed.

From time to time, these Standards may be amended and/or revised by MaineHP, to reflect changes in state or federal regulations, advances in technology, and/or innovative approaches to weatherization.

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1000 Administration, Scope, and Amendments

1100 Administration

The Maine Home Performance with ENERGY STAR® Program (MaineHP) was initiated in 2006 by the Governor's Office of Energy Independence and Security. In 2008 State management of MaineHP moved to the Maine Public Utilities Commission's Efficiency Maine division.

1200 Scope and Definition of MaineHP

MaineHP addresses site-built or assembled homes; single-family and multifamily up to four units (multifamily buildings of more than four units) may be served with approval of MaineHP management. Mobile homes are not covered by MaineHP.

MaineHP is a market-driven program with service providers using for-profit business models.

The objective of MaineHP is to enhance the delivery of building performance services that use state-of-the-art diagnostic tools and the principles of building science to reduce energy consumption cost-effectively, while simultaneously addressing issues pertaining to indoor air pollutants, ventilation, moisture control, and indoor water consumption. The Program aims to accomplish this by increasing awareness of and demand for building performance while building an infrastructure of trained and certified service providers able and willing to deliver such services.

1. The MaineHP Program addresses existing residential structures, single-family detached and up to four units multifamily. Mobile homes are not covered by MaineHP.
2. The official title of this document is “Maine Home Performance with ENERGY STAR® Standards” and may be referred to throughout this document as the “Standards.”
3. The Standards apply to all service providers offering, providing, and installing services within MaineHP.
4. The Standards provide guidelines for the installation of energy conservation measures and repairs. Materials and measures that are allowed or not allowed will be specifically designated.
5. Service providers will be in compliance with the Standards if they choose not to implement items included herein, as long as the alternate method selected provides an equivalent or better result as measured by energy effectiveness, performance testing, or safety. However, the preferred approaches are provided as allowable options that will help to maximize the effectiveness of MaineHP services, protect the health and safety of

customers and work personnel, and contribute to increased energy savings.

6. These Standards are not intended to abridge safety, health, environmental, or local codes or other ordinances. Such requirements, if more stringent than these, shall apply; if these Standards are more stringent, the Standards shall apply.
7. All questions concerning the content or implementation of the Standards should be directed to the technical staff of MaineHP.

1300 Enforcement

Continued service provider inability and/or refusal to comply with these Standards are grounds for MaineHP to suspend, terminate, or otherwise apply special condition(s) to the service providers agreement to provide services. Service providers are directly responsible for MaineHP work done by their subcontractors. MaineHP quality assurance protocols are the mechanism for determining compliance with the Standards.

1400 Amendments to Program Field Standards

1. From time to time, these Standards may be amended and/or revised by MaineHP to reflect changes in state or federal regulations, changes to the BPI BA1 specification, advances in technology, and/or innovative approaches to weatherization. MaineHP encourages service providers to submit suggested changes to these Standards that will result in the delivery of services in a more cost-effective manner while continuing to provide high quality work.
2. Amendments to these Standards will not become effective until thirty (30) calendar days from the date of MaineHP approval, except under the following conditions where approval and service provider notification amendments or revisions will become effective immediately:
    a. Changes in State or federal law or regulations mandate immediate implementation; or
    b. MaineHP determines that an emergency situation exists, such as a potential threat to life, limb, or personal property, and the proposed amendment and/or revision is necessary for the protection of the health and welfare of Maine citizens.
3. Any service provider personnel may submit comments and suggested changes or revisions to these Standards to MaineHP at any time. Suggested changes to the Standards should be accompanied by supporting documentation.
4. The process for implementation of change will be by recommendation of MaineHP technical staff followed by written notification to the MaineHP service providers.
5. All changes, whenever possible, will be provided to all service providers at least thirty days prior to implementation to allow the opportunity for review and comment. Service providers may then submit written

comments regarding the changes to the technical staff of MaineHP for review and consideration. All written comments by service providers will be available for public review.

1500 The Maine Home Performance Homeowner Certificate

[This section reserved]

2000 Requirements of Service Providers

The requirements of this section are minimum requirements for the satisfactory participation in the Maine Home Performance Program. A service provider may exceed these requirements at any time.

2100 Summary of Requirements

1. Submit fees and sign agreement.
    a. Fees for training, mentoring, examinations, and consultations are set by the MaineHP Program for entering service providers and must be paid before or during the initial classroom training.
    b. The MaineHP agreement must be signed before or during the initial classroom training.
2. Attend classroom training.
3. Pass written examination at the end of classroom training.
4. Secure access to necessary equipment.
5. Calibrate necessary equipment according to manufacturer's recommendations.
6. Attend field assessment/software training.
7. Schedule and attend mentoring sessions.
8. Pass the Building Performance Institute's Building Analyst 1 written and field examinations.
9. Offer MaineHP services.
10. Perform the required elements of the:
    a. Job intake process.
    b. Post-installation or test-out process.
11. Submit assessment and job reports for review:
    a. Job intake form.
    b. Home Performance Assessment summary report.
    c. Scope of work.
    d. Post-Installation or Test-out report.
12. Follow the MaineHP Standards, the MaineHP agreement, and all appropriate State laws:
    a. Appropriate State laws include, but are not necessarily limited to, Attorney Generals Model Home Construction or Repair Contract (10 M.R.S.A. c. 219-A, Home Construction Contracts) and Insulation Contractors law (Title 10, Chapter 219).
    b. For combustion safety testing of combustion heating and hot water appliances, have a valid Limited Energy Auditor License from the Oil and Solid Fuel Board and/or the Propane and Natural Gas Board.

13. Building permits, electrical permits, plumbing permits and other permits required by local or State authorities should be obtained by the contractor and the costs of such permits shall be the responsibility of the contractor. Permits should be obtained prior to commencement of work and copies of permits should be provided to the owner.
14. All repair work shall conform to the local building codes, when applicable.

2110 Service Provider Participation Agreement

Service providers are required to sign the Maine Home Performance with ENERGY STAR® Program participation agreement before taking the BPI examinations and before performing work with the Program.

2120 Building Performance Institute Certification

1. Service providers must be certified by BPI as Building Analyst 1 (BA1) technicians according to the requirements of BPI.
    a. Successfully complete the BPI BA1 written examination.
    b. Successfully complete the BPI BA1 field examination.
2. Once a service provider signs the Program participation agreement, passes the BPI examinations, and remains a service provider in good standing, they are eligible:
    a. To use the EPA ENERGY STAR, Maine Home Performance with ENERGY STAR, Efficiency Maine, and BPI logos for marketing purposes, as long as they remain a service provider in good standing.
    b. Be listed as a service provider on the Maine Home Performance website.

2130 Marketing Requirements

1. Marketing and advertising materials used by a service provider to promote their services as a Maine Home Performance with ENERGY STAR® provider shall include:
    a. Specific reference to "Maine Home Performance with ENERGY STAR®".
    b. The ENERGY STAR® logo.
    c. The Maine Home Performance with ENERGY STAR® logo.
    d. The Efficiency Maine logo

2140 Equipment Maintenance

1. All test equipment used for diagnostics, evaluation, and installation of measures should be maintained according to the manufacturers recommendations. This includes:
    a. Calibration of electronic equipment, including, but not limited to:
        i. Instruments for measuring carbon monoxide.

CAUTION!

Do NOT conduct the blower door test if fireplace or wood stove has recently been used.
Do NOT conduct this test if there is evidence of exposed and/or friable contaminants (asbestos, lead dust, bio-aerosols or other dangerous materials) that might become airborne or otherwise be introduced into the living space by conducting the test.

ii. Instruments for measuring combustion efficiency.
iii. Digital manometers.

b. Recommended maintenance of mechanical equipment and electric motors, including, but not limited to:
i. Blower door fans.
ii. Analog manometers.
iii. Insulation blowing machines including their motors, hoses, seals, and filters.

2. Service providers should develop and adhere to an equipment maintenance schedule for equipment.

2200 Home Performance Assessment (HPA) Required and Recommended Elements

2210 Introduction

One of the most important and differentiating aspects of home performance contracting is the home energy assessment. In order to offer the homeowner the opportunity to increase the energy performance and comfort of their home, all of the home's systems are holistically assessed to recommend improvements that work together to improve their home.

The HPA includes the activities (i.e. inspections, tests, etc.) that are completed to assess a home's performance, and prepare a recommended scope of work. Contractors that agree to participate in the MaineHP program need to have clear direction on what services they are expected to deliver. These policies and procedures are intended to establish a minimum level of service that can be marketed to homeowners. This guidance identifies which elements of the HPA are required by MaineHP and optional steps that are recommended because they represent best industry practices or help the contractor understand the homeowner's needs and motivate them to improve their home. The required elements of the HPA do not have to be completed in one home visit but must be completed prior to the commencement of home improvements. The HPA guidance below is sequenced but it is not required that contractors deliver the components of the HPA in the order provided.

Please see the Appendix for the Post-Installation and Inspection form.

2220 Homeowner Interview

The service provider is required to conduct an in-person interview to collect information about the home and homeowner's concerns, motivations and goals. The information gathered can vary based on climate, housing type, site layout, etc.; the objective is to begin to establish a good base of information from which to address the homeowner's concerns. Information that may be valuable includes:

Optional Steps for the Homeowner Interview

Pre-Assessment Telephone Interview
When scheduling the HPA, some participating contractors conduct a quick telephone interview with the homeowner to collect basic information on the home and the homeowners concerns and motivations, so as to be more prepared, focused and time efficient during the home visit. A lead screening tool is available for participating contactors to use.

Disaggregate Energy Bills and Discuss Analysis with Homeowner
If energy consumption history is available, it can be extremely valuable for the participating contractor in building an understanding of the homes energy performance and motivating the homeowner to invest in recommended measures.
By breaking down the energy use, the contractor can more effectively identify the best energy improvement plan, educate the homeowner on the benefits of core air sealing, insulation, high-efficiency HVAC, water heating, and electric base-load measures such as lighting and appliances. A utility bill disaggregation tool is available for participating contractors to use.

Quick Walk-Through with Homeowner
Conduct a walk-through with the homeowner to ascertain additional information (homeowner has opportunity to bring up any issues or concerns that s/he has with any major items in the assessment). The contractor can take this opportunity to inspect major appliances and lighting with the

1. Age of home; years that family has lived there; number of occupants.
2. Health issues that might be related to indoor air quality, such as asthma exacerbated by mold and mildew or flu-like symptoms that might be caused by carbon monoxide.
3. Remodeling, additions, window replacement, room layout.
4. Basic information about HVAC system(s), type of fuel, age of systems (if known).
5. Use of unvented fireplaces and space heaters (if used, educate homeowner on moisture, carbon monoxide and fire risks, and inform them that envelope improvements may not be able to be performed unless they are removed or vented).
6. Swimming pool – dates and hours/day of pump operation, heated or not, heating source(s) and location(s), ventilation strategy if indoors.
7. Utility bills
8. Comfort complaints (cold rooms/hot rooms, drafts, moisture and humidity).
9. Ice damming, wet crawlspaces or other common climate-specific problems.

Optional Steps for the Homeowner Interview, cont'd

the customer and educate them on the benefits of replacing older appliances and lighting with ENERGY STAR qualified products.

2230 Building Envelope Inspection

The building envelope offers many opportunities for energy efficiency improvements. Therefore, participating service providers **must** conduct an inspection of the building envelope:

1. Collect basic information on the envelope of the home:
    a. Record house type, age and condition.
    b. Note key features of home typical of house type (porch roof, multiple roof lines, cantilevers, bay windows, dormers, knee-wall attics, attic access, crawlspaces, basements, attached garages).
    c. Note configuration of home additions, if any.
    d. Sketch house floor plan with orientation and exterior measurements; calculate floor area, and volume.
2. Note condition of external building envelope features (siding, trim, fascia, soffit areas, etc.):
    a. Look for signs of moisture or ice dam damage (if applicable) on walls and soffits that may have resulted from building performance problems.
    b. Check for roof moisture damage (stains, soft or rotted deck or rafters, wet or moisture-damaged insulation) from roof leaks or inadequate ventilation.
    c. Note any issues with shading or exposure to sun (linked to issues with hot/cold rooms and can help prioritize window-related measures).

    Note any grading features, downspout terminations, or sprinklers that may direct water towards the foundation or affect the performance of an exterior wall.

Optional Step for Basic Building Envelope Inspection

Renewable Energy Opportunities
Record house orientation, observe site layout and look for opportunities for renewable energy technology (e.g., access to sunlight on south and west sides)

Optional Steps for Envelope Thermal Inspection

Exterior Wall Insulation Levels
An optic probe can often be used to determine wall insulation levels. It is usually inserted next to electrical outlets or behind wall hangings. This tool can also be used to inspect potential moisture problems found with an infrared camera

Window Details
Some energy savings tools in particular require some details regarding window area and orientation, framing type, number of panes and/or presence of storm windows. Otherwise, such information is most important if it is known that replacement windows are to be included in the scope of work.

3. Envelope Thermal Characteristics:
    a. Determine the thermal boundary of the home and identify thermal bypasses.
    b. Record type(s), amount and condition of insulation in all components of the thermal boundary. For guidance on default and de-rated R-values, see Building Performance Institute (BPI) Technical Standards.
        i. Attic flats, slopes, knee walls, knee-wall flats, dropped soffits, etc., as appropriate for type of home and per configuration of additions.
        ii. Basement and crawlspace walls or ceilings.
        iii. Rim joists.
        iv. Attic staircase walls.
    c. Window inspection: Note condition of windows, type, age, signs of moisture damage and air infiltration around windows.
    d. Door inspection: Note type and condition of all doors to exterior (including garage) – especially note if doors are un-insulated, in poor condition, or if they are leaky and in need of weatherstripping or door sweeps.
4. Envelope air leakage characteristics:
    a. Visual Inspection of attic and basement to identify paths of air leakage
        i. Attic: openings in wall top plates, electrical and plumbing runs, open areas around flues and chimneys, recessed light housings, around exhaust fans, open framing cavities, dropped soffits and ceilings.
        ii. Basement: openings around electrical and plumbing runs and around flue pipes and chimneys, accessible sill plate areas, basement windows, exterior doors, and accessible rim/band joist areas.
    b. Blower door test. This test is an effective way to locate air leaks and educate the customer on air leakage issues.
        i. With blower door depressurizing the home, identify major leakage areas in living area (e.g. window trim, baseboards, upper trim, cabinets, dropped soffits, pocket doors, recessed lighting, duct chases/plenums, band joists, transitions between porch roof and exterior walls, fireplaces, cantilevered floors, etc.).
        ii. Identify any significant misalignments of the pressure and thermal boundaries and ways to correct any misalignments.
        iii. Inspect walls or ceiling between an attached garage and the living space for air leakage.

Optional Steps for Inspections during Blower Door Test

Use of Infrared Camera

Using an infrared camera during a blower door test is an effective way to identify where insulation and air sealing are needed. It is also an effective sales tool when the contractor has the customer(s) involved in the assessment. Showing the infrared images to the customer(s) and relating them to problems that were identified during the homeowner interview demonstrate expertise and builds trust, leading to higher customer motivation and stronger sales.

Zone Pressure Diagnostics (ZPD)

Using the blower door and a manometer, conduct ZPD, if needed, to diagnose particular problem areas within the building (e.g., to determine how much an attic or garage is communicating with the living space compared to the outside). ZPD testing can help focus the inspection and speed up the diagnostics tests.

2240 HVAC and Domestic Home Water (DHW) Systems

The HVAC and DHW systems can offer significant comfort and energy savings opportunities. Therefore, participating contractors must perform a basic visual inspection of the HVAC and DHW systems in the home as follows:

1. Determine number and type of thermostats:
    a. Note number of heating and/or cooling zones.
    b. Note whether thermostats are programmable or manual.
        i. If programmable, check status of setback periods and, if not being used, educate homeowner on the benefits of scheduled setbacks based on their lifestyle.
2. Visually inspect heating system:
    a. Verify system information: age, model, heat in/out, general condition and maintenance history.
    b. Check for evidence of back draft/flame roll-out.
    c. If boiler, verify that pressure relief valve is present and not obstructed.
    d. If condensing unit, check the condensate line for signs of blockage or leaks.
    e. Check exhaust vent connector for proper fitting and termination.
3. Visually inspect air conditioning system:
    a. Verify system information: age, model, capacity (sometimes available on nameplate).
    b. Check condensate line(s) for blockage or leaks.
    c. Note any issues around compressor/fan unit in yard, such as recirculation/air flow obstruction from built features or plantings or problems with coil blockage from leaves, twigs or other debris.
    d. Record number of window or wall units, model and EER if available.
    e. Check for condition of insulation on refrigerant line set.
4. Visually inspect distribution systems:
    a. Inspect air filter(s) and ask homeowner how frequently they are replaced.
    b. Note the presence of any ducts or air handlers in garages (this requires a recommendation to re-locate or create air-tight enclosures to isolate them from garage and prevent transportation of carbon monoxide and other fumes from the garage to the living space).
    c. Record insulation level of ducts outside of the thermal enclosure.
    d. Check for ductwork leaks, disconnects, crimps, signs of moisture presence, return leaks near combustion equipment, damage or other atypical conditions (inspection should include inaccessible ducts to extent possible).

Optional Steps for HVAC System Inspection

In addition to a basic visual inspection of the HVAC system, there is additional information that may be needed in order to produce energy savings estimates for replacement measures. This information can include:

Thermostat Settings:
Ask the homeowner about average thermostat settings for both summer and winter (this information can be important for analyzing energy consumption and savings).

Heating and Cooling Systems:
1) Review maintenance records and/or ask homeowner about frequency, type and last occurrence of maintenance.
2) If the heat pump or air conditioner is more than 10 years old or the furnace or boiler is more than 15 years old consider recommending replacement with ENERGY STAR qualified equipment.
3) Estimate AFUE of heating system and HSPF/SEER of heat pump/cooling system via product nameplate information, looking product up in Gas Appliance Manufacturers Association (GAMA) or Air Conditioning and Refrigeration Institute (ARI) directories, instrumented testing or a combination thereof. Having a good understanding of operating efficiency helps the contractor produce a more accurate estimation of energy savings. Some energy modeling software will require a good estimate of AFUE, HSPF and SEER in order to predict accurate energy savings.
4) Check central air conditioning systems for proper refrigerant charge and airflow across the indoor coil to determine if they are in

e. For hydronic systems, record insulation levels and note opportunity for pipe insulation if practical, especially on long pipe runs if there are comfort issues.

f. For baseboard systems, check for condition and positioning of covers and for presence of dust and other material on the fins.

5. Visually inspect DHW system:
   a. Record approximate age, model, capacity, condition.
   b. Check for evidence of back draft/flame roll-out.
   c. Verify that pressure/temperature relief valve is present and not obstructed.
   d. Note temperature setting on water heater. This is a good opportunity to educate homeowner on standby losses and scalding threats if its above 120 degrees F, and reduce the setting if homeowner approves.
   e. Check for signs of leakage from water heater tank vessel.
   f. Conduct visual inspection of water heater and hot water pipes for efficiency improvements (presence or lack of insulation, convective loop, and feasibility of retrofitting insulation on tank and/or pipes.
6. Combustion appliance zone (CAZ) safety inspection:
   a. Make sure that there are no flammable or explosive materials near any combustion source. This is a good opportunity to recommend moving such items to a safe place.
7. Living-space safety inspection:
   a. Note number, location and operability of CO and smoke alarms. Codes in some jurisdictions may require them.
   b. Note presence of unvented gas fireplaces and propane or kerosene space heaters and discuss with and educate the homeowner – explain that envelope work cannot be performed unless unvented combustion appliances (except gas ranges) are removed or vented with a retrofit kit.
8. Inspect mechanical exhaust ventilation devices:
   a. Check whether mechanical exhaust venting systems in bathrooms and kitchen, if present, are designed, installed, and terminated properly.
   b. If garage is attached, note whether exhaust fan is present and operable in garage.
   c. Note presence and operability of power attic or whole-house exhaust fans and inform homeowner of correct operation.
   d. Determine required ventilation rate according to ASHRAE *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings* (ASHRAE Standard 62.2-2007).

Optional Steps for HVAC System Inspection, cont'd

balance to operate as efficiently as possible. EPA refrigerant certification is required to handle refrigerants and most jurisdictions may require this be completed by a licensed HVAC contractor.

Air Handlers and Ductwork:
1) Determine condition of air handler and coil and need for cleaning.
2) Conduct a test to determine adequacy of air flow, using one of the following methods: Duct Blaster® or other plenum pressure-matching air flow test, flow plate, flow hood, static pressure test, and/or temperature rise/drop tests.
3) If ducts or an air handler are located outside of homes pressure boundary and cannot be relocated inside, conduct a test to determine duct leakage, using a metered and calibrated duct pressurization device.
4) Inspect for condensation moisture or damage from condensation on exterior of duct liner (in hot humid climate) or interior of A/C only ducts (in cold climate) for ducts outside conditioned space.
5) Check air return grills are properly sized.

Water Heater:
Estimate Energy Factor (EF) of water heater based on model number. Most energy modeling software will ask for EF for the purpose of estimating energy consumption.

Mechanical Ventilation:
Educate homeowner on the benefits of a timer-operated or humidity controlled bathroom exhaust fan.

2250 Instrumented Tests for Combustion Appliances, Combustion Appliance Zone (CAZ) and Living Space

1. Combustion appliance and CAZ tests.
    a. Performing these tests can help identify problems that affect the health and safety of the customer. Therefore, participating contractors must perform diagnostic tests on combustion equipment including vented heating systems, water heaters and ovens, in accordance with the BPI Building Analyst 1 Specification. This inspection includes:
        i. Worse-case negative pressure measurement for each CAZ.
        ii. Carbon monoxide measurement at each appliance.*
        iii. Draft measurement and spillage evaluation for vented natural draft and induced draft appliances.*
2. Ambient carbon monoxide readings.
    a. The contractor must take ambient carbon monoxide readings in CAZ zones and in main living spaces and continuously monitor carbon monoxide levels in the ambient air around technician during combustion tests.
3. Carbon monoxide measurement in vent of kitchen gas oven in accordance with the BPI Building Analyst 1 Specification.
4. Using gas leak detection equipment, check for gas leaks at all accessible gas pipe connections, Ts, elbows, unions, and fittings, from the gas meter to the inlet to each combustion appliance.

Optional Steps for Instrumented Tests

Steady State Efficiency (SSE) Test
This test can be performed relatively quickly while conducting other combustion tests on a furnace or boiler. It can provide good information for the contractor in evaluating the condition and operation of the equipment. Some energy modeling software will use the SSE as an input in order to estimate baseline energy consumption.*

*** CAUTION!**
In order to conduct these tests, which require drilling and/or inserting an instrument probe into a vent connector, a person in Maine must be a fully licensed oil- or gas-burner technician, or have a valid "limited energy auditor license" from the Maine Oil and Solid Fuel and/or the Propane and Natural Gas Boards. Any heating systems adjustments are strictly forbidden unless a person is fully licensed.

2260 Moisture Inspection

1. Check basement and crawlspace for moisture deposition or damage on basement floors, walls, sill plate area, around basement windows and bulkhead doors.
2. Determine whether there is a continuous moisture barrier in the crawlspace.
3. Check around exterior of foundation for signs of moisture deposition from such sources as faulty gutters or watering too close to the foundation.
4. Check attic for moisture deposition or damage on roof deck, rafters, joists, and insulation (wet or moisture-compacted insulation).
5. Inspect condition of windows and look for signs of condensation or other conditions that could cause damage or affect durability.
6. If there is evidence of high moisture levels in the living space, check for discoloration on walls behind headboards, furniture – corners of closets on exterior walls, and other areas of stagnation and cold temperature for moisture deposition or damage and conditions that promote fungal growth.

Note
Vented appliances that are going to be replaced with direct vent or power vented equipment as part of the work scope do not have to be tested, except as an interim test if the home is air sealed as part of the work scope prior to installation of the new equipment (having the heating equipment installed first would prevent the need for such a test).

2270 Lighting and Appliance Inspection

1. Record approximate age, type and condition of major appliances and showerheads. If applicable, determine number, age and condition of room air conditioners (check with homeowner if the assessment is performed outside of the cooling season and they could be in storage).
    a. If homeowner has any major appliances older than 10 years, discuss benefits of replacing them with the lowest energy consuming appliance that meets the need. ENERGY STAR guidelines are useful to compare electricity consumption between models.
    b. Educate homeowner on water and energy savings from low-flow showerheads and toilets.
2. Inspect high-use lighting areas for any obvious opportunities to upgrade to ENERGY STAR compact fluorescent lamps (CFLs) or fixtures. Check with homeowner to get estimated daily burn-time for lighting to be recommended for replacement (important for estimating energy savings calculation).

2300 Homeowner Summary Report Required Elements

A sample of the Maine Home Performance Summary Report is included in the Appendix. At a minimum, the following elements are required to be included in a Maine Home Performance Summary Report provided to a homeowner after the assessment has been completed:

1. Participating contractor name, contractor contact information, and name of technician completing the HPA.
2. Assessed homes address.
3. Date assessment was performed.
4. Maine Home Performance with ENERGY STAR® logo.
5. Existing conditions:
    a. Air leakage visual inspection or diagnostic results.
    b. Insulation levels for walls, attic, rim-joists, and foundation (crawl, basement, or slab).
    c. Approximate age and condition of HVAC equipment (heating, cooling, and ventilation fans), water heating equipment, and condition of exhaust flues for HVAC or water heating equipment that consumes fossil fuel.
    d. Type and condition of windows and doors.
    e. Duct system visual inspection findings.
    f. Approximate age and condition of appliances.
    g. Any signs of moisture concerns, building performance failures or conditions affecting the durability of the home.
    h. Results of tests related to the use of combustion appliances (draft, spillage, carbon monoxide, combustion appliance zone (CAZ) depressurization and gas leak testing).

Homeowner Summary Report Recommendation

Reviewing the findings with the customer is the culmination of the Maine Home Performance assessment process. This is the opportunity to present the homeowner with the improvement opportunities discovered during the assessment and solutions for improving the performance of the customers home. At this time the service provider should discuss inspection findings and present a recommended scope of work to the homeowner.

6. A set of recommendations that is reasonably comprehensive in identifying measures that save energy, address combustion safety, comfort, moisture deposition, durability or other building performance problems.
7. Recommendations in the comprehensive work scope must address air leakage between the house and attached garage due to the potential for infiltration of carbon monoxide and other fumes.
8. An estimate of energy savings from recommended improvements and improvement installation cost.

2400 Scope of Work Requirements

The scope of work should be legible, clear, and comprehensive in addressing the work agreed upon between the service provider and the customer. This document may be a contract between the customer and the contractor. The copy of the scope of work submitted to MaineHP need not include prices for the work to be completed.

2500 Post-Installation or Test-Out Requirements

A sample of the Maine Home Performance Test-Out Reporting Form is included in the Appendix. At a minimum, the following elements are required to be included in the test-out procedure and recorded on this form. The required post-installation tests depend upon the scope of work:

1. Confirmation of measures installed, can be a simple check-off list that the participating contractor uses to confirm that all contracted measures have been installed. The customer should also sign the test-out form signifying their agreement that the job has been completed.
2. Blower Door test must be completed after installation of any of the following measures:
    a. Enclosed cavity insulation representing more than 15% of the total building shell area.
    b. Air sealing.
    c. Sealing of ductwork outside the building envelope.
    d. Replacement of atmospherically vented combustion appliance with sealed combustion appliance (due to removal of an exhaust appliance from the home that created negative pressure when operating).
3. Minimum house ventilation requirement calculation will be performed whenever changes to the building shell requiring a blower door test have occurred. This is to ensure that the home is receiving adequate fresh air for acceptable indoor air quality according to ASHRAE Standards 62.2-2007.
4. Combustion appliance tests on all combustion equipment including vented heating systems, water heaters, and ovens, in accordance with BPI Building Analyst 1 Specification, will be completed whenever changes to

the building envelope and/or heating system have occurred. This inspection includes all of the following tests:

a. Worst-case negative pressure measurement for each CAZ.

b. Carbon monoxide measurement at each appliance (including ovens).*

c. Draft measurement and spillage evaluation for atmospherically vented appliances.*

d. Inspection and testing of orphaned water heaters: water heaters may not be left venting alone into a previously shared chimney without ensuring the chimney meets appropriate NFPA requirements under the new condition and the water heater has been tested and passed all required combustion safety tests (spillage, draft, CAZ depressurization).

e. Check all accessible gas/propane lines for leaks using a combustible gas detector.

5. If a new central air conditioner, heat pump, or furnace is installed then installation contractor will provide a commissioning report documenting that the installation met the ACCA HVAC Quality Installation Specification.

Optional Post-Installation Test or "Test-out" Requirements

Radon Testing

Perform a radon test at the finish of any job including air sealing in the scope of work.

*** CAUTION!**

In order to conduct these tests, which require drilling and/or inserting an instrument probe into a vent connector, a person in Maine must be a fully licensed oil- or gas-burner technician, or have a valid "limited energy auditor license" from the Maine Oil and Solid Fuel and/or the Propane and Natural Gas Boards. Any heating systems adjustments are strictly forbidden unless a person is fully licensed.

3000 Health and Safety Requirements

3100 Introduction

The assistance provided by MaineHP service providers has the potential to affect the operation of, and the interaction among, the various "systems" within customers homes. It is therefore important that service providers remain aware of the potential hazards associated with the weatherization process and not compromise the integrity of the building when installing energy-saving measures.

While the primary purpose of the MaineHP Program is to reduce the energy use in dwellings, it is necessary on occasion to make related repairs and to mitigate health and safety concerns which may not result in a decrease in energy use or result in a monetary savings. Therefore, as part of the MaineHP Program, the following health and safety standards have been developed with the objective of providing general guidance to service providers doing work within the program. All persons providing services under this Program should use these Standards as guidance.

Allowable health and safety measures will be limited to measures that result from, or are worsened by, the installation of energy-saving measures.

Each home must be individually assessed to determine the existence of potential hazards to MaineHP service providers and customers. When conditions within the home are such that the health and safety of the customer, crew, or subcontractor will be jeopardized prior to doing work, work should not proceed until such problems are remedied. In some cases, mitigation of problems may be beyond the scope of the MaineHP Program. In these instances, the customer must be notified in writing and referred to alternative resources for resolution of the problem.

Under these Standards, health and safety assessments of the following should be performed:

1. Hazardous conditions and materials assessment, including, but not limited to:
    a. Friable asbestos.
    b. Unsafe levels of combustion byproducts, including carbon monoxide.
    c. Human or animal waste within the occupied dwelling.
    d. Unsafe and excessive levels of chipping and peeling lead paint in pre-1978 homes. This is of particular concern on interior surfaces and components.
    e. Mold or mildew.

2. Air quality assessment, including:
    a. Interviewing customer(s) regarding health conditions of occupants with the intent of determining if air quality is unacceptable.
    b. Determination of ventilation needs for ensuring acceptable indoor air quality. Any mechanical ventilation requirements shall be based on ASHRAE Standard 62.2-2007.
3. Combustion systems assessment, including:
    a. Worst-case draft test in appropriate dwellings before and after all MaineHP work has been completed in accordance with BPI BA1.
    b. Fuel storage hazards, including oil tank or propane storage problems.
    c. Hazardous combustion appliance conditions.
4. Assessment of job personnel and customer safety concerns.
    a. All materials stored on the job site for work must be stacked, organized, and properly marked so that they do not pose a hazard to customers, neighbors or job personnel.
    b. All work must be performed in a manner that does not create a known hazard to customers, neighbors, or job personnel.
    c. In pre-1978 homes, if the scope of MaineHP work exacerbates lead paint hazards, or it is determined that lead paint hazards are significant enough, then lead-safe work practices performed by personnel trained in Maine certified lead-safe work practices should be used.

3200 Worker Health and Safety

1. It is the responsibility of the entity performing the work to initiate and maintain programs that comply with applicable Occupational Health and Safety Act Regulations (29 CFR 1910 & 1926) and any other applicable federal or state laws enacted to protect worker safety.
2. The entity performing the work must assess structural conditions and demonstrate caution when working in potentially dangerous areas.
3. MaineHP services must be provided in a manner that minimizes risk to job personnel.

3300 Health and Safety Procedures

The following section establishes areas of concern that may affect the health and safety of the job personnel and customers. In most cases, the best approach to limiting the health and safety risk is to minimize exposure to any hazard. If job personnel are unable to minimize their own or the customer's exposure to a hazard, work on the dwelling may have to be stopped.

MaineHP Program expects the crews and contractors to be able to work under conditions that do not jeopardize their own health and safety. It also expects that these job personnel will use caution and care while working on the customer's

home. For detailed information on worker health and safety, refer to *Construction Industry OSHA Safety and Health Standards* (29 CFR 1926/1910).

The following are general guidelines for accident prevention and should be followed by all personnel involved in MaineHP work.

3310 Workplace Safety Guidelines

1. It is the responsibility of the entity performing the work to initiate and maintain such programs as may be necessary to comply with these workplace safety guidelines.
2. The entity performing the work must provide training in the area of health and safety, which will allow job personnel to identify existing and potential threats to the customer's and job workers health and/or safety. Upon the identification of a threat to the customer's health and/or safety, the customer will be informed in writing as to the available options for mitigation.
3. The entity performing the work must designate competent persons who will perform regular inspections of the job sites, materials and equipment.
4. The entity performing the work must permit only those members of their crews qualified by training or experience to operate equipment and machinery.
5. The entity performing the work must tag all machines, tools, materials, or equipment identified as being unsafe to those unqualified to operate them. All these items shall be made inoperable when they are not in use by locking the controls or physically removing them from the work site.
6. The entity performing the work must require their employees and representatives to take all reasonable precautions against performing work on homes that will subject customers to health and safety risks. At the time of initial customer contact, the MaineHP service provider will make a cursory evaluation of the individual health of the home's occupants. In cases where a person's health is fragile and/or the work activities constitute a health or safety hazard, the occupants will be asked to leave during the work activities.

3320 Health and Safety Policy

1. When in doubt, service provider should seek consultation services from an OSHA subsidized professional safety consultant (See: OSHA Publication # 3047, *Consultation Service for the Employer*) to identify hazards and develop a worker health and safety program.
2. The entity performing the work should have a health and safety policy in place. This program should contain the following:
    a. Material Safety Data Sheets (MSDS) on the job site and available to medical personnel.
    b. Job personnel should know where to go for treatment.

c. A written procedure for reporting medical emergencies.
d. A written procedure for reporting non-emergency accidents.
e. Provision for prompt medical attention for serious injuries.
    i. Prompt transportation or a system for contacting an ambulance.
    ii. Telephone numbers of physicians, hospitals, and ambulance services posted in a conspicuous location.
f. A first aid program which includes the following:
    i. First aid training provided to at least one member of each job crew.
    ii. CPR training provided to at least one member of each job crew.
    iii. One complete first aid kit per personnel vehicle.
    iv. One eyewash station with at least one refill per person.

3. Entities performing job-site work should establish a personal protective equipment program. This program should include the following:
    a. Respiratory protection equipment and procedures that provide crew members and subcontractors with the following:
        i. The proper personal respiratory protection equipment.
        ii. Respirator fit testing, by a trained person.
        iii. Training for all job personnel on respirator use.
        iv. Medical examination of pulmonary capacity, as frequently as recommended by appropriate OSHA standards.
    b. Eye protection that is appropriate and available when needed.
    c. Gloves and protective coveralls that are made available when needed to protect worker health or safety.
4. The entity performing the work should have in place a tool safety program designed to protect workers from workplace hazards. This program should ensure that:
    a. Tools are safe and adequate for the job.
    b. Ground-fault protection is provided for all power tools.
    c. Job personnel are trained in the safe and proper operation of tools and equipment used in their work.
    d. Safety guards are in place on all tools that come equipped with such devices.
    e. Ladders and scaffolding are adequate, have the proper weight rating, and are constructed of non-conductive material.
    f. Hearing/ear protection is provided to individuals working around high decibel equipment or in high dust environments.
5. The entity performing the work should have a job hazards identification program. This program should include the following:
    a. Investigation of job-specific safety hazards.
    b. Hazard communication procedures that require:
        i. Written policies for dealing with job hazards.
        ii. That all hazardous materials containers are labeled:

1. With the hazardous chemical contents.
2. A hazard warning appropriate for worker protection.
3. Legibly and prominently.

iii. A means for the exchange of information between contractors and sub-contractors.

c. A catalog of Material Safety Data Sheets (MSDS) for all hazardous material that is made available to all job-site workers, kept on file at the offices of the entity performing the work, and on all jobs sites. The MSDS catalog should contain the following:

i. The chemical and common names of hazardous materials.
ii. Physical and chemical characteristics of these materials.
iii. Known acute and chronic health effects and related heath effects.
iv. Precautionary measures.
v. Exposure limits.
vi. Identification of carcinogens.
vii. First aid procedures.
viii. Poison control hotline telephone number, 1-800-222-1222.

3330 Asbestos Inspection Procedures

1. Prior to performing work or conducting tests, the service provider must conduct an inspection for materials suspected of containing asbestos if there is the possibility that they may be disturbed during the weatherization testing or work.
2. Decisions on approaches to work where asbestos is present should be based on the judgment of the most qualified individual available or to the senior technical consultant for the MaineHP Program.
3. When major energy-saving measures might be sacrificed as a result of suspected asbestos-containing materials, the MaineHP service provider or entity performing the work may have the suspected material tested for asbestos content.
4. All work personnel should wear high quality respirators any time they are working with or near asbestos materials.
5. Materials containing asbestos may not be cut, drilled, or disturbed in any manner that may cause asbestos fibers to become airborne.
6. Energy analysts or entities performing the work must use certified asbestos abatement contractors to remove or dispose of asbestos-containing materials.

3340 Customer Health and Safety

1. MaineHP services must be provided in a manner that minimizes risk to customers.

2. Health and safety issues should be addressed as part of the customer education process, both verbally and by distributing educational pamphlets during the pre- or post-work analysis.
3. Dwellings with unvented or vent-free combustion appliances, with the exception of gas ranges, may not be tightened in any manner or insulated until such appliances are properly vented (according to the appropriate code) to the outdoors.
4. Customers must be notified in writing of any health or safety problems that require MaineHP work to be postponed or terminated.
5. Use of materials that may be hazardous to the customer should be minimized or restricted; however, if hazardous chemicals must be used, it must be discussed with the customer prior to their use.
6. Special precautions must be taken if an occupant of the home has respiratory ailments, allergies, is pregnant, or has unique health concerns. Job personnel should try to protect all customers from respirable particles, such as paint or insulation dust, during the work process.
7. During the installation of hazardous materials, such as spray foams, the work area must be well-ventilated.
8. MaineHP service providers and job-site personnel should not smoke cigarettes, cigars, or pipes in a customer's home.
9. If strong-smelling chemicals, such as formaldehyde, are detected in the customer's home, job-site personnel should not perform any weatherization measures that reduce the natural air leakage of the dwelling until the source of the chemical is removed.
10. At a minimum, MaineHP service providers should inform customers of safety problems, code problems and other health and safety issues. These items might include:
    a. Hazardous levels of carbon monoxide.
    b. Leaks in waste plumbing pipes of raw sewage.
    c. Hazardous levels of mold.
    d. Mercury.
    e. Friable asbestos in an area that children frequent.

3350 Moisture Remediation, Assessment, and Repairs

Moisture problems that might 1) result in health problems for the occupants, 2) damage the structure over the short- or long-term, or 3) diminish the effectiveness of the MaineHP measures must be repaired before the job is completed.

If existing mold or mildew problems are beyond the scope of the MaineHP program, the work should be postponed until the related hazards are corrected. If a mold condition is discovered that will defer or prevent weatherization services, the customer should be notified in writing of the mold condition. All homes should be checked for previous or existing moisture problems.

1. During the pre-work assessment, check for:
    a. Evidence of condensation on windows, walls, or ceilings indicated by stains or mold.
    b. Standing water, open sumps, open wells, dirt floors, water stains, etc. in basements. Also, check to see if firewood is stored in the basement and whether laundry is hung to dry indoors during the winter months.
    c. Leaking supply or waste pipes.
    d. Attic roof sheathing that shows evidence of mold or mildew.
2. If existing moisture problems are found, no air sealing should be done unless the source of the moisture can be substantially reduced, or effective mechanical ventilation can be added to cost-effectively remove the moisture. In some cases, air sealing must be done in order to reduce the source of the moisture (i.e., sealing off crawl spaces from the house, or sealing attic leakage to eliminate condensation on the roof deck).
3. Because air sealing may cause an increase in relative humidity, the customer should be informed about moisture problems and possible solutions.
4. In the course of MaineHP work, any low-cost measures that help reduce the humidity levels in the house should be installed. Examples of these measures are venting dryers, venting existing bath or kitchen exhaust fans or installing moisture barriers on dirt floors.
5. Moisture problems can be reduced or eliminated by controlling the source of the moisture. This can involve:
    a. Installing a ground cover on a crawl space floor.
    b. Venting dryers to the outside of the building.
    c. Sealing the foundation.
    d. Providing drainage away from the foundation.
    e. Repairing the roof, flashing, gutter, and downspout.
    f. Educating the customer about the sources of moisture that they are able to control.
6. Moisture problems can be reduced or eliminated by ventilating areas where excessive moisture is produced, such as bathrooms and kitchens. This should include installation of a high quality exhaust fan in the subject area, and informing the customer of the related moisture issues and the proper operation and use of the fan. See Section 3370 for exhaust fan installation guidelines.

3360 Dryer Vents

1. Electric and gas dryers must always be vented to the outdoors.
2. Dryer vent ductwork should be smooth-surfaced. No more than two 90° elbows may be used in the vent system, and ductwork should not exceed 15 feet. If three 90° elbows are required, the total length of the vent may not exceed 10 feet.

3. Flexible vinyl vent pipe shall not be used.
4. Flexible metal vent pipe may be used if it does not exceed 6 feet in length.
5. Gas dryer vent pipe should not be installed with sheet metal screws or other intrusive fasteners that will collect lint (according to NFPA 54).

3370 Ventilation Systems for Acceptable Indoor Air Quality

Ventilation and other indoor air quality measures should be based on ASHRAE Standard 62.2-2007. The "infiltration credit" defined in ASHRAE Standard 62.2-2007 may be used only if a post-weatherization blower door test is performed on the dwelling.

1. New systems, local, on-demand operation.
    a. Exhaust system ductwork must consist of galvanized metal, rigid aluminum, PVC or metal flex duct less than 6 feet in length. Vinyl flex duct shall not be used.
    b. Exhaust system ductwork must extended through the roof or sidewall to the outdoors and the duct must be insulated to at least an R-5 where it passes through an unconditioned area.
    c. For intermittently operated exhaust fans, controls may be by a push-button switch timer, a separate on/off wall switch, an occupancy sensor switch, or hard wiring with a primary light switch (such as in a bathroom). Controls should be installed in the same room as the fan.
2. New systems, continuous operation.
    a. Exhaust system ductwork should consist of galvanized metal, rigid aluminum, PVC, or metal flex duct. The duct should not exceed a maximum length recommended by the manufacturer. Vinyl flex duct should not be used.
    b. Exhaust system ductwork must be extended through the roof or sidewall to the outdoors and the duct shall be insulated where it passes through an unconditioned area.
    c. For continuously operated exhaust fans, controls may be by a push button switch, a separate on/off wall switch, or hard wiring with a remotely located switch. Controls may be installed in the same room as the fan.
    d. Fans should be located in a central hallway, kitchen, or bathroom.
    e. When installing a continuously operating ventilation system, educating the customer about its use is extremely important. The customer should be informed about:
        i. The purpose(s) of the system installation.
        ii. The importance of operating the fan(s) whenever the house is closed up and occupied, such as during the heating season.
        iii. The disadvantages of not operating the system.

3. Existing exhaust fans
    a. Existing mechanical exhaust ventilation systems should be made to terminate outside the building shell by extending the ventilation duct through the roof or sidewall.
    b. Replacement exhaust system ductwork should consist of galvanized metal, rigid aluminum, PVC, or aluminum flex duct under 6 feet in length, with the duct insulated where it passes through an unconditioned area.

3400 Carbon Monoxide

3410 Measurement of Carbon Monoxide

1. CO emissions *must* be measured in atmospheric gas-fired water heaters, as long as the probe for the measuring instrument is inserted just below the draft hood without drilling a hole in the vent connector.
    a. All gas-fired direct-vent (sealed combustion) and atmospheric combustion water heaters should be tested for carbon monoxide emissions at the outdoor vent termination.
    b. If the measured CO levels are higher than the threshold levels in the BPI BA1 specification, the appropriate action must be taken.
2. When the service provider has a limited energy auditor technicians license, CO emissions *must* be measured:
    a. In the vent connectors of oil-fired appliances.*
    b. In the vent connectors of gas-fired appliances.*
    c. In ambient air.
3. When the service provider *does not have* a limited energy auditor technician license, CO emissions *may only* be measured in ambient air.
4. MaineHP views any ambient CO as potentially hazardous. Service providers may measure the ambient levels of CO whenever they think it is prudent to do so.
    a. For solid-fuel burning appliances (including wood, pellet, and coal space heaters and cook stoves), test the ambient air close to the appliance for CO concentrations.
    b. For oil- or gas-fired furnaces or boilers, test the ambient air in the room in which the furnace or boiler is installed. Ambient measurements should be taken approximately five feet above the floor.
    c. If ambient levels are higher than 9 ppm, action to repair or replace the appliance should be taken; the source of the CO must be found and corrected before any MaineHP measures are installed.

* CAUTION!
The MaineHP service provider's right to measure carbon monoxide (CO) emissions in combustion appliance vent connectors is restricted in Maine; a "limited energy auditor technician" license is required. The two separate licenses are obtained through the Oil and Solid Fuels and the Propane and Natural Gas Boards.

3420 Carbon Monoxide Alarms

1. When a dwelling has any combustion appliances, at least one carbon monoxide (CO) alarm should be installed in the dwelling. Follow the

manufacturers recommendations for location and installation of the alarm.

2. All CO alarms installed shall be the equivalent to the latest Underwriters Laboratory standard (ANSI/UL 2034).
3. Installed CO alarms may be used that alarm at a lower concentration of CO, such as the CO-Experts UL-1B.

OPTIONAL

Measurement of CO emissions in gas-fired ranges, including range top burners and ovens, is not required by this Standard; however, measurement of these emissions is allowable and is recommended when the energy analyst thinks it is prudent to do so.

3500 Unvented Space Heaters

1. A dwelling utilizing an unvented space heater should not be tightened or insulated.
2. The service provider should explain the consequences of using an unvented space heater to the customer.
3. When the customer has agreed in writing that they understand and will not use the unvented space heater, the MaineHP work may commence.

3600 Exceptions

1. Diagnostic equipment or test procedures should not be used in or on dwellings where such equipment or testing could exacerbate existing problems – such as friable asbestos or carbon monoxide – or pose a threat to the health of occupants.
2. In all cases, it is the service provider's responsibility to determine if a condition exists that could cause any diagnostic equipment or test procedure to be potentially harmful to occupants or job personnel.

4000 Customer Education

4100 Customer Education Recommendations

1. Customer education should be provided during all phases of the MaineHP process. This includes, but is not limited to:
    a. During customer intake and scheduling, education should cover how the energy analysis and MaineHP work process will proceed.
    b. During the initial assessment, education should cover:
        i. What the customer should expect during the initial assessment.
        ii. Air leaks discovered with the blower door.
        iii. An explanation of any appropriate health and safety issues, such as:
            1. Lead paint.
            2. Asbestos.
            3. Combustion venting.
            4. Carbon monoxide.
            5. Mold and mildew.
            6. Plumbing leaks.
            7. Animal hazards such as rodent feces or insect infestations.
            8. Other possible hazards.
            9. Health and safety issues should be addressed as part of the customer education process.
        iv. An explanation of energy-conserving measures that might be installed.
            1. Air sealing.
            2. Addition of insulation.
            3. Heating system improvements.
            4. Baseload measures, including water heater improvements.
        v. Improvements in thermal comfort in the dwelling as a result of the installed energy-saving measures.
        vi. An explanation of required maintenance for existing equipment, added equipment, or energy-saving measures.
        vii. What will take place after the assessment:
            1. Schedule of events.
            2. Who will contact customer next.
            3. When the work will be complete.
        viii. What the customer must do to prepare for the MaineHP assessment and work.
            1. Movement of stored items to make room for the work.
            2. Fully extinguish wood or other solid-fuel stoves or heaters.

2. Whenever possible, demonstrate to educate. Get the customer involved in the educational process, if possible.
3. The use of up-to-date written materials is encouraged for customer education, but demonstration has proven to work better in most cases.

5000 Air Sealing

5100 Air Sealing Requirements

Before air leakage reduction measures are installed, the pressure boundaries of the building enclosure must be defined and existing health and safety problems must be corrected.

During the air sealing process, a blower door should be set up so that the effectiveness of air sealing can be determined by measuring the reduction in the dwelling CFM_{50} value. This should be done at least two or three intervals during air sealing.

Usually, as air sealing work progresses, it becomes less cost effective because the large leaks are sealed first. When it is calculated that the effectiveness of air sealing has diminished to a point below that which is cost effective, the sealing work should stop.

The infrared scanning device is a powerful tool for finding air leaks when used in conjunction with a blower door. Energy analysts and service providers are advised to use infrared scanning whenever the equipment is available and the use is practical.

5200 Blower Door Guided Air Sealing

5210 Gross and Guided Air Sealing

Air sealing work on dwellings is of two types:

1. *Gross air sealing*. Examples include replacing window glass where glass is missing, and sealing gross holes in the building envelope. Prior to any work done on the dwelling, an "as-is" blower door test should be performed as a means of finding these gross holes. This test will indicate whether gross air sealing is needed before a more representative blower door test can be made.
2. *Guided air sealing*. This is air sealing completed with the guidance of the blower door. Operate the blower door in depressurization mode while inspecting for leaks. Do not forget to check for leaks in a conditioned basement. If inspecting for leakage in an attic, it is best to pressurize the dwelling with the blower door by using the blower door fan reversal switch.

5220 Blower Door Use Requirements

1. Pre- and post-weatherization CFM_{50} testing must be completed on each unit. A one-point CFM_{50} blower door measurement is preferred over the multi-point computer-derived method. (See Section 12100 for proper blower door setup and use.)

Pre- and post-weatherization blower door tests may be delayed or waived due to the following circumstances:

i. Problems may be created in the unit due to a lack of structural integrity.
ii. Solid-fuel combustion appliances are operating. Attempts must be made to have the customer shut down a solid-fuel burning appliance approximately twenty-four hours before the pre-weatherization assessment is conducted. Similar attempts must be made before the post-work inspection if a blower door test will be required.
iii. Suspected friable asbestos-containing material may be significantly disturbed.
iv. Other documented extenuating circumstances.
v. If it is not possible to perform the pre- or post-work blower door test to determine the location of leakage and determine the pre- and post-work CFM_{50}, the reason should be documented in the customers file.

5230 Air Sealing Guidelines

1. Before blown insulation is installed, all obvious leaks should be sealed. These leaks might include, but are not limited to:
   a. Open top plates (usually in balloon-frame dwellings).
   b. Chases around masonry and metal chimneys.
   c. Chases around plumbing stacks.
   d. Missing window sashes or lights.
   e. Window sashes without locks.
   f. Such sashes should be tightened by installing sash locks on double- and single-hung windows. (Two cam-type locks per window sash are preferred.)
   g. Doors that are misaligned in their frames.
   h. Missing drywall or other interior finish materials.
   i. Missing or misaligned attic doors or hatches.
   j. Missing or misaligned outside access doors in basements.
   k. Other obvious holes or leaks in the dwelling envelope that:
      i. If filled, will protect the structure from damage, or
      ii. Are necessary for the proper installation of insulation.
2. The use of performance-based products is acceptable for achieving reductions in air leakage. Whenever feasible, installation of tube-filled, high density cellulose insulation in sidewalls, cathedral ceilings, convective bypass areas, open top plates/drop ceilings and other air leakage locations is preferred over the use of air sealing techniques using air barrier materials.

Air Leakage from the House to the Attic

For the sake of preventing moisture problems in the attic and energy savings, it is preferred that the flow rate between the house and the attic be reduced to 10 percent (or less) of the whole house CFM_{50} value. For example, if the whole house CFM_{50} value is 2400, MaineHP would like to have measured air leakage between the house and the attic reduced to a CFM_{50} flow value of 240 (approximately 24 square inches) or less. Zone pressure diagnostics testing must be used to determine the CFM_{50} flow value between the house and the attic. See Section 12400 for more information.

Air Leakage from the House to an Attached Garage

For the sake of customer safety and energy savings, it is preferred that the flow rate between the house and an attached garage be reduced to measured 50 CFM_{50} (approximately 5 square inches) or less. Zone pressure diagnostics testing must be used to determine the CFM_{50} flow value between the house and an attached garage. See Section 12400 for more information.

5300 Room-to-Room Pressures

Room-to-room pressure(s) should be measured in all rooms with forced air heating return or supply ducts and operable doors, after all MaineHP tasks have been completed, but before the post-work combustion safety test is performed. Please refer to Section 12230 for detailed instructions.

5400 Penetrations and Holes

1. All penetrations through the exterior sidewalls of a dwelling that require sealing must be sealed from the interior with the exception of:
    a. Foundations, which may be sealed from either the interior or exterior.
    b. Any hole or penetration requiring sealing to keep out rain or snow.
2. Before blown insulation (used as an air sealant) is installed, all obvious leaks should be sealed. These leaks might include, but are not limited to:
    a. Open top plates (usually in balloon frame dwellings).
    b. Chases around masonry and metal chimneys.
    c. Chases around plumbing stacks.
    d. Missing window sashes or lights.
    e. Doors that are misaligned in their frames.
    f. Missing drywall or other interior finish materials.
    g. Missing or misaligned attic doors or hatches.
    h. Missing or misaligned bulkhead doors in basements.
    i. Other obvious holes or leaks in the dwelling envelope that are cost-effective to seal, will prevent the structure from damage, or are necessary for the proper installation of insulation.
3. Openings in recessed light fixtures must not be sealed unless the fixture is rated as a type "IC" fixture.
4. Firestopping around masonry chimneys "shall be of galvanized steel not less than 26 gauge thick or of noncombustible sheet material not more than ½ inch thick."[1] Such material must be used to seal gaps or chases greater than ¼ inch wide around masonry or metal chimneys. Aluminum flashing may not be used for this purpose. This fire-rated material must be sealed to the chimney and the surrounding framing and finish materials with high temperature caulking. Gaps of ¼ inch or less are to be sealed with high temperature caulking only. This treatment is intended to stop the flow of air and water vapor into the attic from these gaps or chases.
    a. In addition to stopping the flow of air around a chimney, a block must be installed to keep flammable insulation (for example, cellulose and faced fiberglass) at least 2 inches from the masonry or metal chimney. This is to be accomplished with a block of a rigid

material. If this material is not fire-rated, it must be at least two inches from the masonry or metal chimney.

b. If an existing chimney or flue is treated incorrectly, correct it to comply with these standards. If it is not reasonable to bring a chimney up to these standards, document this fact in the customer file and include photographs.

5410 Penetrations in Basement Ceilings

1. If the basement is defined as outside the thermal enclosure, seal all significant leaks in the basement ceiling.
   a. If the basement ceiling will be insulated, make sure the penetrations are air-sealed before insulating.
   b. Use the blower door to help find leaks in the basement ceiling by pressurizing the house, closing the door to the basement, and opening a basement window or door to the outdoors.
2. If the basement is defined as inside the thermal enclosure, leaks that are not connected to the outdoors should not be sealed.
   However, some penetrations in a basement ceiling, while initially appearing to be between two conditioned zones, might be connected to the outdoors through attics, open interior walls, exterior walls, or unconditioned attached structures. These circuitous leaks are more likely found in a balloon-framed house. Leaks of this type should be sealed. Follow the procedure below to identify circuitous basement ceiling leaks that are connected to the outdoors:
   a. First, carefully complete all attic bypass air sealing.
   b. Insulate the attic after completing the attic bypass air sealing.
      i. insulate the house walls. (The walls should be dense packed with cellulose unless conditions will not permit.)
      ii. after completing the attic air sealing and the attic and wall insulation installation, depressurize the dwelling with the blower door.
      iii. with the blower door running, the interior door to the basement open, and the basement closed to the outdoors, search for leaks in the basement ceiling connected to the outdoors. If air is flowing through penetrations in the basement ceiling, this air is circuitously leaking in from the outdoors. Possible examples of these leaks include:
         1. Chimney chases.
         2. Plumbing stacks.
         3. Interior walls open to the basement.
      iv. if, under blower door depressurization, the basement ceiling penetrations are leaking air from the outdoors, seal them.
      v. If penetrations are not leaking, do not seal them.

NOTE

It is always best to stop these circuitous leaks by sealing attic bypasses or dense packing exterior walls with cellulose. However, in some cases, difficult air leaks remain after this work.

5420 Fireplace Plugs and Whole House Fans

1. Removable fireplace "plugs" should be installed in a manner that prohibits the use of the fireplace when the "plug" is in place.
2. Covers for whole house fans should be easy to remove and reinstall.

5430 Window Air Conditioners

1. Window air conditioners should be removed and stored when not needed. When it is found that the customer does not remove a window air conditioner for the heating season, customer education should address the advantages of:
    a. Removing and closing the window, or
    b. Installing an airtight cover on the exterior of the air conditioner unit, or
    c. Sealing the air conditioner unit from the interior.

5500 Zone Pressure Diagnostics

Zone Pressure Diagnostics (ZPD) testing to assist in the determination of the location pressure boundaries and the effectiveness of air sealing measures is highly recommended in some dwellings. Please refer to Section 12400 for the details of ZPD procedures.

5600 Duct Leakage

5610 Introduction

Duct leaks can lead to many problems in a dwelling, the most common one being wasted energy. Other problems can include thermal discomfort, substandard indoor air quality, and hazardous combustion venting.

Duck leakage to or from the outdoors wastes more energy than duct leakage within the confines of the thermal enclosure.

On the other hand, although duct leakage within the thermal enclosure usually does not have a significant energy impact, it might pose a hazard to occupant health by causing poor indoor air quality or backdrafting of combustion appliances. These potential problems are addressed on-site by an Indoor Air Quality (IAQ) appraisal, and by performing combustion safety testing.

5620 Duct Leakage Standards

1. For ducts located *within* the thermal enclosure, such as a basement or crawl space:
    a. Visually inspect the space to ensure that the shell is properly air sealed and insulated. There are a number of techniques that can be used to help find hidden leaks in ductwork. These methods include:

i. careful visual inspection.
ii. operating the air handler while searching for leaks; existing leaks often become leakier if the conditioned basement or crawl space is opened to the outdoors.
iii. pressure pan testing at registers and grilles while the blower door is operating and the basement or crawl space is opened to the outdoors.
iv. use of a duct blower.

b. Perform a house-to-zone pressure and flow test (ZPD) to determine if the space in question is effectively within the thermal envelope in terms of its pressure boundaries. The house-to-zone pressure should be 20 Pascals or less.

d. If it is determined that air sealing and other weatherizing should be done to the enclosure of the space that houses the ducts, perform a house-to-zone pressure and flow test (ZPD) before and after the work to quantify the effectiveness of the work.

d. Repair disconnected ducts.

2. For ducts located *outside* the thermal enclosure:

a. Sealing the enclosure of the space, rather than the duct joints, is preferred. If possible, bring the ducts into the thermal enclosure of the unit, making sure the air and thermal barriers are installed effectively.

i. demonstrate the effectiveness of this alteration by performing a house-to-zone pressure and flow test (ZPD) before and after the conversion, and
ii. repair disconnected ducts.

b. If it is impossible or impractical to effectively bring the ductwork within the thermal enclosure (examples include crawl spaces, unconditioned basements, attics, attached or tuck-under garages, and exterior walls),

i. make all necessary ductwork repairs,
ii. seal all ductwork joints with appropriate mastic, and
iii. thermally insulate ducts outside of the thermal enclosure to at least R-8.

3. MaineHP recommends testing before air sealing and other weatherizing to determine whether the furnace air handler affects the pressure in the combustion appliance zone (CAZ). This test is part of the BPI combustion safety test procedure for homes with furnaces.

a. To conduct this test:

i. make certain the basement door to the upstairs is in the worst-case position and the basement or crawl space is closed to the outdoors as much as possible.
ii. measure the pressure in the CAZ with reference to the outdoors with the furnace air handler off.

iii. measure the pressure in the CAZ with reference to the outdoors with the furnace air handler on.

b. If the air handler significantly affects the pressure in the CAZ, call for the appropriate duct sealing on the job work order.

(**Footnotes)**

[1] NFPA 211 - 2006 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, 7.1.6.3

6000 Insulation Standards

Cellulose insulation from most manufacturers is available in at least two grades that are characterized by the fire retardant added to the insulation. The fire retardants are usually 1) a mix of ammonium sulfate and boric acid or 2) boric acid only (termed "borate only"). For the MaineHP Program, cellulose insulation should be the "borate only" grade.
Because cellulose is recycled, has low embodied energy, and is less prone to air intrusion, it is the preferred insulation in the attics of homes.

6100 Attic and Roof Insulation

6110 Inspection, Preparation, and Repairs

1. Prior to installing insulation, a thorough inspection of the attic area should be performed.
2. The inspection should include a determination of the R-value and integrity of existing insulation, the location of air leaks from the conditioned spaces to the attic, and the suitability of the structure for receiving insulation.
3. The inspection should determine the necessity of any repair work associated with the installation of the attic insulation. Repairs should be completed before installing insulation.

6111 Electrical Safeguards

1. Correct electrical problems such as unsafe wiring, open junction boxes, or other electrical code violations prior to performing any other work in the attic.
2. All visible electrical junction boxes shall be covered with an appropriate junction box cover.
3. All electrical fixtures shall be blocked with rigid material to ensure a minimum insulation clearance of 3 inches and a maximum clearance of 6 inches.
    a. Exceptions to this rule include Type IC (insulation contact) recessed lights and light/fan combinations, and closed junction boxes.
4. It is acceptable to remove recessed light fixtures if this is the most practical method of air sealing.
5. Knob-and-tube wiring:
    a. If knob-and-tube wiring has been deactivated and the dwelling has been rewired with BX, NM, or other approved electrical cable, the attic may be insulated over the inactive knob-and-tube.
    b. Any insulation must be keep at least 3 inches from active knob-and-tube wiring, unless the wiring has been approved or upgraded by a licensed electrician.

i. Blown insulation must be appropriately dammed to keep the insulation 3 inches or more away from the knob-and-tube wiring.

6112 Moisture, Inspection and Repair

1. Roof leaks and all other attic moisture problems should be repaired prior to the installation of attic or roof insulation.
2. All mechanical vents from exhausting and combustion appliances must be vented through the roof or sidewall.

6113 Treatment of Other Hazards

1. Use appropriate personal protective equipment and work practices in the presence of animal or insect hazards. Ensure personal safety during work.
2. Repair any rotted, broken, or damaged attic structural components. Ensure that the ceiling will safely hold the weight of the insulation. Repair or replace any weakened, damaged, or missing interior ceiling material.

6114 Attic Access

1. When it is necessary to install an interior attic access in the ceiling, it must be accessible for inspection.
    a. The access panel should be weatherstripped and insulated with at least 4 inches of extruded polystyrene (R-20).
2. In pre-1978 homes, installation of an attic access must be performed using lead-safe work practices, and all dust and debris caused by the installation shall be wet-cleaned.
3. An attic ceiling access shall have an insulation dam, made of rigid materials, that exceeds the height of the insulation to be installed. The dam must be strong enough to hold the weight of a person entering or exiting the attic. The use of fiberglass or other non-rigid material as a dam around the attic access is not allowed.
    a. Examples of approved attic access insulation dam materials include:
        i. Plywood of at least ¾-inch thickness.
        ii. Wood board of at least ¾-inch thickness.
        iii. Plywood of at least ½-inch thickness with ¾-inch by 2-½ inch strapping securely fastened to the exterior face of the plywood box, with the edge of the strapping flush with the top edge of the fabricated plywood box.
4. If there are no interior accesses, at least one exterior access to each attic space shall be left for inspection purposes. Before such access is sealed, the attic and/or knee wall area must be inspected by an appropriate MaineHP representative. This inspection must be adequately documented in the job file.

5. When it is necessary to install an interior access in a knee wall, it must be at least the width of the knee wall stud cavity by 24 inches high, and shall be weatherstripped and insulated to the same R-value as the knee wall. At least one latch should also be installed to ensure air tightness. In pre-1978 homes, lead-safe work and clean-up practices shall be utilized.

6115 Insulation Shielding and Blocking

1. All electrical fixtures shall be blocked with rigid material to ensure a minimum insulation clearance of 3 inches and a maximum clearance of 6 inches.
    a. Exceptions to this rule include Type IC (insulation contact) recessed lights and light/fan combinations and closed junction boxes.
2. No insulation, including fire-rated insulation, shall be installed above recessed light fixtures so as to trap heat or prevent free air circulation. However, insulation may be installed over Type IC (insulation contact) light fixtures.
3. Blocking must be installed so that it is effective in shielding the heat source from the insulation, and no insulation shall be left within the blocked area.
4. Metal blocking must be notched so that it does not contact electrical wiring.
5. If insulation is added to the attic, rigid permanent blocking is required around the attic access opening if adequate clearance exists.
6. Firestopping around masonry chimneys "shall be of galvanized steel not less than 26 gauge thick or of noncombustible sheet material not more than ½ inch thick."[1] Such material must be used to seal gaps or chases greater than ¼ inch wide around masonry or metal chimneys. Aluminum flashing may not be used for this purpose. This fire-rated material must be sealed to the chimney and the surrounding framing and finish materials with high temperature caulking. Gaps of ¼ inch or less are to be sealed with high temperature caulking only. This treatment is intended to stop the flow of air and water vapor into the attic from these gaps or chases.
    a. In addition to stopping the flow or air around a chimney, a block must be installed to keep insulation away from the masonry or metal chimney. This is to be done with a block of rigid material. If this material is not fire-rated, it must be at least 2 inches from the masonry or metal chimney.
    b. If an existing chimney or flue is treated incorrectly, correct it to comply with these standards. If it is not reasonable to bring a chimney up to these standards, document this fact in the customer file and include photographs.

7. Requirements for furnaces installed in attics:
   a. Attic furnace blocking must be installed to ensure a minimum free air clearance of 18 inches, but not more than 24 inches.
   b. If there is a work platform for an attic furnace, or if one is installed as part of the weatherization work, 30 inches of clearance adjacent to the furnace controls must be provided.
   c. Attic furnaces must be checked after adding attic insulation to ensure they are free of insulation and operate properly.

6120 Installation Methods for Attic Insulation

1. Locate and seal attic air bypasses, chases, and open-topped partition walls. Remove enough of any existing flooring so that a thorough inspection for, and repair of, attic bypasses is possible. Properly treat ceiling height changes and stairwells as necessary to stop air leakage. Seal knee wall floor cavities. Make sure bypasses are completely sealed before installing any insulation.
2. Attic insulation must completely cover conditioned areas and must be installed at a consistent thickness, except where physical constraints exist.
3. Insulation must be installed to the outside edge of the top plate of an exterior wall.
4. Insulation may not cover soffit vents or fill the eave/soffit area.
5. Insulation must be installed according to the manufacturer's specifications for coverage and R-value.
6. Attics should be tested using zone pressure diagnostics (ZPD) when the housing construction type or the air leakage rate indicates that there may be hidden air leaks or bypasses into the attic. This test should be conducted prior to, and then after, installing insulation in order to determine the quality and completeness of the air leakage and bypass sealing. Please refer to Section 12400 for zone pressure diagnostics instructions.
7. If the installation of cellulose insulation on top of existing batt or blanket insulation is warranted, cut and remove or roll back 1 to 2 feet of this insulation at the eave sides of the house so that the top surface of the ceiling material is exposed.
   If the finished ceiling material is strapped perpendicularly to the joists, remove all of the batt insulation from the joist bays that border the gable ends before insulating with blown cellulose.

6121 Insulation Coverage and Density

1. Insulate uninsulated open-joist attics to at least R-38 in all dwellings that are conditioned and lived in year-round. Energy economics and the desire of the customer might demand higher R-values.
2. For attics with existing insulation, measure the density of the insulation in a selected test area before beginning the major installation. Blown

insulation should be installed using any nozzle type or tubing method. The density of blown insulation in enclosed cavities should be within the range of the values listed under #3 and #4 below.

3. Insulate enclosed areas: under floors, behind slopes, etc. to the following density levels, as long as interior finish materials are able to withstand the density without damage:
    a. Blown cellulose at a density of at least 3.5 lb/ft^3.
    b. Blown fiberglass at a density of 1.6 lb/ft^3
4. Insulate knee wall cavities as follows:
    a. Blown cellulose at a density of at least 3.5 lb/ft^3.
    b. Blown fiberglass at a density of 1.6 lb/ft^3.
    c. Fiberglass batts to an insulating value of R-19.
    d. Appropriate foam insulation for open knee wall cavities.
5. Calculating the number of bags is the preferred method for determining the proper amount of material (density) to be installed into an attic area at a given R-value.
6. Where the combined material and labor costs can be reduced, it is preferred that dropped soffits and similar construction details be filled with cellulose insulation.
7. When a vapor barrier (Aroostook County) or vapor retarder (all but Aroostook County) is installed with the insulation, the barrier should be installed on the warm side of the insulation, but never more than 1/3 of the R-value away from the warm-side surface.
8. Add insulation as necessary to eliminate voids and areas of incomplete coverage. When using cellulose, after properly blocking the eaves to prevent insulation from filling soffit, cut or pull back existing fiberglass batts 1 to 2 feet from the soffit and blow the perimeter and then over the existing insulation.

6122 Vaulted or Sloped Ceiling/Roof Cavities

1. A vaulted ceiling or sloped ceiling/roof cavities should be insulated to a value of at least R-19 whenever possible.
2. If batt insulation is used, the vapor retarder or barrier should always face the conditioned building space. If this vapor retarder faces a habitable space, the vapor retarder must be covered with a 15-minute fire-rated material, such as ½ inch drywall mudded once, or ¾ inch of wood.
3. If cellulose insulation is used, the cellulose should be dense-packed in the vaulted or sloped ceiling/roof cavities.
4. When vaulted or cathedral ceilings (as contrasted from sloped ceiling sections in Cape Cod style houses) are dense packed with cellulose, steps should be taken to ensure that the winter-time relative humidity in the dwelling is kept below 35 percent.

6123 Enclosed Ceiling/Floor Cavities

1. When insulating enclosed sloped ceiling cavities, it is preferred that insulation be installed in the rafter cavities from the attic, through the eave or from the interior of the home, rather than through the roofing material.

6124 Attic Access Insulation

1. When it is necessary to install an interior access in the ceiling, it must be at least 4 square feet and at least 20 inches in width or length. It should be weatherstripped and insulated with at least 4 inches of extruded polystyrene (R-20) that is properly secured to the exterior surface of the attic hatch.

6125 Ductwork Insulation

1. Ductwork must be sealed appropriately with the proper materials (duct mastic) before insulation is installed. Refer to Section 9120 for instructions.
2. When working ducts are located in an attic, install a minimum of R-8 (preferably R-11 or greater, if possible) on ducts and plenums.
3. A minimum of 3 inches of clearance between duct insulation and heat sources (e.g., recessed lights that are not Type IC) must be maintained, unless the insulation material is rated for closer proximity.

6126 Drill-and-Blow Patching

1. If a drill-and-blow method is used for installing floor or ceiling insulation, holes must be properly plugged, secured with adhesives, and sealed.

6130 Attic Ventilation

With proper air sealing and insulation installation in the attic floor, the need for attic ventilation is reduced. It is important to avoid over ventilating the attic because this can increase the CFM_{50} value of the dwelling. Please refer to Section 6135.

6131 General Installation

1. Ensure that existing vents are not blocked, crushed, or otherwise obstructed. Correct problems as necessary, or replace.
2. When attic insulation is installed, a reasonable amount of attic ventilation should be in place, unless local codes supersede.
3. When roof vents are installed, they should be nailed and well sealed to the roof to prevent water leakage. If possible, roof vents should be located on the areas of the roof least visible from the ground.

4. All ventilation openings should have suitable louvers and screens to prevent snow, rain, and insects from entering the attic.

6132 High-Low Vents

1. Roof vents should be installed close to the peak.
2. Install high gable vents at least three feet above the soffit vents used for low venting.

6133 Gable Vents

1. Gable-end vents should be installed as high in the gable as possible and positioned to provide cross ventilation.
2. Precautions should be taken to prevent the wind from "washing" insulation near the attic vents.

6134 Knee Wall Ventilation

1. Knee walls or attic spaces that are sealed from other attic spaces may need to be ventilated as if they are separate attics.

6135 Attic Vent Area Guideline

1. When attic ventilation is installed, use the following guideline:
    a. If the attic floor is air sealed, then 1 square foot of net-free ventilation may be installed for every 300 square feet of attic floor area. This rule assumes that the ceiling below the attic has an adequate vapor barrier or retarder in the form of paint, plastic sheeting, foil or kraft facing on the insulation, etc.

6200 Sidewall Insulation

6210 Inspection, Preparation, and Repairs

1. Perform an inspection of the home from the interior and exterior prior to installing insulation. This inspection should identify all potential hazards and needed repairs.
    a. An inspection from the exterior of the home should include an examination of the following:
        i. Building construction details.
        ii. Siding type and condition.
        iii. The location of electrical, gas, oil, and phone lines.
        iv. Plumbing pipes.
        v. Existing moisture and drainage problems.
        vi. Existing structural problems.
    b. An inspection from the interior of the home should include an examination of the following:
        i. Interior wall finish type and condition.
        ii. Electrical and plumbing utilities.
        iii. Duct work in wall cavities.

iv. Dropped or suspended ceilings.
v. Moisture problems.

c. An inspection from the attic should include an examination of the following:
i. Open top plates and balloon framing (attic flooring might have to be removed to adequately inspect for these bypasses).
ii. Type of electrical wiring in the walls.
iii. Knee wall areas.
iv. Chimney and plumbing chases (attic flooring might have to be removed to adequately inspect for these bypasses).

d. An inspection from the basement should include an examination of the following:
i. Type of electrical wiring in the walls; in particular, knob-and-tube.

6211 Electrical Safeguards

1. A licensed electrician should correct electrical problems such as unsafe wiring, open junction boxes that are accessible, or electrical code violations prior to performing any other work in the walls.
2. Knob-and-tube wiring:
   a. If knob-and-tube wiring has been deactivated and the dwelling has been rewired with BX, NM, or other approved electrical cable, the walls may be insulated around the inactive knob-and-tube.
   b. Live knob-and-tube wiring must be approved or upgraded by a licensed electrician before insulation can be installed in any wall cavities.

6212 Moisture, Inspection and Repair

1. Any leaks or other moisture problems must be repaired prior to the installation of wall insulation.

6213 Treatment of Other Hazards

1. Use appropriate personal protective equipment and work practices in the presence of animal or insect hazards. Ensure personnel safety during work.
2. Remove any items that need to be moved in order to install wall insulation effectively.
3. Repair any rotted, broken, or damaged structural components. Ensure that the finished wall material will safely withstand the pressure of the insulation. Repair or replace any weakened, damaged, or missing interior wall surfaces. Use lead-safe work practices in all pre-1978 dwellings.
4. Set up ladders in a safe manner, using ladder levelers or other safety devices, to compensate for uneven ground or other physical impediments to safe ladder use.

6214 Interior Inspection and Repairs

1. Repair or replace weak or damaged drywall or lath-and-plaster sections. In pre-1978 homes, repairs to these surfaces can generate a lot of lead paint dust and debris, so lead-safe work and clean-up practices must be employed. Locate any areas of the interior wall surface that are weak or not securely fastened. Choose an insulation installation method that will not damage the interior wall surface. Repair or replace damaged or missing baseboard, casing, jambs, etc., that may allow insulation to escape from the wall cavity. Holes drilled for insulation must be plugged, finished, and returned to a condition as close to the original as possible.
2. Locate the positions of all wall-mounted switches and outlets before beginning insulation work. Locate all chases, utility runs, duct runs, wall heaters, vent fan penetrations, etc. prior to insulating. Block around these areas, if possible. If it is not possible to block around an area, avoid that area when insulating.
3. Find any interior soffit areas, pocket doors, or other structural details that may need preparation prior to insulating, and prepare as necessary. Locate critical framing junctures and ensure adequate insulation densities in these areas.

6215 Exterior Inspection and Repairs

1. Note all types of siding material. Note siding material that may contain asbestos and/or lead-based paint. If the home is pre-1978, install a 6-mil polyethylene ground cover at the bottom of the wall to catch chipping or flaking paint caused by the weatherization work. At the end of every workday, clean up all paint chips on the ground cover. Wherever possible, determine the presence and condition of old layers of siding or sub-siding.
2. Determine the best drilling strategy. The preferred method is to lift the siding or temporarily remove it before drilling the sheathing.
3. Repair or replace severely deteriorated window or door components. Replace all missing glass.
4. Patch holes in exterior walls.
5. Determine the source of, and correct any problem that has led to, moisture in wall cavities prior to installing insulation. Repair or replace damaged, rotted, or deteriorated siding to ensure the integrity of the insulation. If any missing siding, flashing, etc. would allow disintegration of installed insulation, replace it with a comparable material.
6. Access structural additions and critical junctures to determine the ability of these areas to contain high-density insulation. Correct any openings or gaps prior to installing insulation.

6220 Installation Methods for Wall Insulation

1. Wall areas above windows and doors, and the area below windows must be insulated, whenever possible.
2. Uninsulated exterior walls without drywall, paneling, or other interior finish material should be insulated as part of the work scope.
    a. If faced fiberglass batt insulation is used, the vapor retarder must face indoors.
        i. All vapor retarders must be covered with a 15-minute fire-rated material, such as ½-inch drywall or ¾-inch wood.
        ii. If drywall is used to cover the insulation, it should be taped and mudded with at least one coat.
        iii. Fiberglass insulation should not be left exposed in habitable areas.
    b. If wet-spray cellulose is used, a vapor retarder must be installed on the winter-warm side, but only after the wet-spray cellulose is properly cured.
        i. All vapor retarders and cellulose must be covered with a 15-minute fire-rated material, such as ½-inch drywall or ¾-inch wood.
        ii. If drywall is used to cover the insulation, it should be taped and mudded with at least one coat.
3. For all enclosed walls where dense packed cellulose is used (where there is both exterior and interior surface finish materials), insulation must be installed using the tubing method rather than the nozzle method.
    a. As an exception, a nozzle may be used in small cavities such as above windows and doors.
4. The tubing method may be used to install insulation in the sidewall by drilling one hole per story.
5. Walls must be dense-packed whenever the interior wall surface material allows. Dense-packing requires:
    a. An insulation machine with the proper capacity (at least 80 inches of water pressure at takeoff or 2.9 pounds per square inch of pressure).
    b. The proper machine settings. For dense-packing, the air-to-material ratio must be high enough for a cellulose density of at least 3.2 pounds per cubic foot. On the other hand, if this ratio is too high, the job of insulating will take much longer. A balance must be found for each machine, delivery system, and wall.
    c. Effective delivery of the insulation material from the machine to the end of the wall tube. This includes:
        i. No air leaks in the hose or at the joints.
        ii. A hose that is as short as possible for the job, but at least 50 feet.

iii. Gradual reductions or transitions in the delivery system to minimize clogging.
iv. A tube that is cut at an angle at the end to facilitate insertion into the wall cavity.

d. An operator that uses an effective technique, characterized by:
i. Inserting the tube all the way up to the top plate and then pulling down just less than 1 foot before the machine is turned on.
ii. Pulling the tube out of the fill hole by just less than 1 foot at a time as the flow in the hose and tube slows and stops due to increasing resistance in the cavity. If the tube is pulled out too soon, the density will decrease.
iii. Inserting the tube downward through the fill hole after the wall cavity is filled upward from the fill hole. Inserting the tube with only the air running will help "drill" through the cellulose that has fallen from the upward fill. This will help achieve a higher density in the downward fill.

6221 Blocking

1. Construction details that allow insulation to escape from sidewall cavities (such as balloon framed walls) must be blocked or packed with insulation or other material in a manner that effectively retains the insulation.

6222 Insulating Floor Cavities Between Conditioned Stories

1. Open floor cavities between conditioned stories should be insulated in balloon-framed buildings.
   a. Only those parts of floor cavities that border the exterior must be insulated.
      i. In balloon-framed buildings, cavities are usually open to the walls, allowing access from the rim or band joists and also from the wall cavities above or below these floor cavities.
   b. The R-value of the insulation in these floor cavities must be at least equal to the R-value of the insulation installed in the adjacent wall cavities.
2. It is recommended that these floor cavities be insulated using the bag or bladder method. This method is probably the most cost effective when considering time and materials.[2]
   a. Joist cavities that are perpendicular to the band joists (usually on the eave sides of a dwelling) should be treated with the bag method.
   b. Joist cavities that are parallel to the band joists (usually on the gable-end sides of a dwelling) should be completely filled with insulation.

6223 Materials

1. If possible, insulate all closed-cavity sidewalls to 3.5 – 4.5 lbs/ft3 with cellulose insulation.
2. Insulate open cavity walls with cellulose blown behind an appropriate mesh, with wet-spray cellulose, or with fiberglass (faced or unfaced) using a density and thickness appropriate for the cavity. Cover any flammable insulation facing or vapor barrier installed in an occupiable space with a fifteen-minute fire-rated material such as ½ inch drywall (taped at least once) or ¾-inch plywood.
3. Rigid plastic insulation may be used when appropriate. Cover any rigid insulation or vapor barrier installed in an occupiable space with a fifteen-minute fire-rated material such as ½-inch drywall (taped once) or ¾-inch plywood.

6224 Insulation Coverage, Density, and Voids

1. Sidewall insulation should be installed according to the manufacturers' recommended density, and in a manner that does not allow the material to settle.
2. When insulating sidewalls with cellulose, install the insulation to a density of 3.5 – 4.5 lbs/ft^3 using the tubing method, unless there is good reason not to dense-pack. If the insulation is not installed to at least 3.5 lbs/ft^3, documented reasons must be included in the job file.
3. When using blown fiberglass, install at a density of 1.6 lb/ft^3.
4. Contractors should warranty wall insulation work for at least one year against voids of more than 5 percent.

6225 Plugs and Patching

1. Where possible, remove the exterior lap siding and drill the sheathing and/or sub-siding for the installation of insulation. Holes in the sheathing or sub-siding must be patched. Various materials may be used for this patching, including wood plugs, plastic plugs, or spray foam insulation.
    a. If there is no other way of installing insulation in a wall other than face drilling through finished siding and plugging the exposed drill holes, first obtain approval in writing from the owner of the dwelling.
2. Plugs that are compatible with the siding or wall type must be used to fill and cover the exposed surface that has been drilled.
3. Exposed plugs must be sealed tightly, glued, and primed.
4. Any wood that is replaced as a result of the weatherization work and that is exposed to the weather must be primed.

5. Stucco-sided dwellings may be insulated from the exterior or the interior. If insulated from the exterior, the stucco patch must match the existing stucco in texture and color.

6226 Brick Siding

1. Interior drill and blow techniques are preferred for homes with brick veneer siding.
2. A vented drainage plane should always be retained or provided.

6227 Quality Control by Installer

1. A final inspection to assess quality and quantity of wall insulation should be performed. This inspection can be performed by using a bore scope, removing interior outlet and switch plates, using an infrared camera, or other acceptable inspection techniques.
2. When possible, infrared scanning should be used as a quality control tool to check wall insulation work and identify areas of excessive air leakage. The infrared scanning device is a very useful tool for finding air leaks when used in conjunction with a blower door. Service providers are advised to use infrared scanning whenever the equipment is available and the use is practical.

6300 Foundation Insulation

This section addresses rim joist insulation, basement wall insulation, and crawl space wall insulation.

6310 Defining the Thermal Enclosure or Boundary

1. If the basement or crawl space houses a heating system or other appliance, it should be treated as a part of the thermal enclosure. Therefore, it is preferred to air seal and insulate the basement or crawl space walls because this strategy encloses the furnace, ducts, pipes, water heater, and other appliances within the conditioned envelope.
2. Basements and crawl spaces should be tested using zone pressure diagnostics (ZPD) when the housing construction type or the air leakage rate indicates that there may be hidden air leakage into or from the basement or crawl space, or air quality problems are resulting from air leakage from a basement or crawl space. This test should be conducted prior to, and then after, air sealing and installing insulation in order to determine the quality and completeness of the air sealing. In addition, this test can help determine the appropriate location of the pressure and thermal boundaries. Please refer to Section 12400 for instructions.
3. If the appropriate thermal enclosure boundary is determined to be the basement or crawl space wall (rather than the floor above the basement or crawl space), then the crawl space wall should be air sealed, as necessary, before any insulation is installed on these surfaces.

6320 Inspection, Preparation, and Repairs

1. An inspection from the interior and exterior of the home should be performed prior to installing insulation. This inspection should identify all potential hazards and needed repairs and should include the following:
    a. Building construction details.
    b. Foundation type and condition.
    c. The location of electrical, gas, oil, cable and phone lines.
    d. Plumbing pipes.
    e. Existing moisture and drainage problems.
    f. Existing structural problems.
2. An inspection from the interior of the home should include an examination of the following:
    a. Interior foundation wall type and condition.
    b. Any active knob-and-tube wiring.
    c. Electrical and plumbing utilities.
    d. Moisture problems.
3. Make any necessary repairs before installing insulation.

6321 Moisture, Inspection and Repair

1. All dwellings must be inspected for problems associated with excess moisture.
2. Identification of potential moisture problems should be documented in the job file.
3. Repair any moisture problems that will degrade or diminish the effectiveness of weatherization measures.
4. In crawl spaces, whenever conditions warrant, install an impermeable ground cover on the floor. This cover should overlap at least 6 inches at the joints, and extend 6 inches up the crawl space wall. Note: If the entire dirt floor is not accessible, cover as much as possible.
    a. If the crawl space area has 18 inches of clearance or more between the crawl space floor and ceiling, a ground cover should be installed unless there are substantial reasons not to. If a moisture barrier is not installed, the reasons must be included in the job file.
5. For basements with dirt floors, whenever feasible, install a non-skid ground cover on the floor. This barrier should overlap at least six inches at the joints, and extend six inches up the basement wall. Mobile home rubber roofing (EPDM) or rolled roofing qualifies as non-skid moisture barriers.

6322 Electrical Safeguards

1. A licensed electrician should correct electrical problems such as unsafe wiring, uncovered junction boxes, or electrical hazards prior to

performing any other work. If insulation exists, ensure that wiring is safe and meets applicable codes.

2. Knob-and-tube wiring:
    a. If knob-and-tube wiring has been deactivated and the dwelling has been rewired with BX, NM, or other approved electrical cable, the basement insulation may be in contact with the inactive knob-and-tube.
    b. Insulation must be keep at least 3 inches from any live knob-and-tube wiring, unless the wiring has been approved or upgraded by a licensed electrician.

6323 Wall Moisture Barrier

1. If there is evidence of water leaks or moisture coming through the foundation wall from the exterior, a moisture barrier must be attached to the sill plate in a manner that drains the moisture behind the insulation, and covers the insulated section of the foundation or crawl space wall.

6324 Treatment of Other Hazards

1. Use appropriate personal protective equipment and work practices in the presence of animal or insect hazards.
2. Repair any rotted, broken, or damaged structural components.

6330 Installation Methods

6331 Materials

1. Interior basement wall insulation:
    a. Please refer to Section 6313 above.
    b. If the wall is studded out on the interior, it may be filled with unfaced fiberglass batt of an appropriate thickness, or with vinyl-faced fiberglass (metal building insulation). A polyethylene vapor retarder should be installed if the fiberglass does not have one.
    c. Vinyl-faced fiberglass (metal building insulation) may be fastened at the band joist area, hung down 4 feet, and fastened and air sealed at the bottom.
    d. Interior rigid insulation may be glued and fastened to the basement wall.
    e. Wet-spay cellulose insulation may not be used on basement or crawl space walls.
2. Exterior basement wall insulation:
    a. Foundation panels (factory pre-finished on the exterior) may be used if they are glued and fastened, have drip caps installed, and are sealed around windows. They must extend below frost depth at minimum.
    b. Extruded polystyrene that is not pre-finished may be used if it is glued and fastened, has drip caps installed, and is sealed around

windows. The insulation must extend below frost depth at minimum. The exterior surface of these panels must be covered with a material that will protect it from ultraviolet light and physical damage.

c. Other insulations may be used that are appropriate and durable.

6332 Insulation Coverage

1. Insulation must be installed in a manner that provides as continuous a thermal boundary as possible.
2. Perimeter batt insulation must not be installed in a manner that excessively compresses the insulation material.

6333 Rim or Band Joist Insulation

1. Insulation must be a minimum of R-10. MaineHP recommends an R-19 or greater.
2. Fiberglass, rigid, foam, or other appropriate insulation may be used for this application.
3. If there is significant air leakage, the band or rim joist area must be properly air sealed before the insulation is installed.
4. The insulation must be secured in a permanent manner.

6334 Foundation Insulation

1. Route any exhaust fans to the outside using dampered vents, smoothbore rigid pipe, and an appropriate termination fixture.
2. If necessary, repair or replace exterior doors or door components to reduce air leakage. If necessary, replace all missing glass and repair or replace window components to reduce air leakage.
3. When foundation walls are insulated, no section above grade should be left uninsulated.
4. Fiberglass insulation must not be left exposed in habitable areas.
5. Mechanical fasteners must be used to secure perimeter insulation in a permanent manner.
6. Interior wall installation:
    a. Stud out the walls and insulate with fiberglass or glue and fasten rigid insulation.
    b. An alternative method for installing perimeter insulation is to attach metal-building insulation at the floor above the rim or band joist, so that the blanket extends from the floor above to 4 feet down the foundation wall. It should be run horizontally in a continuous manner to eliminate as many seams as possible. The blanket may be slit at each floor joist to allow installation in a manner that minimizes gaps around the joist. The bottom of this fiberglass batt insulation should be air sealed to the wall with a strip of wood nailed to the foundation, or by sealing the vinyl facing to the wall with adhesive caulk.
    c. Other insulation types and methods may be used.

7. Exterior-wall installation:
    a. Foundation insulation may be installed on the exterior. This requires digging to below the frost line and installing the rigid insulation so the bottom edge of the insulation is not bucked by frost action. If this method is used, the rigid insulation must be extruded polystyrene at least 1 inch thick and R-5 and it must be protected from sunlight and exterior physical damage by an appropriate rigid material.

6335 Crawl space Insulation

1. Separate a crawl space outside of the thermal enclosure from an adjoining basement or crawl space that is within the thermal enclosure with suitable materials.
2. Seal all direct air leaks into the crawl space.
3. Seal all bypasses and chases into and through the conditioned areas of the house.
4. Route any exhaust fans to the outside, using dampered vents, smoothbore rigid pipe, and an appropriate termination fixture.
5. Install interior perimeter insulation from the rim or band joists to the crawl space floor. The crawl space wall insulation should extend downward to:
    a. A distance that is 2 feet below the exterior grade, or
    b. The crawl space floor.
    c. Mechanically fasten the insulation and seal all joints with appropriate tape.
6. An alternative method for installing interior perimeter insulation is to attach metal-building insulation (vinyl faced) at the floor above the rim. It should be run horizontally in a manner that minimizes the number of seams. The blanket may be slit at each floor joist to allow installation in a manner that minimizes gaps around the joist. This insulation should extend downward to:
    a. A distance that is 2 feet below the exterior grade, or
    b. The crawl space floor and then horizontally across the floor for 2 feet on top of the ground cover, whichever is appropriate.
    c. Mechanically fasten the insulation and seal all joints with tape.

6400 Floor Insulation

6410 Inspection, Preparation, and Repairs

1. Precautions must be taken to ensure adequate combustion air is being supplied, through non-operable vents, for combustion appliances in crawl spaces or basements.

6411 Electrical Safeguards

1. Correct electrical problems such as unsafe wiring, open junction boxes, or other electrical hazards prior to performing any other work in the floor.
2. Do not use any metal mesh material, such as chicken wire, to support floor insulation. This can cause an electrical hazard to the insulation installers.
3. Knob-and-tube wiring:
    a. If knob-and-tube wiring has been deactivated and the dwelling has been rewired with BX, NM, or other approved electrical cable, a floor may be insulated around and in contact with the inactive knob-and-tube.
    b. Insulation must be keep at least 3 inches from the live knob-and-tube wiring unless the wiring has been approved or upgraded by a licensed electrician.

6412 Moisture, Inspection and Repairs

1. All homes should be inspected for problems associated with excess moisture.
2. If floor insulation is installed over a crawl space area, the crawl space floor should be covered with a moisture barrier when conditions warrant. This ground cover should be lapped at least 6 inches at the joints and extended up the crawl space wall 6 inches.
3. Identification of potential moisture problems should be documented in the job file.
4. Repair any moisture problems that will degrade or diminish the effectiveness of weatherization measures.

6420 Defining the Thermal Enclosure or Boundary

1. If the basement or crawl space houses a heating system and/or other appliances, it should be treated as part of the thermal enclosure. Therefore, it is preferred to air seal and insulate the basement or crawl space walls because this strategy encloses the furnace, ducts, pipes, water heater, and other appliances within the conditioned envelope.
2. Basements and crawl spaces should be tested using zone pressure diagnostics (ZPD) when the housing construction type or the air leakage rate indicates that there may be hidden air leakage into or from the basement or crawl space, or air quality problems are resulting from air leakage from a basement or crawl space. This test should be used to determine quality and completeness of air leakage and bypass sealing prior to, and then after, air sealing and installing insulation. In addition, this test can help determine the appropriate location of the pressure and

thermal boundaries. Please refer to Section 12400 on page 3 for instructions.

3. If the appropriate thermal boundary is determined to be the floor above the basement or crawl space (rather than the walls of the basement or crawl space), then this floor should be air sealed, as necessary, before any insulation is installed under it.

6430 Installation Methods for Floor Insulation

1. Install a minimum of R-19 insulation between the floor joists.
2. The insulation should be installed without voids or gaps. Fit insulation tightly around cross bracing and any obstructions.
3. Floor insulation must be fastened securely in place with wire fasteners, nylon mesh, or another appropriate method. Friction fitting or stapling floor insulation is not considered an appropriate method for securing the material.
    a. Do not support insulation with Tyvek, Typar, or other house wrap stapled to the bottom edges of the joists.
    b. Do not use chicken wire or other metal mesh to support floor insulation.
4. Whenever possible, install insulation so that it is in contact with the underside of the subfloor above.
5. Faced fiberglass insulation must have the facing upward toward the heated area.
6. Ensure that floor insulation is in direct contact with the rim or band joints. If the dwelling is balloon framed, air seal the bottom of the stud cavities prior to installing the insulation.
7. Fiberglass insulation must not be left exposed in habitable spaces because the fibers might be hazardous to breathe.

6431 Insulation Coverage

1. Floor insulation should be installed in a manner that provides as continuous a thermal boundary as possible.
2. Floor insulation should not be installed in a manner that excessively compresses the material.

6432 Ducts and Pipes

1. When floor insulation is installed, ductwork below the floor insulation should be appropriately sealed and insulated. Please refer to Section 9130 for instructions.
2. When floor insulation is installed, any water pipe that is susceptible to freezing and all furnace supply and return ducts below the insulation should be insulated or otherwise protected from freezing as part of the floor insulation measure. Please refer to Sections 9210 and 9220.

3. Do not insulate over pumps, valves, pressure relief devices, or vents; do not insulate over heat tape unless the manufacturer's specification indicates that such installation is safe.

6440 Crawl space Ventilation

1. If the crawl space walls or ceiling are insulated and a moisture barrier covers the crawl space floor, the crawl space should not be vented to the outdoors. If a ground cover cannot be installed, the crawl space should be summer-time vented. If a ground cover cannot be installed, the reason should be documented in the job file.
    a. If crawl space vents are provided, they should provide 1 square foot of free vent area for every 1,500 square feet of crawl space ground area if there is a polyethylene ground cover, or 1 square foot of free vent area for every 150 square feet of crawl space ground area if a ground cover cannot be installed.
    b. Crawl space vents should be louvered and screened or otherwise designed to prevent the entry of snow, rain, animals, and insects into the building.
    c. If operable crawl space vents are installed, the customer should be informed of the benefits of closing the vents in winter and opening the vents in summer, but only when the outdoor relative humidity is below 40 percent.
    If there are more vents than are needed, it is preferred that surplus vents be closed off with removable rigid insulation. Where possible, close off vents on the windward side of the crawl space. Do not close off or restrict combustion air vents.

(Footnotes)
[1] NFPA 211 - 2006 *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 7.1.6.3.
[2] Woven plastic bags are available from NYP Corp., 805 East Grand Street, Elizabeth, NJ 07201, 800-524-1052. Seconds might be available. For normal floor cavity use, bag size should be at least 24 inches wide by 30 inches long. Used woven bags might be available from agricultural stores for a low cost.

7000 Window and Door Replacements

7100 Primary Windows

7110 Window Assessment

1. All existing egress windows must remain operable.
2. Non-operable windows may be permanently sealed against air leakage.

7120 Window Replacements

1. The installation of replacement windows must meet applicable building codes.
2. Lead-safe practices must be used for the replacement of pre-1978 windows.

7130 Window Repairs

1. It is often more cost effective to repair windows rather than replace them.
2. Repairs to prime windows must be done to keep exterior moisture out before an interior storm window may be installed over the prime window.
3. Storm windows should be securely fastened in place, installed straight, plumb, and level, and without distortion.
4. Metal storm windows should not come in contact with frames or fasteners constructed of dissimilar metals.
5. Installed storm windows in kitchens, baths, and other high moisture areas should be operable if they provide the only source of ventilation into the space.
6. Operable storm windows should move freely.

7200 Doors

7210 Door Assessment

1. Doors should be assessed for needed repairs, air leaks and comfort-related problems.
2. All existing egress doors must remain operable.

8000 Combustion Appliances

8100 Combustion Appliance Requirements and Restrictions

The following are requirements and restrictions of the MaineHP Program:

1. The pre- and post-installation testing required by the Building Performance Institute Building Analyst 1 Standard shall be performed on all MaineHP jobs when appropriate.
2. Any service provider inserting instrument probes in appliance vent connectors or drilling holes for probes must hold a "Limited Energy Auditor License" from the Oil and Solid Fuel Board if the equipment is oil-fired or from the Propane and Natural Gas Board if the equipment is gas-fired. The service provider/contractor must hold a Limited Energy Auditor License to perform:
    a. Combustion safety testing according the BPI BA1.
    b. Combustion efficiency testing.
3. Unless a MaineHP service provider/contractor is fully licensed by the Oil and Solid Fuel Board (if the equipment is oil-fired) or the Propane and Natural Gas Board (if the equipment is gas-fired), no adjustments of any kind may be made to combustion equipment.

Note: Before the efficiency of an oil-fired system is measured, the smoke reading should be taken. If the smoke reading is 2 or less, proceed with the efficiency test; otherwise do not perform an efficiency test on the heating unit. Instead, recommend a cleaning and tuning for the burner and heating unit.

8200 Combustion Efficiency and Analysis

Acceptable combustion analysis values are found in Table 8-1 (this is a generalized chart and is not a substitute for obtaining specific manufacturers information).

1. The steady-state efficiency of a central heating system can be checked to determine:
    a. If it needs cleaning and tuning.
    b. If it functions as efficiently as it was designed to.
        i. (Refer to Section 8300 on page 3 for steady-state efficiency testing instructions.)

Table 8-1

Acceptable Combustion Test Analysis Values

Heating Unit Type	Oxygen (O_2)	Carbon Dioxide (CO_2)	Net Stack Temp	Smoke Test
Gas				
Atmospheric	4 - 9%	Natural 9.6 - 6.8%	300-600° F	NA LPG 11.2 - 7.8%
Fan-assisted	4 - 9%	Natural 9.6 - 6.8%	300-480° F	NA LPG 11.2 - 7.8%
Condensing	See man. Info.	See man. Info.	See man. Info.	NA
Standard Power Burner	4 - 9%	Natural 9.6 - 6.8%	300-650° F	NA LPG 11.2 - 7.8%
Oil (No. 1 & 2)				
Oil gun burner	4 - 9%	12.5 - 8.8%	325-600° F	1 or less
Flame Retention burner	4 - 7%	12.5 - 10.3%	325-600° F	1 or less

8300 Related Heating System Measurement Techniques

8310 Steady-state efficiency

1. *Gas systems:* Follow these procedures for conducting a steady-state efficiency test of a gas heating system.
    a. Unless the technician performing this test is a fully licensed in Maine to make adjustments to a gas-fired appliance, absolutely no adjustments may be made before, during, or after this test.
    b. Inspect the unit for hazardous conditions.
    c. Locate an existing hole, or drill and appropriately-sized hole for measuring the draft.
    d. Allow the unit to reach a steady state after firing the burner. Measure the temperature before dilution air enters the vent system. When the temperature has stabilized, steady-state conditions have been reached.
    e. With a combustion analyzer, measure the oxygen (O_2) percentage in the flue gas.
    f. Measure the net stack temperature at the same spot(s) the oxygen percentage was measured.
    g. Determine the steady-state efficiency from these values.
    h. Proceed to measuring the draft.
2. *Oil systems:* Follow these procedures for conducting a steady-state efficiency test of an oil heating system. If a visual inspection indicates a cleaning and tuning is necessary, do so before an efficiency test is taken.
    a. Unless the technician performing this test is a fully licensed in Maine to make adjustments to an oil-fired appliance, absolutely no adjustments may be made before, during, or after this test.
    b. Inspect unit for hazardous conditions.

c. Locate an existing hole or drill and appropriately-sized hole for measuring the breech draft. This hole is also used for measuring the smoke, the oxygen percentage, and the temperature.
d. Allow the unit to reach a steady state after firing the burner. When the temperature has stabilized, steady-state conditions have been reached.
e. With a combustion analyzer, measure the oxygen (O_2) percentage in the flue gas.
f. Measure the net stack temperature at the same spot(s) the oxygen percentage was measured.
g. Determine the steady-state efficiency from these values.
h. Proceed to measuring the draft.

8320 Draft measurement

1. *Gas systems:* The proper draft hole test location is 2 feet downstream from the draft hood or draft diverter in a straight section of the flue pipe; or, if the 2-foot measurement falls on an elbow, in the first straight section of flue pipe beyond 2 feet. Acceptable generalized draft values for atmospheric gas systems are listed in Table 8-2.

Table 8-2

Atmospheric Gas Appliances Only Acceptable Draft Test Readings for Various					
	Outdoor Temperature Ranges				
ºF	<20	21-40	41-60	61-80	>80
Pascals	-5	-4	-3	-2	-1
Water Column inches	-.02	-.016	-.012	-.008	-.004

2. *Oil systems:* Flue pipe or breech draft: This draft reading should be taken through an appropriately sized hole – usually ¼-inch or slightly larger – drilled about 12 inches from the heating unit and at least 6 inches before the barometric damper (draft regulator). This draft reading should be from -10 to -15 Pascals (-0.04 to -0.06 inches W.G.). Acceptable generalized draft values for oil-fired systems are listed in Table 8-3.

Table 8-3

Power Oil Burners Acceptable Draft Readings Overfire and at Breech	
Draft Reading Location	**Acceptable Draft**
Vent Connector or Breech	-0.04 to -0.06 inches or -10 to -15 Pascals

8400 Water Heater Inspection

1. All gas-fired water heaters must meet the following specifications:
   a. All identified gas leaks should be referred to the appropriate person for repair. All gas leaks should be documented and reported.
   b. All gas-fired direct-vent (sealed combustion) and atmospheric combustion water heaters must be tested for carbon monoxide emissions and comply with BPI Building Analyst 1 specification.
2. All oil-fired water heaters must meet the following specifications:
   a. Any oil line leaks should be referred to the appropriate person to repair.
   b. All oil-fired water heaters must be tested for carbon monoxide emissions and comply with BPI BA1 specifications.
3. All water heaters must be properly vented.
4. All free-standing storage water heaters, with the exception of direct-vent units, must be safety tested with appropriate BPI Building Analyst 1 procedures.
5. All water heaters should have a water temperature test. If the water temperature is above 120ºF at a faucet near the water heater, the customer should be informed about the advantages and disadvantages of lowering the water temperature. If the customer agrees to an adjustment, lower the water temperature to 120ºF. Mark the old setting on the control as a reference point.
6. Visually inspect the combustion chamber for rust, dirt, and proper burner alignment. Visually inspect the venting, plumbing, and gas piping. Check the tank for water leaks and note any code violations.

9000 Heating System and Domestic Water Heating Distribution

9100 Ducted Distribution Requirements

Ductwork treatment is dependent on a number of factors, including its location, accessibility, its impact on dwelling pressures, and its condition.

9110 Ductwork Inspection, Cleaning, and Sealing

1. Ductwork should be tested and sealed according to Section 5600 on page 3, Duct Leakage Testing.
2. Delivery and return ductwork should be cleaned as necessary to remove large objects and debris that may impede airflow through the heating system.
3. Uncover any blocked registers or grilles. Explain to the customer the importance of maintaining the unrestricted airflow.
4. As necessary, delivery and return air grilles and registers should be removed and cleaned to remove excessive dirt and debris that may impede airflow.
5. When appropriate, remove and block off ducts, registers, and grilles located in unconditioned spaces.
6. Ductwork outside the thermal boundaries of the dwelling should be sealed with mastic and insulated.
7. All accessible return air ductwork within a combustion appliance zone (CAZ), except gravity systems, should be sealed enough to eliminate the potential for backdrafting. Please refer to Section 12300 on page 3 for Combustion Safety Testing procedures.
8. Existing crawl spaces used as plenums should be abandoned and replaced with a sealed duct system.
9. Cloth duct tape shall never be used for duct sealing.
10. Ductwork sealing shall be done with mastic, mesh tape, sheet metal, or pressure sensitive metal tape.
    a. Gaps of 1/8-inch or less may be sealed with:
        i. Duct mastic.
        ii. Pressure sensitive metal tape.
    b. Gaps between 1/8 inch and 1 inch shall be sealed with:
        iii. Duct mastic embedded with fiberglass mesh.
    c. Gaps larger than 1 inch should be covered with sheet metal or valley flashing, fastened with screws, and sealed with mastic.
11. New ductwork installations may not include panned joists or stud cavities for ducts. All passageways for distribution air must be hard ducted.

12. If the boot is loose to the floor, it should be reattached to the subfloor with roofing nails or staples. Wood screws may also be used. Ensure that the heads of the screws do not prevent the register or grille from fitting properly into the boot.
    a. If gaps exist between the boot and the floor and the space below the floor is unconditioned, fill the gaps with mastic or other appropriate materials.

9120 Ductwork Sealing Materials

1. *Cloth duct tape shall never be used for duct sealing.*
2. Existing duct tape must be removed before installing duct mastic or other approved sealing materials
3. Mastic shall meet the following requirements:
    a. Non-toxic and water-resistant.
    b. UL listed and labeled per UL 181A or 181B standards.
    c. Shall be compatible with the duct material to which it is applied.
4. Mesh fabric used to reinforce duct mastic shall meet the following requirements:
    a. Comply with the mastic manufacturers specifications.
    b. Made of fiberglass.
    c. Have at least a 9 x 9 weave per inch.
    d. Be at least 0.006 inches in thickness.
5. Pressure sensitive metal tape shall meet the following requirements:
    a. UL listed and labeled per UL 181A or 181B standards.
    b. Tape width must be at least 2 inches.
    c. Butyl adhesive must be at least 15 mils thick.
6. Draw bands used to support or seal ductwork shall meet the following requirements:
    a. Comply with the manufacturers installation instructions.
    b. Weather- and UV-resistant duct ties or stainless steel worm drive clamps
    c. Loop tensile strength must be at least 150 pounds.
    d. Service temperature rating must be at least 165°F.
7. Duct supports shall conform to the duct manufacturers installation instructions and must be corrosion resistant.

9130 Ductwork Insulation

1. Active ductwork outside the thermal envelope must be repaired if damaged, sealed, and insulated.
    a. Prior to installing insulation, ductwork must be sealed according to these standards.
    b. Exception: Inaccessible parts of the distribution system do not require thermal insulation. Inaccessible means nearly impossible to insulate because of location or obstructions.

2. Supply and return ducts and plenums in conditioned spaces usually do not require thermal insulation.
    a. Exception: There might be cases where duct insulation is appropriate in a conditioned area, such as a basement. For example, if there is not adequate heat getting to a room, the branch duct may be insulated for reasons of thermal comfort as long as the following items have been checked and/or implemented first:
        i. There are no branch duct obstructions to airflow.
        ii. The branch duct balancing damper is fully open.
        iii. The branch duct air leakage has been checked and sealed, if necessary.
3. Combustion or exhaust vents should not be insulated.
4. For ductwork that is not within the thermal boundaries of the dwelling, install a minimum of R-8 (preferably R-11, when possible) on ducts and plenums.
    a. If ductwork is already insulated to a level of R-4 or greater, no additional insulation is required, however, make appropriate repairs to the existing insulation.
5. Insulation must have a flame spread rating no greater than 25.
6. Only vinyl-backed or reinforced foil duct wrap insulation is to be used on ducts.
7. The duct insulation should be installed with the vapor barrier on the outside, which will serve to cover the insulation.
8. Do not wrap duct insulation so tightly that it is excessively compressed. It should not be compressed more than 50 percent of normal thickness.
9. Maintain a minimum of 6 inches between duct/pipe insulation and all heat sources;
10. Install protective covering around the insulation where required by local regulations.

9140 New Ductwork Installations

1. Ducts, supply registers, and return grilles should be sized and selected according to the latest editions of *Residential Duct Systems*, Manual D, by ACCA; *Residential Comfort System Installation Standards Manual* by the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA); or a comparable industry-accepted method.
2. Ductwork should be installed by personnel with the appropriate State licenses.
3. Attempt to install all new ductwork within conditioned spaces.
4. Do not install ductwork within exterior walls.
5. All distribution-air enclosures must be hard-ducted, that is, building frame cavities, closets, crawl spaces, and chases must not be used as distribution-air enclosures. However, ductwork may be housed by, or pass through these spaces.
6. Ductwork must be installed at least 4 inches from any bare earth.

7. Panned floor joists may not be used for air distribution.
8. A crawl space may not serve as a distribution plenum.
9. Do not use a dropped ceiling cavity as a plenum.

9200 Piped Distribution Requirements

Treatment of distribution pipes for hot water or steam heat, or for domestic hot water treatment is dependent on a number of factors, including its location, accessibility, and its condition.

9210 Steam and Hot Water Heating Distribution Pipes

1. Make certain there are no leaks in hot water or steam distribution pipes.
2. Hot water and steam distribution should be installed by personnel with the appropriate State licenses.
3. Supply and return lines installed outside of the thermal enclosure should be insulated if they are accessible.
4. Pipes may be insulated within the thermal enclosure if it is determined that the space does not require heating.
5. Pipe insulation should be sized to the pipe being insulated.
6. Secure the pipe insulation with mechanical fasteners or appropriate tape.
7. Pipe insulation should have mitered cuts at corner joints. Tape joints appropriately.
8. Pumps, valves, pressure relief devices, or vents should not be insulated. Do not insulate over heat tape.
9. Closed cell foam, high temperature rated insulation or elastomeric pipe insulation should be used that has a flame spread rating no greater than 25.
10. Maintain a minimum of 6 inches between pipe insulation and all heat sources.

9220 Domestic Hot Water Pipes

1. Make certain there are no leaks in domestic hot water pipes.
2. Domestic hot water distribution should be installed by personnel with the appropriate State licenses.
3. From the water heater, insulate the first 9 feet of hot water pipe and the first 3 feet of cold water pipe with ¾ inch pipe insulation.
4. Closed cell foam, high temperature rated insulation or elastomeric pipe insulation should be used that has a flame spread rating no greater than 25.
5. Maintain a minimum of 6 inches between pipe insulation and all heat sources.
6. Domestic hot water pipes running through unconditioned spaces should be insulated if accessible.

9300 Water Heater Insulation Blankets

The installation of water heater blankets on electric water heaters in conditioned

spaces is recommended unless this will void the warranty. Gas water heaters should not be insulated.

Water heaters located in unconditioned areas should be moved to a conditioned area, if possible. If the water heater cannot be moved, the heater and distribution pipes, both hot and cold, should be insulated.

9310 Water Heater Blanket Materials

1. The water heater blanket must be fiberglass batt insulation with a protective covering.
2. An R-11 water heater blanket is preferred on all tanks not labeled with a prohibition to installing additional insulation to that already installed by the manufacturer.
3. A water heater blanket should be secured to the water heater with at least two (2) straps with buckles. The installed straps must not excessively compress the water heater blanket.

9320 Installation

1. The water heater tank should be inspected to determine the type of water heater (gas, electric, other), and whenever possible, the amount of existing insulation.
2. If there are signs that the water heater is leaking, this problem should be solved before insulation is added.
3. A water heater blanket should not be installed when a temperature and pressure relief valve does not exist or when the existing temperature and pressure relief does not operate properly.
4. A water heater blanket must not cover the following:
    a. The temperature and pressure relief valve on an electric unit.
    b. The drain valve on an electric unit.
    c. Where the electrical line attaches to an electric unit. Insulation must be keep at least two inches away from where this electrical line attaches to the water heater.

9400 Domestic Hot Water Temperature

1. Whenever feasible, the domestic hot water temperature should be measured and reduced to 120°F or less with the approval of the customer.
2. The customer should be informed that lowering the temperature of the water will result in less thermal energy stored in the hot water; therefore, they may run out of hot water sooner.
3. The original water temperature setting should be marked on the thermostatic control.

9500 Energy-Saving Showerheads

1. An energy-saving (low-flow) showerhead may be installed with customer permission, if the existing showerhead flow is measured at greater than 3 gallons per minute (gpm).
2. The energy-saving showerhead must have a flow rating of 2.5 gpm or less.
3. If an energy-saving showerhead is installed in conjunction with lowering the domestic hot water temperature, the chances are high that the customer will not notice less hot water for showering, as they might if the temperature is reduced without installing the new showerhead.

10000 Service Provider Post-Installation Inspections

It is strongly recommended that Maine Home Performance service providers and their contractors and trade allies engage in post-installation inspection procedures to ensure that measures are installed properly and that all required diagnostic testing has been completed. The items listed in this section are not required, except where noted.

10100 Test-Out and Final Inspection — Required

1. The appropriate MaineHP/BPI certified person on a MaineHP job is required to:
    a. Complete test-out procedures and documentation.
    b. Ensure all items specified in the work order have been completed according to the MaineHP Standards and appropriate BPI specifications.

10200 Inspection of Wall Insulation

1. Verify that the sidewall insulation has been installed in all required wall cavities. Use infrared scanning for this inspection whenever possible.
2. All structural damage on the work order should have been repaired before the installation of wall insulation. This may include:
    a. Exterior moisture damaged areas, such as missing or rotted siding or trim boards.
    b. Deteriorated window or door components.
    c. Missing or damaged siding or trim boards.
3. Any replaced wood siding or trim must match the existing grade and be primed with an appropriate paint or stain.
4. Verify that blown insulation has not deformed or damaged the interior wall surfaces.
5. If the insulation was blown into the wall cavities from the inside, make sure that:
    a. The interior fill holes have been filled properly and patched and that the final finish is as close to the original as possible.
    b. Verify that no insulation or debris is left in the house.
6. Verify that insulation has not escaped into wall heaters, vent fans, ducts, or other mechanical penetrations.
7. Make sure that structural details such as interior soffits, pocket doors, and other bypasses have been properly addressed during the insulation installation.
8. Make sure the siding has been reinstalled properly and that the siding removal and replacement of siding has not unnecessarily damaged the siding or trim.
9. If the finished siding has been face-drilled and plugged, make sure that the reasons for doing so are included in the client file along with a permission form signed by the client.

10. Verify that cellulose insulation has been installed at the proper density.
    a. Cellulose should be installed at a high density in walls whenever conditions permit. High density is at least 3.5 pounds per cubic foot.
    b. The density may be determined by
        i. Core sampling after the insulation is installed.
        ii. Calculating density *during* installation by determining the cubic feet of wall to be insulated, taking note of the number of pounds of insulation installed in the calculated cubic feet of wall, and then figuring the pounds per cubic feet of installed cellulose.
        iii. Other methods approved by MaineHP.

10300 Inspection of Attic Insulation

1. Verify that damaged or rotted ceiling components have been repaired or replaced as needed. Verify that the ceiling can safely hold the weight of the insulation.
2. Verify that all voids and areas of incomplete coverage in the existing insulation have been repaired.
3. All appropriate attic bypass and safety items must have been addressed properly, including:
    a. Chimney bypasses.
    b. Plumbing stack bypasses.
    c. Attic hatch or pull-down stair sealing and insulating.
    d. Recessed light damming.
    e. Junction boxes.
    f. Bathroom and kitchen exhaust fan venting.
    g. Knob-and-tube wiring.
4. Verify that the proper type and amount of attic insulation has been installed. Uninsulated attics must be insulated to at least R-38.
    a. Cellulose insulation must be installed to allow for 10 percent settling. For example, if 12 inches of cellulose are called for on the work order, 14 inches must be installed so that the settled thickness is 12 inches.
    b. The thickness of blown insulation should be uniform throughout. The final top surface of the insulation must be reasonably level and uniform.
5. Verify that attic ventilation is added as specified in the work order. Attic ventilation shall not be blocked with installed insulation.

10400 Inspection of Attic Access and Knee Wall Doors

1. Make sure the attic is accessible through the hatch and that the hatch is weatherstripped and insulated to R-20.
2. Verify that pull-down stairs are properly insulated and weatherstripped.
3. Make sure knee wall access doors are properly insulated, weatherstripped, and latched.

10500 Inspection of Basement and Crawl Space Insulation

1. Verify that the treatment of a basement or crawl space corresponds with the appropriate definition of the thermal boundaries of the dwelling.
2. Make sure that all foundation air sealing has been completed.
3. Verify that allowable repairs have been made to correct any moisture or sewage problems.
4. Verify that all insulation installation required by the work order has been properly installed.
5. Verify that an appropriate ground cover has been installed in crawl spaces, when possible.
6. Verify that water lines have been protected from freezing, if necessary.
7. Verify that damaged or missing exterior doors have been repaired or replaced and that they are weatherstripped and insulated according to the work order.

10600 Inspection of Dryer Vent

1. Verify that the dryer is properly vented to the outdoors and that the damper in the dryer vent is working properly.
2. Verify that dryer vents are extended to the outdoors.
3. Verify that the dryer vent is installed according to Section 2 on page 3.

10700 Inspection of Kitchen and Bathroom Exhaust Fans

1. Verify that all exhaust fans are properly vented to a weather-protected termination fixture located on the outside of the dwelling, either through a sidewall or roof by means of rigid or flexible metal (no vinyl) duct.
2. Verify that all exhaust fans comply with Section 3370 on page 3.
3. Make sure the client knows how to properly use all newly installed exhaust fans.
4. If ASHRAE Standard 62.2-2007 is being used to size ventilation fans, verify that the exhaust fans are working properly and are exhausting at the required CFM rate.
    a. Measure the actual exhaust fan CFM rate with the Exhaust Fan Flow Meter from The Energy Conservatory or with a similar device.

11000 Quality Assurance Procedures

11100 Introduction

In accordance with the terms and conditions of participation in the Maine Home Performance with ENERGY STAR® Program, a program of the Maine Public Utilities Commission (Efficiency Maine), and to maintain a reputation for quality and value, these quality assurance (QA) procedures will be followed by the management of the Maine Home Performance. This procedure includes strategies to ensure that completed improvements meet program standards.

These QA procedures include:

1. Reporting process that requires participating contractors to report jobs that are promoted to homeowners and performed as part of the Maine Home Performance with ENERGY STAR® Program.
2. Job report review process that ensures program compliance and provides for follow-up with the service provider, when necessary.
3. Customer feedback mechanism which allows customers to provide feedback directly to the Maine Home Performance with ENERGY STAR® Program.
4. On-site inspection protocols, including a sampling rate set at a minimum of 5 percent (1 in every 20 jobs) for all participating service providers.
5. Conflict resolution mechanism for responding to and resolving customer complaints.
6. Record keeping and tracking of results from on-site inspections, customer surveys, and corrective actions. Records must be available for review upon request from the National HPwES Program operated by the Environmental Protection Agency (EPA).

11200 Required Elements of Quality Assurance

The Maine Home Performance with ENERGY STAR® Program is required by EPA to implement a QA procedure that evaluates whether participating contractors have:

1. Performed a Home Performance Assessment (HPA) and made comprehensive recommendations for improving the performance of the home.
2. Installed improvements which will reduce energy use in the home, improve comfort, or address specific building performance problems, such as failures on combustion tests.
3. Satisfactorily completed the contracted scope of work.
4. Performed required diagnostic tests and inspections upon completing the improvements.

11210 Job Reporting Documents Review

MaineHP staff will review all service provider documents to ensure the proper job reporting, installation, and completion. The job documents will be reviewed for 100 percent of the jobs a service provider/contractor submits. If deficiencies are found, the service provider/contractor will be notified. These job document evaluations will be used as the basis for random site evaluations.

This document review will include the Home Performance Assessment, the Home Performance Summary report, the scope of work, and the test-out report.

1. Home Performance Assessment (assessment report).
2. Home Performance Assessment Summary Report (findings and recommendations to customer). This review is intended to verify:
    a. Compliance with Maine Home Performance with ENERGY STAR® Program delivery requirements.
    b. Recommendations provided to the homeowner are reasonably comprehensive and consistent with the findings of the Home Performance Assessment.
    c. Recommendations include an estimate of energy savings from the proposed improvements.
    d. The table below will be used by MaineHP staff for this review.

Home Performance Assessment Summary Report Review	Yes	No
All required diagnostic tests have been performed and information provided is consistent with program policies and procedures. Findings reflect strong adherence to the technical guidelines and local program requirements.		
Combustion equipment tests have been completed and appropriate recommendations have been made to mitigate any hazardous conditions.		
Recommendations are comprehensive and consistent with program policies and procedures and with HPA findings. Estimated savings for proposed improvements have been provided as part of the summary report.		
Notes:		

3. Scope of Work Review.
    a. The table below will be used by MaineHP staff for this review.

Scope of Work Review	Yes	No
Any findings of combustion safety issues have been included and addressed in the scope of work		
The scope of work is consistent with the recommendations in the HPA Summary Report and program policies (cost effectiveness or allowed measures and installation specifications).		
The scope of work is comprehensive in nature and includes the replacement of more than one system (e.g. Not just an HVAC replacement or window replacement job)		
Notes:		

4. Test-out Report Review.
    a. This review is intended to verify compliance with Maine Home Performance with ENERGY STAR® Program delivery requirements.
    b. The test-out report must include the customers signature signifying that the work is complete and meets their reasonable expectations.
    c. If corrective action is necessary, based on results of an on-site QA inspection, then an additional test-out report will be submitted to document the corrective action completed with a customer signature.
    d. The table below will be used by MaineHP staff for this review.

Test-out Report Review	Yes	No
All appropriate post diagnostic and visual inspections have been recorded per the contracted scope of work.		
All installed measures in the contracted scope of work have been verified as installed.		
Airflow tests have been completed on the HVAC system if work on ducts or an HVAC system was replaced in the scope of work. Is the airflow within the acceptable range? Refrigerant charge was check for AC or HP replacements		
Combustion equipment testing and combustion appliance zone testing has been completed and results recorded. No corrective action is needed based on results. Building air- tightness standards have been calculated and appropriate recommendations for ventilation or required corrective action has been installed		
The contractor and customer have signed the test-out reporting form attesting to the completeness of work.		
Notes:		

5. Follow-up action.
    a. If the review of documents indicates that a service providers reported jobs do not meet program policies and procedures, MaineHP will consider conducting an on-site inspection for the job in question.

11220 On-site Inspection: Job Selection

Jobs will be selected randomly in order to obtain a representative sample of each contractors work. However, the sample is not expected to be purely random. Some homeowners will not be willing to schedule the inspection; other customers may request an inspection due to issues or concerns about the work performed; and some inspections may be conducted as a result of issues raised in the job report review process.

All on-site job inspections will occur after improvements have been installed. However, the on-site inspection may be scheduled during the contractors test-out and prior to the job completion being reported to MaineHP. On-site inspections will be made on a continuous basis and not completed in bulk (e.g., do not wait until a contractor has completed their first 20 jobs to start performing on-site inspections). Contractors with multiple offices or locations across wide geographic areas will be treated as separate participants for the purpose of determining their on-site inspection rate.

Inspections will be scheduled using a tiered procedure:

1. Tier 1 - In-field inspection or mentoring on 3 of the first 5 jobs completed by a new contractor participant. MaineHP may use the Tier 1 sampling rate for a new contractor beyond the contractors first five jobs if the initial in-field inspections indicate significant difficulties in meeting program requirements.
2. Tier 2 - After the first 5 jobs are completed, 20 percent of the next 20 jobs will receive in-field inspections.
3. Tier 3 - After completion of their first 25 jobs, MaineHP will begin inspecting jobs at a lower sampling rate while maintaining an overall rate that is above or equal to 5% of total completed jobs.

11230 On-site Inspection: Customer Discussion

It is required that the on-site inspection begin with the MaineHP inspector stating to the homeowner that the primary purpose of the inspection is to verify that the work meets the MaineHP program standards. The inspector should address any questions that the customer has about the inspection and determine if the customer has any specific concerns about the installed work. It is very important the inspector present a positive and objective attitude during all conversations with the homeowner.

The inspector may interview the customer about their experience with their home performance consultant and/or contractor to gain valuable insights that may enhance the program. This discussion might include:

1. Confirming that the customer received a Home Performance Assessment report and recommendations for comprehensive improvements.
2. Verifying the important pre-existing conditions (if appropriate) and installation of contracted measures.
3. Verifying who installed the measures and when the improvements were completed.
4. Inquiring whether the customer has utility bill data available, if the utility bills were requested by the contractor and, if so, whether the customer provided the utility bills to the contractor.
5. Verifying completion of diagnostic test(s) before and after installation of measures (e.g. blower door test prior to beginning installation of shell measures and again after they were complete).
6. Discussing the customers satisfaction with: the participating contractors assessment, the installation; and their overall experience with the MaineHP Program.
7. Encouraging customers to refer friends and family to the program.

11240 On-site Inspection: Visual and Diagnostic Tests

After completing the introductory discussion with the customer, the inspector will begin the required visual and diagnostic inspection. The visual and diagnostic

inspections are derived from Home Performance Assessment requirements (see Section 2200) and required test-out diagnostic tests and inspections based on the installed scope of work

.

The following list describes the areas the inspector will examine:

1. Obvious missed opportunities for improving home performance that were not reflected in the HPA findings and recommendations.
2. Proper installation of measures installed by the contractor.
3. Verify test-out inspections and diagnostic results completed by the participating contractor.

In order to evaluate performance, results of these visual and diagnostic inspections will be compared to the documentation (Home Performance Assessment summary report, recommended improvements, installed improvements, and test-out data) reported to the program by the contractor.

The inspector will not make judgments about the contractors professional integrity or service to the customer. Any communication about the contractors performance will always follow program protocols for contractor feedback and corrective action.

11250 On-site Inspection: Inspection Documentation

MaineHP will keep a record of all inspections performed including on-site Quality Assurance inspection form(s), and any follow-up actions with the contractor and/or customer. MaineHP will document:

1. On-site inspection report.
2. Follow-up with contractor, if required. This includes a record of any remedial actions, such as corrective measures in the home by the contractor; assignment of program technical or administrative assistance to address a particular contractor need; or, in more serious cases, program disciplinary actions. If corrective measures in the home are requested and installed, the program must receive additional documentation with appropriate test-out information and a customer signature.

11260 On-site Inspection: Job Scoring Procedure

The following methodology will be used during on-site inspection to evaluate a contractors work. The scoring tables give examples for the MaineHP scoring system that is based on the BPI BA1 and the MaineHP Standards. The items in these five job inspection tables may be changed or expanded at any time. They are included here to demonstrate the concept of the scoring of the on-site inspection findings.

The scoring method presents a set of statements that characterize a contractors work performance. The MaineHP inspector will begin with the first table below

(Score 0) and answer each question either "Yes" or "No". If the contractor receives a "Yes" answer to any question, the contractor receives a score of 0. If not, the inspector proceeds to the next table (Score 1) and repeats the process. **A service provider/contractor will receive the lowest score for which they received a "Yes" on an inspection finding.** The scoring is on a scale of 0 to 4. Scores from 0 to 2 are in the "fail" range; scores of 3 and 4 in the "pass" range.

Note that the items in the Score 0 through Score 3 tables may require different degrees of corrective actions. For corrective action procedures, please refer to Section 11280 on page 3. The items the Score 4 table do not require corrective action.

Score 0 - Contractor's performance does not meet technical standards or program requirements and the home requires immediate corrective action:

On-site Inspection Findings – Score 0	Yes	No
Combustion appliance testing (including carbon monoxide test, draft measurement, spillage evaluation, and worse-case depressurization of CAZ) results do not meet BPI BA1 Standards or relevant equivalent program standard.		
Measures in contracted scope of work not installed (e.g. attic insulation not installed or duct sealing work not completed).		
Minimum standards for building ventilation are not being met according to ASHRAE Standard 62.2 - 2007.		
Unsafe conditions resulting from installed work and posing an immediate risk to occupants are found (e.g., greater than 35 ppm recording during combustion appliance testing).		

Notes:

Score 1 - Contractor's performance does not meet technical standards or program requirements and the home requires corrective action:

On-site Inspection Findings – Score 1	Yes	No
Serious moisture issues have gone unaddressed and have not been included in recommendations per MaineHP requirements.		
Health and safety issues present, but do not pose an immediate risk to occupants.		
Measures were not installed correctly or completely (e.g., new water heater is leaking or dirt floor in crawl space was not treated with a ground cover).		
Customer did not receive HPA report or did not receive comprehensive recommendations.		

Notes:

Score 2 - Contractor's performance meets all combustion safety requirements but several technical deficiencies were observed that require corrective action:

On-site Inspection Findings – Score 2	Yes	No
Below standard installation of insulation (e.g., significant gaps or voids in installation of attic insulation or attic insulation levels do not meet specifications in the contracted scope of work).		

Air sealing work does not address significant pathways for infiltration (e.g. large attic bypasses into the living space around duct work penetrations, dropped soffits ceilings, etc.).
Windows installed did not meet program requirements (e.g. specified performance for u-value and solar heat gain co-efficient).
Garage-to-living-space leakage found and not addressed in the HPA findings and recommendations or the scope of work.
HVAC equipment not installed to program guidelines or not operating properly (e.g. flame interference found in gas furnace, indoor evaporator coil not matched to the outdoor coil for AC system replacement, or furnace temperature rise test not within manufacturer specified range).
Recommended measures on HPA report were not comprehensive; inspection found several cost-effective improvements that were not recommended to the customer (e.g. blower door test results indicate considerable opportunities for air sealing that were not included in HPA findings and recommendations).

Test-out reporting does not match on-site QA inspection (inaccurate testing results).
Notes:

Score 3 - Contractor's performance meets all technical standards and program requirements but some areas of technical performance need improvement and may require corrective action:
On-site Inspection Findings – Score 3 Yes No
Installed measures did not meet all technical installation standards, but no serious deficiencies and contractor corrected items (e.g., use of sealant on ductwork that does not meet UL 181, UL 181A, or UL 181B).
Some incorrect data gathered and provided to customer but with no significant impacts on the work completed or effectiveness of the job.
Recommendations in customer report are not comprehensive (e.g., did not address minor moisture issues like downspout extensions or some air sealing opportunities were missed).
Notes:

Score 4 - Contractor's performance meets all technical standards and program requirements:
On-site Inspection Findings – Score 4 Yes No
All technical standards for installation have been met (e.g., BPI BA1 Standards and MaineHP Standards).
Work comprehensive in nature, and high priority items have been installed.

Recommended and installed measures were consistent with program requirements; work not performed was by customer decision.
Test-out reporting found to be accurate.
Notes:

11270 Customer Feedback

The Maine Home Performance with ENERGY STAR® Program has a mechanism for customers to provide feedback. Direct customer feedback can reduce risks and costs by helping to:

1. Determine customer satisfaction.
2. Check for program compliance.
3. Identify high performing and low performing contractors.
4. Focus marketing efforts.

If either positive or negative feedback is received from a customer, that information will be recorded as part of a contractor s performance history. An on-site inspection will be scheduled if customer feedback warrants additional investigation to verify that the contractor is meeting program policies and procedures.

11280 Contractor Feedback and Corrective Actions

This quality assurance component of the Maine Home Performance with ENERGY STAR® Program serves a dual purpose: first, it ensures that contractors are meeting all program guidelines and technical standards. Second, it provides a mechanism for constructive feedback intended to improve contactors diagnostic capabilities, comprehensiveness and quality of work, and customer relations.

When issues are discovered as a result of job reporting reviews, customer surveys, customer inquiries and concerns, or on-site inspections, the first step will be to contact the contractor and try to resolve the issue(s). This initial contact will be by telephone or e-mail. The contractor will have 30 days in which to correct the deficiency. Documentation of the deficiency will be provided at the contractors request.

If the service provider/contractor does not or refuses to correct the documented deficiency, they will be subject to a probationary period or expulsion from the Program (see Section 11290 on page 3). Notice of such action will be in writing via certified mail.

If a service provider/contractor demonstrates patterns of deficiencies over time, the MaineHP staff might require retraining, additional mentoring, or a higher percentage of on-site inspections.

The MaineHP process for evaluating and managing service provider/contractor performance includes the following:

1. Written field reports followed by contractor performance feedback discussion.
2. If required, corrective-action work scopes and completion verification.
3. Written notification of recurring, systematic or otherwise serious non-compliance with program policies, standards behavior, or applicable laws or regulations.
4. Provisions for disciplinary action, such as probation or expulsion.
5. Provisions for contractor to appeal a disciplinary action.

The following demonstrates five potential scenarios of the quality assurance process and/or corrective actions that could be:

1. If there are no deficiencies in performance found and the contractor has provided comprehensive recommendations, fulfilled the work scope, and installed measures that meet all technical standards:
    a. The quality assurance inspector will provide positive feedback to the service provider/contractor on their performance.
    b. Exemplary performance should also be documented and, if consistent, service providers/contractors be recognized for their contributions to the program.
2. If the customer is satisfied with the work, program and technical standards have generally been met, but there are relatively minor deficiencies or opportunities to improve a contractors performance, such as a non-comprehensive set of recommendations in the homeowner report, evidence of repeatedly non-comprehensive job scopes (suggesting a lack of desire or success in selling comprehensive work), or an indication of minor inaccuracies in tests performed:
    a. Constructive feedback will be provided to the service provider/contractor. It is hoped this feedback will encourage performance improvement in the future and to reinforce positive aspects of their job performance.
3. If the customer is satisfied with the work and program standards have generally been met, but deficiencies are present in the completeness, compliance with the contract or quality of the work performed, the quality assurance inspector will contact the service provider/contractor to discuss findings and corrective actions to be taken.
    a. The quality assurance inspector will provide a work scope of corrective actions to the contractor and require the contractor to correct deficiencies within 30 days.
    b. The service provider/contractor is required to provide written documentation with the customer s signature after completing the corrective actions.
    c. MaineHP management will evaluate whether additional training or job mentoring is necessary to improve the service providers/contractors performance,

d. MaineHP management will evaluate whether a higher on-site inspection rate is applied to future jobs.

4. If the customer is dissatisfied and the quality assurance inspector verifies that deficiencies are present but are not an immediate health or safety threat to the homes occupants:
    a. The quality assurance inspector is required to document findings and contact the service provider/contractor to discuss the findings and corrective actions that will be taken.
    b. The quality assurance inspector will provide a list of corrective actions to the contractor and require the contractor to correct deficiencies within 30 days.
    c. The service provider/contractor is required to provide written documentation with the customers signature after completing the corrective actions.
    d. MaineHP management will determine whether additional training or job mentoring is necessary to improve the contractors performance.
    e. MaineHP management will evaluate whether a higher on-site inspection rate is applied to future jobs.
5. If any serious condition is found through the quality assurance process (typically on-site inspection) that must be addressed immediately because of imminent health and safety threats, it is required that the quality assurance inspector contact the service provider/contractor without delay and inform the homeowner of the condition.
    a. The quality assurance inspector will take remedial action, as appropriate, which may include educating the homeowner, calling the fire department, or shutting off appliances.
    b. The quality assurance inspector will ensure to the maximum extent possible that the condition has been addressed in the short term and provide the contractor with a list of corrective actions.
    c. The contractor will provide the program with written documentation that the customer has signed, to verify completion of the corrective actions.
    d. MaineHP management will determine whether additional training or job mentoring is necessary to improve the contractors performance.
    e. MaineHP management will evaluate whether a higher on-site inspection rate is applied to future jobs.

11290 Contractor Probation and Expulsion Procedures

Based on the results of quality assurance activities, MaineHP will document and inform participating service providers/contractors of any significant or serious deficiencies and any required corrective actions. Service provider/contractors who continuously deliver inconsistent results, even after intervention by MaineHP, will be considered for probation or expulsion from the Program.

Probation and/or expulsion (de-listing) from the Program occur based on the evaluation of performance during the quality assurance process and upon recommendation of the Program manager.

1. A probationary period shall be used for service providers/contractors as the initial step toward expulsion and de-listing.
    a. The service provider/contractor will be notified in writing via certified mail that they are subject to a probationary period.
        i. This notification will outline the deficiencies that have been found through the quality assurance process;
        ii. The period of probation – in time or number of jobs; and
        iii. Corrective actions that the contractor must take in order to be re-instated to full participation status in the Program.
    b. During the probationary period the service provider/contractor:
        i. Will be subjected to additional quality assurance inspections;
        ii. May be required to attend additional training; and/or
        iii. May be required to attend additional mentoring sessions.
    c. During the probationary period the service provider/contractor may participate in the Program, but continued failure of quality assurance inspections could result in program expulsion.
2. If a service provider/contractor does not meet the corrective actions outlined in their notification of probation, then they will be subject to program expulsion and de-listing.
    a. If a service provider/contractor receives three probationary notices within a 2-year period, or if they are found to engage in wrongdoing, they will be subject to immediate Program expulsion and de-listing.
    b. The service provider/contractor will be notified in writing via certified mail of their expulsion and de-listing. Such notification will state:
        i. The deficiencies found in their performance;
        ii. The reason(s) for expulsion; and
        iii. Steps, if any, the service provider/contractor can take in order to be reinstated in the Program.
    c. If a service provider/contractor is removed from the Program, the EPA (the national operator of Home Performance with ENERGY STAR® programs) will be notified.

112100 Contractor Appeal Procedures

A service provider/contractor may appeal a MaineHP decision to place the service provider/contractor on probation or to expel and de-list them. When one receives notice of probation of expulsion, they should:

1. Submit in writing to MaineHP, a letter requesting review of the appeal of the action made by MaineHP, including specific supporting documentation that substantiates the reason MaineHP should reconsider their action.
2. MaineHP shall have a maximum of 30 days to review the matter internally and respond to the service provider/contractor with a formal written response.
3. After appealing, service providers/contractors who disagree with the final decision made by MaineHP may opt to move to arbitration at their own expense.

12000 Diagnostic Testing Procedures

12100 Blower Door Testing

12110 Introduction

The use of a blower door as a diagnostic and weatherization tool is very important. It can be used to determine the pre- and post-weatherization dwelling leakage rates, giving the contractor an accurate idea of the effectiveness of their air sealing efforts. In addition, the blower door is used for zone pressure testing and duct leakage testing.

Because the blower door is such an important tool, it is very important that it be set up and used properly at each job. The **depressurization** blower door test is preferred because it takes less time to perform than a pressurization test, and it is the standard test used in programs across the United States.

The blower door testing procedures below assume the use of The Energy Conservatory (TEC) Minneapolis Blower Door, Model 3, with the companion TEC digital manometers, Model DG-700.

12120 Preparation for Blower Door Test

1. Service providers should maintain accurate calibration of their blower doors and related equipment. This includes:
    a. Blower door fan.
        i. There should be no physical damage to the fan.
        ii. The flow sensor on the Minneapolis Blower Door, Model 3, is the white ring that is permanently attached to the end of the motor opposite the fan blade. It is one of the most critical parts of the blower door fan. Make sure the sensor is in its proper position, not damaged, that the connected hose is in good condition, and that the 4 holes in the sensor are not blocked.
    b. If there is a problem with the fan or the flow sensor, contact the manufacturer before further use.
    c. Digital pressure gauges should be calibrated annually by the manufacturer.
2. Deactivate all vented combustion appliances before depressurizing the structure by turning the thermostat down, or by shutting the appliance off.
3. Prevent the ashes of wood- or coal-burning units from entering the habitable space by closing and sealing doors and dampers, by cleaning out the ashes, or covering them.

4. Inspect the house for loose or missing hatchways, paneling, ceiling tiles, or glazing panes. Secure any items that may become dislocated during the test and seal any missing hatchways.
5. Close all prime windows, self-storing storm windows (if possible), skylights, and exterior doors and latch them in the position they normally would be found during the winter.
6. Open all livable areas to the interior of the structure, even if the occupants close them off during the winter.
7. If the basement is defined as part of the thermal enclosure area, determine the CFM_{50} value with the blower door with the basement door closed and with the basement door opened.
8. Set up the blower door unit in an exterior door opening in an area free from obstructions and wind interference, if possible.

12130 Blower Door Test, Depressurization (typical)

1. Set up the blower door in an exterior door that has the least number of obstacles within 3 feet of the blower door fan. If the doorway leads to an enclosed area, make sure the space is open to the outdoors. Do not set up in a door facing the wind if an acceptable alternative exists.
2. Install the frame and panel securely into the doorframe, making sure there are no gaps between any of the components or between the components and the doorframe.
3. Set the fan into the panel/frame assembly, making sure that the panel opening fits snugly around the fan. Install the fan so that the flow ring assembly (or low flow plate) is facing toward the inside of the house. Set up the fan in a level, or nearly level, position.
4. Set up the digital gauge properly.
5. Make sure the blower door variable speed control is in the off position. Plug the fan electric cord into a safe and fully functional electrical outlet.
6. Insert the hose from the house pressure gauge into the hole in the door panel. As an alternative, you may route the house pressure hose between the fan housing and the nylon fabric. Make sure that the end of the hose is not in front of the fan outlet or positioned so that it is exposed to windy conditions. Leave the fan pressure gauge tube end inside the house (not connected to the fan). Ensure that the fabric cover or all the rings and the center plug are on the fan.
    a. When using the DG-700 digital manometer, record the baseline pressure reading according to the manometer instructions. This reading is usually a result of stack pressure. Once you enter the baseline value into the DG-700, you can proceed with the blower door test without being concerned with the baseline value, except as noted below.
        i. If you turn the DG-700 off and on again or press the "MODE" or "CLEAR" button, you must re-enter the baseline again for a valid blower door test.

ii. If you change blower rings while performing a blower door test, make sure to change the "CONFIG" setting on the DG-700 to correspond. If you do this, there is no reason to enter the baseline again.

7. Perform a one-point test by depressurizing to -50 Pascals house pressure or, if unable to reach -50 Pascals, take a reading at the highest possible house pressure. If wind seems to be affecting the test results, take several one-point tests and average the results.
8. Calculate the CFM_{50} of the dwelling by using the digital gauge, TECTITE or ZipTest Pro™ software, or the blower door tables.

12140 Blower Door Test, Pressurization

1. Use the pressurization blower door test only if a solid fuel heating unit or a drip-pot, oil-burning space heater is in operation, or for some other appropriate reason, such as evidence friable asbestos.
2. Install the door panel as it is normally.
3. Attach a tube to the lower tap of the house pressure gauge and run the other end of the hose through the hole in the upper part of the door panel, making sure it is away from the fan outlet. See the digital manometer instructions for the proper hose connection for house pressurization.
4. Install the fan with the flow rings/low-flow plate facing the outdoors. The fan hose and the extra hose will run outside between the fan housing and the elastic collar. The fan speed control must remain on the indoor side.
5. Level and stabilize the fan as necessary.
6. Do not change the fan directional switch from its normal (forward) position.
7. Install the open end of the fan pressure gauge tube on the blower door fan pressure tap.
    a. If you are using the DG-700 digital manometer, record the baseline pressure reading according to the manometer instruction. This reading is usually a result of stack pressure. Once you enter the baseline value into the DG-700, you can proceed with the blower door test without being concerned with the baseline value, except as noted below.
        i. If you turn the DG-700 off and on again or press the "MODE" or "CLEAR" button, you must re-enter the baseline again for a valid blower door test.
        ii. If, while performing a blower door test, you change blower rings, make sure to change the "CONFIG" setting on the DG-700 to correspond. If you do this, there is no reason to enter the baseline again.
8. Perform a one-point test by pressurizing to 50 Pascals, or the highest house pressure possible if unable to reach 50 Pascals. Use one of the 2.

Imbalances of air distribution resulting from closed interior doors. These closed doors can act as dampers to the free flow of air within the conditioned space of the dwelling.

3. Imbalances of air distribution resulting from airflow differences between the supply side and return side of the ductwork. Such an imbalance could result from a restricted return trunk, for example.

Such pressure imbalances can result in increased air leakage to and from the outdoors when the air handler is running.

12220 Whole House Test Procedure

1. Set up the house in winter operating mode.
2. Run a pressure hose from the main body of the house to the outdoors.
3. Record any pressure difference between the main body of the dwelling and the outdoors. This is the reference baseline pressure.
    a. A reference baseline pressure might be due to stack-effect air leakage (especially if it is cold outdoors) or wind.
4. Turn on the air handler and measure the pressure of the main body of the house with reference to the outdoors.
    a. If the pressure difference between the main body and the outdoors is different with the air handler on than with the air handler off, there is probably some duct leakage to the outdoors:
        i. Either from the return side of the system (the pressure difference of the dwelling with reference to outdoors will move toward positive when the air handler is activated), or
        ii. From the supply side of the system (the pressure difference of the dwelling with reference to outdoors will move toward negative when the air handler is activated).
5. Close all interior doors.
6. Repeat the pressure measurement from the main body of the house with reference to the outdoors.
    a. If this pressure is different than it was when all the interior doors were open, the interior doors are acting as dampers to the air distribution system. This can cause thermal discomfort and stuffiness in the room and it can increase the air leakage to and from the outdoors when the air handler is running.

Note: Room-to-room pressure testing and adjusting should be completed before the post-work worst-case draft test is performed. Please refer to Section 12230 on page 3 for detailed instructions.

12230 Room-to-Room Test Procedure

1. With a digital manometer measure the pressure difference across all interior doors. Record measurements for all rooms with reference to the main body of the house. Make sure that registers and grilles are not blocked, even though they appear open. Provide pressure relief to any room with readings greater than three Pascals by:
    a. Opening the door slightly while measuring the pressure difference across the door. Open the door until the pressure

difference is less than three Pascals and measure the square inches of the opening. This is the number of square inches:

i. By which the door should be undercut.

ii. Of the cross sectional area of a direct grille, offset grille, or jump duct that should be installed to properly relieve the pressure imbalance caused by the distribution system when the door is closed.

2. Turn off the air handler and return the house to the condition it was in before testing began.

12300 Combustion Safety Testing

12310 Introduction

The purpose of combustion safety testing (worst-case draft testing) is to ensure the proper venting of all vented combustion devices in a dwelling. This testing must always be conducted during the initial assessment and then after all work has been completed.

Only persons holding valid BPI Building Analyst 1 certification may perform any type of combustion safety testing within the MaineHP Program.

In addition, only those holding a "limited energy auditor technician" license from the Maine Oil and Solid Fuel Board may insert a probe for any test equipment into an existing hole in a vent connector or drill a test hole in a vent connector on oil-fired equipment. Only those holding a "limited energy auditor technician" license from the Maine Propane and Natural Gas Board may insert a probe for any test equipment into an existing hole in a vent connector or drill a test hole in a vent connector on gas-fired equipment.

Adjustments shall never be made to any oil- or gas-fired heating systems by anyone other than a fully licensed technician. A limited energy auditor technician does not qualify as a fully licensed technician.

12320 Dwellings Requiring Combustion Safety Testing

1. Combustion safety testing must always be performed during the initial assessment and then after all work has been completed.

The following are *exceptions* to this requirement:

1. If the dwelling is all-electric with no combustion appliances, woodstoves or fireplaces, or has appliances that are all sealed combustion (direct vent) or unvented (vent free), combustion safety testing does not have to be performed.
2. In apartments with no combustion appliances other than unvented or direct-vent combustion appliances, combustion safety testing does not have to be performed. Testing of gas ovens must always be performed.

12330 Test Procedure

MaineHP service providers must follow the latest version of the Building Performance Institute Building Analyst 1 specification for combustion safety (worst-case draft) testing procedures.

"Worst-case" is defined as the configuration of the house that results in the greatest negative pressure *in the combustion appliance zone* (CAZ).

12400 Zone Pressure Diagnostics (ZPD) Testing

12410 Introduction

Zone pressure diagnostics (ZPD) testing is performed to answer some fundamental questions: where is the functioning air barrier and how leaky is it? These test procedures can also be used to measure the size of the leakage paths to various house zones. Leaking air often takes a path through two surfaces that have a cavity, or zone, between them. These zones can include attics, basements, garages, knee-wall areas, or attached porch roofs.

ZPD testing is not required by MaineHP, but is recommended in cases where additional information is needed regarding the relative and absolute leakage of air barriers (pressure boundaries). For example, CFM_{50} air leakage can be measured through an attic floor before and after air sealing and insulating to determine the effectiveness of the MaineHP work. These ZPD procedures are most valuable on dwellings of moderate air leakage, rather than on dwellings of very high or very low air leakage.

ZPD procedures require the measurement of *pressure differences* across air barriers, like the pressure difference between the house and the zone (attic, for example), while the house is depressurized or pressurized by a blower door. The procedures also require the determination of *flows* across air barriers. These flows can be calculated with the steps of the ZPD procedures and a computer or a programmed calculator. Once these flows are calculated, an estimate of the square inches of leakage through an air barrier can be determined.

These procedures can be used with primary and secondary zones. Primary zones are zones to which you have access, such as basements or attics. This access allows you to open a temporary hole or door between the zone and the dwelling or between the zone and the outdoors. For primary zones, ZPD can be conducted because of:

1. Air leakage/energy loss concerns. If, after initial tightening of large leaks, the house still has significant, but not obvious, air leakage, performing

ZPD can help identify whether the leaks are in the attic floor, the house walls, or through the basement or crawl space walls.

2. Indoor Air Quality concerns. Examples include air movement from attached or tuck-under garages into a living area, and moisture or soil gas movement from a crawl space into the dwelling.
3. Attics with potential or actual moisture-related problems. This might be the case if:
    a. The attic has obvious moisture problems,
    b. The dwelling has evidence of high relative humidity in winter, or
    c. Ice dams are a concern.

Secondary zones are zones to which you have no access, such as porch roofs. This lack of access prevents you from creating a temporary hole between the zone and the dwelling or the zone and the outdoors. Because of this, you cannot determine the flow between secondary zone and the dwelling or outdoors. However, if you are able to insert a pressure hose into the zone, you can measure the pressure difference between the zone and the dwelling or outdoors. Knowing these pressure differences can be helpful at times.

The procedures in this section describe the use of *basic* zone pressure diagnostics. There is also an *advanced* zone pressure diagnostics procedure that can make some testing procedures easier to perform, while yielding results that are more accurate. For advanced zone pressure diagnostics software programs, see http://www.energyconservatory.com/products/products8.htm and then go to "Free ZPD Calculation Utility (for Windows)." Also, check the "ZPDa" program in the ZipTest Pro[2] software package for the Texas Instruments TI-86 calculator from WxWare Diagnostics.

12420 Test Procedures

1. Use the ZipTest Pro™ software package, the Energy Conservatory ZPD utility software, appropriate tables or equations for these tests.
2. Perform the whole-house blower door test before doing any zone pressure diagnostics (ZPD) testing.
    a. If you cannot reach a house pressure difference of 50 Pascals and/or there are obvious large leaks, repair large leaks before any ZPD testing. You must be able to reach a house pressure difference of 50 Pascals in order to do basic ZPD testing, both before and after you create a temporary hole for the add-a-hole test.[1]
    b. If you can reach a house pressure difference of 50 Pascals, but the house is relatively loose for its size, find and seal large leaks before performing ZPD testing.
    c. If the house is relatively tight for a dwelling of its size, there is probably no reason to perform basic ZPD testing for energy reasons. However, there might be reason to perform testing for moisture or indoor air quality concerns.

3. Identify zone types. ZPD can be done on all primary zones including attics, crawl spaces, basements, and attached or tuck-under garages. ZPD can also be done on some secondary zones, such as porch roofs and cantilevers, which will be sealed off from the house.

(Footnotes)
[1] Advanced zone pressure diagnostics procedures do not require a house pressure of 50 Pascals.

13000 Electricity Efficiency Measures

13100 Refrigerator Metering and Replacement

1. If household has an inefficient refrigerator that is going to be replaced, the removed refrigerator should be removed from the premises, demanufactured, and properly disposed of.
2. If there is reliable evidence that a refrigerator was manufactured before 1995, it is probably cost effective to replace it. A refrigerator considered for replacement can be metered with a watt meter, such as the Brultech ECM-1200 or a Watts Up Pro. If a refrigerator is metered, the meter should remain connected for at least two hours.
3. The estimate of the kWh/yr for the existing refrigerator can be determined by one of the two methods below:
    a. An estimate of KWh/yr usage based on actual metering of the refrigerator with a watt meter; or
    b. KWh/yr usage data from the AHAM (Association of Home Appliance Manufacturers) database.
        i. The AHAM database may also be found electronically at www.homeenergy.org and www.waptac.org (as part of the Weatherization Assistant NEAT energy audit).

13200 Incandescent Bulb Replacement with CFLs

13210 Introduction

Many new compact fluorescent lamps (CFLs) meet the stringent criteria of Energy Star® for long life, start time, energy savings, color, and brightness. These new CFLs provide high quality, warm light without the flickering or humming of older fluorescent bulbs.

Advanced technology enables CFLs to use up to 75 percent less energy than a standard incandescent bulb and last up to 10 times longer. This means that over the life of one CFL, a customer can avoid replacing up to 13 incandescent bulbs.

13220 Replacement Procedure

1. All replacement CFLs should be Energy Star® rated.
2. CFLs are now available in a variety of types, including dimmable, three-way, and outdoor.
3. When replacing incandescent lamps with CFLs it is important to attempt to match the lumen output of the replacement CFL with the lumen output of the replaced incandescent lamp

13300 Other Electric Baseload Measures

Discuss electrical use with the customer and analyze their electric bill. In some cases taking an inventory of electric appliances is useful.

1. Other electrical appliances may be metered for electrical use to determine the daily or monthly electric usage.
2. Standby or phantom power might be used by a number of electric appliances in the house. All AC to DC converters use electricity when they are plugged in, even though the appliance they are attached to is turned off.
3. Check for electric space heaters, humidifiers, dehumidifiers, heat tape, and other high users that might have been forgotten by the homeowner. Sometimes such appliances are found in crawlspaces, garages, or utility rooms.

Maine Home Performance Test-In Form (Page 1)

Company Logo

Maine Home Performance Assessment

[Enter Company Name]

HOME PERFORMANCE WITH ENERGY STAR

Customer Name: _____ **Customer Phone Number (h):** _____
Customer Address: _____ **Customer Phone Number (w):** _____
City, State, Zip: _____ **Customer Email:** _____
Inspection Date: _____ **Home Performance Analyst:** _____

Homeowner Interview and Consumption History

How Did They Hear? Article Referral Web Search Radio Regional Program Nat'l Program Other: _____

Type of Home: Colonial Dutch Colonial Cape Split Level Duplex Town/Rowhouse: End Unit? Y N Other: _____

Foundation/Basement: Slab on Grade Basement: Conditioned / Unconditioned / Partially Conditioned Crawlspace: Vented / Unvented

Year Built/Age: _____ **Roof Age/Cond:** ____/____ **Fireplace/Wood Stove:** Yes No **Pool Open/Close Dts:** ____/____
Yrs in Home: _____ **Siding Type/Cond:** ____/____ **Confirm no fires for HPA:** Yes No **Pool Pump Hrs/Day:** _____
 # Occupants: _____ **Heating Fuel:** _____ **DHW Fuel:** _____ **Pool Pump HP/Watts:** _____
Additions: _____ **Back-Up Elect Heat:** Yes No **Pool Htg Fuel:** _____ **Pool Area (L x W):** _____

Top Homeowner Priorities / Concerns / Motivations
1. _____
2. _____

Energy Consumption History

Month	Electric kWh	Electric $	Fossil Units	Fossil $
Jan				
Feb				
Mar				
Apr				
May				
Jun				
Jul				
Aug				
Sep				
Oct				
Nov				
Dec				
Total				

Customer Needs / Complaints

Interviewee:			Details
1. High Bills	Yes	No	
2. Drafts	Yes	No	
3. Hot/Cold Rooms	Yes	No	
4. Air Quality Problems	Yes	No	
5. Odors	Yes	No	
6. Moisture Issues	Yes	No	
7. Water Leaks	Yes	No	
8. Window Problems	Yes	No	
9. Door Problems	Yes	No	
10. Moisture Issues/Damage	Yes	No	
11. Excessive Dust	Yes	No	
12_____	Yes	No	
13_____	Yes	No	

Appliances, Lighting, T-Stats, Other

Major Appliances	Estar	Size	Age	Model Number/ Condition/ Usage
Refrigerator 1				
Refrigerator 2				
Freezer				
Dishwasher				
Washing Machine				
Dehumidifier				
Dryer	NA			
Cooking Range / Oven	NA			
_____				
_____				

Lighting	# Bulbs	% CFL
High Use (>3 hrs/day)		
Other		

Room Air Conditioners
# of Units: _____ **Age:** _____
Estar: Yes No **EER (if known):** _____

Dryer Fuel: _____ **Vented Properly?** Yes No

 # CO Detectors: ____ **Per Floor:** Yes No
 # Smoke Detectors: ____ **Per Floor:** Yes No

 # Thermostats: ____ **Programmable?** Yes No **Heating Setpoint:** _____ **Cooling Setpoint:** _____

 # Bathrooms: ____ **# of Bath Fans:** ____ **Vented Properly?** Yes No **Low-Flow Showerheads?:** Yes No

Building Info

Conditioned Sqft: _____ **Outside Temp:** _____ **Knob & Tube Wiring?:** Yes No
Avg Ceiling Hgt: _____ **House Orientation:** _____ **Whole House Fan?:** Yes No
Number Stories: _____ **Roof Vent Type(s):** _____ **Unvented Space Htrs/Fireplaces?:** Yes No
Volume Cond Space: _____ **Roof Vents Are:** OK Inadequate **Balloon Framing?:** Yes No
Moisture/Other Issues: _____

Attic Insulation

Attic Flats and Slopes	R-Val	Insulation Type.	Insulation Amount	Cav Size (e.g. 2x6)	Open or Enclosed	Surface Area (sqft.)	# Rec. Cans	Attic Access	Attic Fan	Notes
				2 x	Open Encl					
				2 x	Open Encl					
				2 x	Open Encl					
				2 x	Open Encl					
				2 x	Open Encl					

Attic Kneewall/Vertical	R-Value	Insulation Type.	Insulation Amount	Cav. Size (e.g. 2x4)	Surface Area (sqft.)	Notes
				2 x		
				2 x		
				2 x		
				2 x		

Maine Home Performance Test-In Form (Page 2)

Wall Insulation

Sidewall Sections	R-Value	Insulation Type.	Insulation Amount	Cav. Size □e.g. 2x4)	Surface Area □sqft.)	Notes
				2 x		
				2 x		
				2 x		
				2 x		

Basement/Crawl Insul.

Basement Walls & Sill Plate	Condi-tioned?	Insulation Location	R-Value	Wall Height	Depth Bel. Grd.	Sqft or Linear Ft	Notes
	Yes No						
	Yes No						
Sill Plate	Yes No						

Crawlspace	Access	Vented?	Insulation Location	R-Value	Wall Height	Depth Bel. Grd.	Sqft Walls	Sqft Floor	Notes
	Gd Pr	Yes No							
	Gd Pr	Yes No							

Windows/Doors

Windows □Select typical size)

Orientation	Qty.	Panes	Storms?	Frame	Condition	Typ Size	%Wall
		1 2 3	Yes No	W V M	Gd Fair Pr	x	
		1 2 3	Yes No	W V M	Gd Fair Pr	x	
		1 2 3	Yes No	W V M	Gd Fair Pr	x	
		1 2 3	Yes No	W V M	Gd Fair Pr	x	

Exterior Doors

Location	Type	Condition	Insulated	Air Seal Needed
	Wd Mtl	Gd Fair Pr	Yes No	WX Sweep Clk
	Wd Mtl	Gd Fair Pr	Yes No	WX Sweep Clk
	Wd Mtl	Gd Fair Pr	Yes No	WX Sweep Clk
	Wd Mtl	Gd Fair Pr	Yes No	WX Sweep Clk

Air Leakage

Blower Door Test: _____ CFM50 / ACH (circle one) **Ventilation Standard:** _____ CFM50 / ACH (circle one) **Excess Air Leakage:** _____ CFM50 / ACH (circle one)

Air Leakage Locations □check all that apply)

Attic Wire/Pipe Penetratrions		Recessed Lights		Crawlspace		Porch Roof	
Kneewalls / Attic Stairs		Chimney / Flues		Windows		Garage Wall	
Pocket Doors / Attic Access		Basement Penetrations		Cantilevers		Garage Ceil	
Drop Soffits		Sill Plate		Bay Window		El. Outlets	

Notes: _____

Heating and Cooling Systems

	Heating System 1	Heating System 2		Cooling System 1	Cooling System 2
Brand:			**Brand:**		
Type □Furnace, Boiler, HP)			**Type** □AC, HP):		
Fuel:			**Model #:**		
Model #:			**Tonnage:**		
Age / Cond.:			**Age / Cond.:**		
Input/Output BTU's:			**SEER / EER:**		
Eff. Rating □AFUE, HSPF):			**Air Handl Loc.:**		
Steady State Eff.:			**Coils Cond:**		
Location □Bsmt, Gar):			**Cond. Out Unit:**		
			Loc. Outside Unit:		

Freq. of Servicing: _____ **Filter Clean:** Yes No **Condensate Line Issues:** _____

Humidifier: Yes No **Flue Vent Issues:** _____

Combustion Related Tests

	Flue Gas CO ppm	Natural Draft	Worst Case Draft	Natural Spillage	Worst Case Spillage
Heating System 1:		pa	Pass Fail	Pass Fail	Pass Fail
Heating System 2:		pa	Pass Fail	Pass Fail	Pass Fail
DHW System:		pa	Pass Fail	Pass Fail	Pass Fail
Other:		pa	Pass Fail	Pass Fail	Pass Fail

	Fuel	CO ppm	Vent Out?
Oven 1:			Yes No
Oven 2:			Yes No

	Kitchen	Main Living	Other
Ambient CO 1:			
Ambient CO 2:			

	Ambient CO	Base Pressure	Worst Cse Pressure	Final □Net) CAZ Depressurization	CAZ Standard	Pass or Fail
CAZ 1:						P F
CAZ 2:						P F

Fuel Leaks: ☐ None detected ☐ Leak(s) detected - see below:

_____

DHW

Location: Conditioned Bsment / Utility Room / Closet Unconditioned Basement / Utility Room Garage Crawlspace Other: _____

Type: _____ **Age/Condition:** _____ **Model #:** _____ **Tank Wrapped?:** Yes No

Gallons: _____ **Output BTU:** _____ **Temp Setting:** _____ **Press. Relief Valve?** Yes No

Fuel: _____ **Efficiency** □EF): _____ **Flue Issues:** _____

Distribution System and Notes

% Ducts in Uncond Attic: _____

% Ducts in Uncond Bsmt/Crawl: _____

Duct / Pipe Insulation: R - _____

Visual Leakage: Low Med High

Duct Leakage Test (optional): Duct Blast BD Subtract Delta Q Press Pan

Duct Test Result (use note field for press pan): _____

Airflow Test Result (optional): _____

Notes Field:

Pressure Pan Test □Duct WRT House)

House WRT Duct Location: _____ pa

Location	Pa	Location	Pa
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	

Maine Home Performance Test-Out Form

Sponsor or Contractor Logo Here

Home Performance with ENERGY STAR

Post-Installation Tests and Inspections

[Enter Company Name]

HOME PERFORMANCE WITH ENERGY STAR

Customer Name: _____ **Customer Phone Number (h):** _____

Customer Address: _____ **Customer Phone Number (w):** _____

City, State, Zip: _____ **Customer Email:** _____

Inspection Date: _____ **Home Performance Analyst:** _____

Blower Door Test and Ventilation Compliance

Method Used to Determine Building Leakage Standard (check one):

- ☐ Whole Building Mechanical Ventilation per ASHRAE 62.2 - 200☐
- ☐ Ventilation Credit for Air Leakage (indicate software used):
  - ☐ TECTITE ☐ ZipTest Pro2
- ☐ Ventilation Exemption for Existing Homes per ASHRAE 62.2 - 200☐
- ☐ BPI Legacy Building Air Tightness Std per ASHRAE 62.2 - 1989
- ☐ Other: _____

Bldg Leakage (Test-In): _____ **CFM50 / ACH (circle one)**

Bldg Leakage (Test-Out): _____ **CFM50 / ACH (circle one)**

_____ **CFM50 / ACH / Mech. Ventilation CFM (circle one)**

☐ Pass ☐ Pass w/ Ventilation Recommended

☐ Fail - Action Required: _____

Combustion Equipment Testing / Combustion Appliance Zone Testing

	Worst Case Test Results			Natural Condition Test Results			
	Spillage	Draft	CO	Spillage	Draft	CO	Flue Inspection
Heating System 1:	Pass Fail	pa	ppm	Pass Fail	pa	ppm	Pass Fail ☐ Action Required:
Heating System 2:	Pass Fail	pa	ppm	Pass Fail	pa	ppm	Pass Fail ☐ Action Required:
DHW System 1:	Pass Fail	pa	ppm	Pass Fail	pa	ppm	Pass Fail ☐ Action Required:
Other:	Pass Fail	pa	ppm	Pass Fail	pa	ppm	Pass Fail ☐ Action Required:

	CO Ambient	Base Pressure	Worst Case Pressure	Net CAZ Depress.	Limit for CAZ	Result	
CAZ 1:						Pass Fail	☐ Action Required:
CAZ 2:						Pass Fail	☐ Action Required:

Gas Leak Testing: ☐ No Leaks Detected ☐ Leaks Detected as Noted: _____

	Kitchen	Main Living	Other - ppm	
Ambient CO:				☐ Action Required:

	Fuel	CO ppm	Vent Out?	
Oven CO:			Yes No	☐ Action Required:

Dryer Vent: ☐ Electric ☐ Gas Properly Vented ☐ Gas Improperly Vented. Action Required: _____

Distribution System Air Flow (required if ducts were sealed as part of project) and Leakage Tes

Airflow Test Result: _____ ☐ Pass ☐ Fail

If fail, action to be taken: _____

Duct Leakage Test: Duct Blaster BD Subtract Delta Q Press Pan

Duct Test Result (enter here or attach separate form): _____

Pressure Pan Average (Test-In): _____ **Pressure Pan Average (Test-Out):** _____

Verification of Measures Installed:

- ☐ Basement Air Sealing
- ☐ Attic Air Sealing
- ☐ Basebrd / Molding Air Sealing
- ☐ Windows / Doors Air Sealing
- ☐ Ext. Wall to Garage Air Sealing
- ☐ Attic Flat Insulation
- ☐ Attic Slope Insulation
- ☐ Attic Kneewall Insulation
- ☐ Exterior Wall Insulation
- ☐ Attic Stairs Insulation
- ☐ Attic Tent
- ☐ Window Replacement / Repair Qty: ____
- ☐ Window Film / Solar Screen Qty: ____
- ☐ Door Replace / Repair Qty: ____
- ☐ Heating System Replace / Repair
- ☐ Central Air Conditioner Replace / Repair
- ☐ Htg / DHW Flue Replace / Repair
- ☐ Air Handler Replace / Repair
- ☐ Duct Sealing / Insulation / Replacement
- ☐ DHW System Replace / Repair
- ☐ DHW Blanket / Pipe Insulation
- ☐ Exhaust Fans - Qty ____ / HRV
- ☐ Exhaust Vents Reroute / Insulate
- ☐ Attic Vents Qty: _____
- ☐ Appliance: _____
- ☐ Appliance: _____
- ☐ Appliance: _____
- ☐ Lighting:CFL's / Fixt. Qty: _____
- ☐ Renewable Energy Syst: _____
- ☐ Health & Safety: _____
- ☐ Other: _____
- ☐ Other: _____
- ☐ Notes/Items Requiring Follow-Up:

Contractor Statement and Signature:

I attest that all of the information entered above is correct to the best of my knowledge. I agree to complete any items noted above for follow-up corrective action, and will submit an additional Post-Installation Tests and Inspections form that verifies the successful completion of those items and records required follow-up tests or inpsections:

Contractor Signature: _____ **Date:** _____

Customer Statement

I attest that I am the owner of the property specified above, and that all materials and equipment included my home improvement contract with the above Contractor have been furnished and installed by the Contractor, and that the work has been completed pursuant to the contract.

Customer Signature: _____ **Date:** _____

Maine Home Performance Homeowner Summary Report

Home Performance Assessment Summary Report

Smith Home Performance Contracting

1 Address Street, City, ST 00000 • Phone: 000-000-0000 • Fax: 000-000-0000 • smithhpc@smithhpc.com

Customer Name:		**Customer Phone Number (h):**	
Customer Address:		**Customer Phone Number (w):**	
City, State, Zip:		**Customer Email:**	
Inspection Date:		**Home Performance Analyst:**	

Your Home Performance Assessment identifies opportunities to improve the performance of your home based on our analysis.
This report summarizes the findings, prioritizes recommended improvements, and helps you determine the best improvements for your home.

Findings and Recommendations

Building Envelope Evaluation

Air Sealing

Priority	Findings on Existing Conditions	Recommendations for Improvements
	Blower door test: _____cfm50 Tightness std: _____ cfm50	○ Reduce leaks by _____ % ○ No recommendations
	Leakage pathways observed:	**Air seal the following leakage pathways:**
	○ Basement/crawl ceiling ○ Interior baseboard/top molding/fireplaces	○ Bsmnt/crawl penetrations ○ Exposed sill plate
	○ Sill plate ○ Window and door frames	○ Attic penetrations ○ Top wall plates in attic
	○ Attic floor ○ Attic hatch(es)	○ Flue/chimney penetrations ○ Open attic stairs/walls
	○ Band joist between floors ○ Recessed lights	○ Attic hatch/pulldown ○ Base and ceiling molding
	○ Major air leakage bypass(es): _____	○ Door and window frames ○ Around fireplace/mantle
	○ Other: _____	○ Weatherstrip: ○ doors ○ windows ○ hatches ○ outlets
		○ Recessed lights: ○ covers ○ inserts ○ new housings
		○ _____

Duct Sealing

	Duct leakage observed at: ○ No ducts in unconditioned space	○ Duct sealing: _____ hours ○ Air flow balancing
	○ Main trunk connections ○ Duct disconnects/failures at:	○ Include duct blaster test for leakage to outside
	○ Branch line connections _____	○ Repair or reconnect ducts ○ Add return(s)
	○ Accessible register connections _____	○ Replace approx. ____% of duct system
	○ Unable to visually diagnose duct work _____	○ Duct cleaning ○ No recommendations

Insulation Levels

	R-Value/Inches Insulation	Insulate in the following locations:	R-Value/Inches Insul.
	○ Above grade walls _____	○ Walls	_____
	○ Attic (flat) _____	○ Attic (flat)	_____
	○ Attic (slope) _____	○ Attic (slope)	_____
	○ Kneewall(s) _____	○ Kneewall	_____
	○ Floor over uncond. _____	○ Floor	_____
	○ Rimjoists _____	○ Rimjoist	_____
	○ Crawl walls _____	○ Foundation walls	_____
	○ Basement walls _____	○ Ductwork	_____
	○ Ductwork (uncond. space) _____	○ No recommendations	_____

Windows and Doors

	○ Single pane windows Condition: ○ Good ○ Fair ○ Poor	○ Replace windows with a u-value ≤ _____ and solar gain ≤ _____
	○ Double pane windows Condition: ○ Good ○ Fair ○ Poor	○ Replace _____ door(s) w/ _____
	○ Double pane low-e Condition: ○ Good ○ Fair ○ Poor	○ Solar screens ○ Other: _____
	○ Storm windows Condition: ○ Good ○ Fair ○ Poor	○ No recommendations
	○ Doors Condition: ○ Good ○ Fair ○ Poor	

Mechanical Equip. Evaluation

Space Heating

	Main heating system is a _____	○ Replace **main heating system** with new _____ with _____ rated efficiency
	System efficiency is _____ and age _____	○ Replace **2nd heating system** with new _____ with _____ rated efficiency
	Condition: ○ Good ○ Service ○ Replace	○ Fix/replace condensate line
	Prog. thermostat ○ Yes ○ No # of thermostats: _____	○ Remove **2nd heating system**
	2nd heating system is a _____	○ Install prog. thermostat ○ Replace filter(s)
	System efficiency is _____ and age _____	○ Fix/replace condensate line
	Condition: ○ Good ○ Service ○ Replace	○ Other: _____
	Prog. thermostat ○ Yes ○ No	○ No recommendations
	Filter condition: _____ Filter size: _____ Qty: _____	
	Condensate line: Blocks: ○ Yes ○ No Leaks: ○ Yes ○ No	
	○ Other: _____	

- A -

Abatement – A measure or set of measures designed to permanently eliminate a hazard (e.g., lead-based paint). Abatement strategies include removal of the hazardous materials, replacement of building components containing the hazardous material, enclosure, or encapsulation. All of these strategies require proper preparation, cleanup, waste disposal, post-abatement clearance testing, and if applicable, record keeping and monitoring. Abatement activities are not allowable expenses to be funded by Department of Energy Weatherization Assistance Program dollars.

Absorption – Absorption is the process by which a substance can be readily taken into the body through the skin or membranes. The best defense is to have a protective barrier between the substance and the skin.

AHAM – Association of Home Appliance Manufacturers.

Air Changes per Hour at 50 Pascals (ACH_{50}) – The number of times that the complete air volume of a home is exchanged for outside air in one hour when a blower door depressurizes or pressurizes the home to 50 Pascals.

Air Changes per Hour Natural (ACH_{nat}) – The number of times the indoor air is exchanged with the outdoor air in one hour under natural driving forces. It can be estimated using a blower door.

Air Exchange – The process whereby indoor air is replaced with the outdoor air through air leakage and ventilation.

Air-Free Carbon Monoxide – A measurement of carbon monoxide (CO) in an air sample or flue gas that estimates the amount of excess air (oxygen, O_2) in the sample, incorporating an adjustment to the as-measured CO ppm value to simulate oxygen-free conditions in the sample. Usually measured in units of parts per million (ppm). See As-Measured Carbon Monoxide.

Air Handler – A steel cabinet containing a blower fan with heating (and sometimes cooling) coils, connected to ducts, which circulates indoor air across the exchangers and into the habitable space.

Air Infiltration Barrier – A spun polymer sheet (for example, house wrap) that stops almost all the air traveling through a building cavity, while allowing moisture to pass through it under ideal conditions.

Altitude Adjustment – The input modification for a gas appliance installed at a high altitude. When a gas appliance is installed more than 2000 feet above sea level, its input rating must be reduced by approximately 4 percent per 1000 feet above sea level.

Ambient Air – Air in the habitable space.

Ampere – A unit of measurement that tells how much electricity flows through a conductor. It is comparable to a cubic foot per second measurement of water flow. For example, a 1,200-watt, 120-volt hair dryer pulls 10 amperes of electric current (watts divided by volts).

ANSI – American National Standards Institute, Inc.

AFUE – Annual Fuel Utilization Efficiency – A laboratory-derived efficiency for heating appliances that accounts for chimney losses, jacket losses, and cycling losses, but not distribution losses or fan/pump energy use.

Aquastat – A heating control that switches the burner or the circulator pump in a hydronic heating system.

Asbestos – A fibrous mineral with fireproof and insulation characteristics which may be shaped into a variety of building materials. Small, sharp, asbestos fibers may cause damage to lungs if they are inhaled.

ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

As-Measured Carbon Monoxide – A direct measurement of CO in a sample of air or flue gas, usually measured in units of parts per million (ppm). See "air-free carbon monoxide"

ASTM – American Society for Testing and Materials.

Atmospheric Appliance – A combustion appliance that takes its combustion supply air from the surrounding room without the use of a fan. Also, know as open-combustion heater.

- B -

BA1 – See Building Analyst 1. One of the Building Performance Institute (BPI) standards. Those working within the Maine Home Performance Program must be certified for the BPI Building Analyst 1 specification. See www.bpi.org for more information.

Backdrafting – Continuous spillage of combustion gases from a vented combustion appliance into the conditioned space. Sometimes referred to as draft reversal.

Backdraft Damper – A damper, installed near a fan, that allows air to flow in only one direction and prevents reverse flow when the fan is off.

Backer Rod – Polyethylene foam rope used as backing for caulking.

Baffle – A plate or strip designed to retard or redirect the flow of flue gases.

Balance Point – The outdoor temperature at which no heating is needed to maintain inside temperatures.

Ballast – A coil of wire or electronic device that provides a high starting voltage for a lamp and limits the current flowing through it.

Balloon Framing – A method of construction in which the vertical framing members (studs) are continuous pieces, running the entire height of the wall. In Maine this type of framing was commonly used from about 1870 to 1930.

Band Joist – See rim joist.

Barometric Vent Damper – a device installed in the heating unit vent system to control draft. Usually used on oil-fueled units or gas units with power burners.

Batt – A blanket of preformed insulation, generally 14.5" or 22.5" wide, and varying in thickness from 3.5" to 9".

Benefit-to-Cost Ratio (BCR) – See Savings-to-Investment Ratio (SIR).

Bimetal Element – A metal spring, lever, or disc made of two dissimilar metals that expand and contract at different rates as the temperature

around them changes. This movement operates a switch in the control circuit of a heating or cooling device.

Blocking – A construction element or material used to prevent the movement of air or insulation into or through building cavities.

Blow-Down – Removing water from a boiler to remove sediment and suspended particulates.

Blower – The "squirrel-cage" fan in a furnace or air handler.

Blower Door – A calibrated device to measure the air tightness of a building by pressurizing or depressurizing the building and measuring the flow through the fan and, thus, the air leakage rate of a building.

Blown Insulation – A loose-fill insulation that is blown into attics and building cavities using an insulation blowing machine.

Boiler – A space heating appliance that heats water with hot combustion gases.

Boot – A duct section that connects between a duct and a register, floor, or wall cavity, or between round and square ducts.

Branch Circuit – An electrical circuit used to power outlets and lights within a home.

Brightness – The luminous intensity of any surface in a given direction per unit of projected area of the surface, as viewed in that direction.

British Thermal Unit (Btu) – The quantity of heat required at sea level to raise the temperature of one pound of water by one degree Fahrenheit.

Btuh – British thermal units per hour.

Building Analyst 1 (BA1) – One of the Building Performance Institute (BPI) specifications. Those working within the Maine Home Performance Program must be certified for the BPI Building Analyst 1 specification. See www.bpi.org for more information.

Building Cavities – The spaces inside walls, floors, and ceilings or between the interior and exterior sheeting.

Depressurization Limit – Expressed in Pascals and measured in the immediate area around vented combustion appliances that use indoor air for combustion supply air. If a combustion appliance experiences a negative pressure of a greater

magnitude than its depressurization limit, it has the potential to backdraft, causing a hazardous condition for the occupants.

Building Performance Institute (BPI) - The Building Performance Institute, Inc. supports the development of a professional building performance industry through individual and organizational credentialing and a rigorous quality assurance program. The mission of BPI is to "ensure that the professional bar for excellence in building performance contracting is established and maintained at the appropriate level by creating and regularly updating technical requirements through an open, transparent consensus development process." See www.bpi.org for more information. Those working within the Maine Home Performance Program must be certified for the BPI Building Analyst 1 specification.

Building Science – A complex perspective on buildings, using contemporary technology to analyze and solve problems of design, construction, maintenance, safety, and energy efficiency.

Burner – A device that facilitates the burning of a fossil fuel like gas or oil.

Bypass – An air leakage site that allows air to leak out of a building passing around the air barrier and insulation.

- C -

Carbon Dioxide (CO_2) – A heavy, colorless, nonflammable gas formed by the oxidation of carbon, by combustion, and by the respiration of plants and animals.

Carbon Monoxide (CO) – An odorless, colorless, tasteless, and poisonous gas produced by incomplete combustion.

Carbon Monoxide Emissions – Carbon monoxide emissions are measured in parts per million (ppm); measurement of CO emissions in flue gas requires that a sample must be taken before dilution air enters the venting system. See "air-free carbon monoxide" and "as-measured carbon monoxide"

Caulking – A mastic compound for filling joints and cracks.

Category I Fan-Assisted Gas Appliance – An appliance that operates with negative static pressure in the vent, a temperature that is high enough to avoid condensation in vent, and an integral fan to draw a controlled amount of combustion supply air through the combustion chamber.

Category I Gas Appliance — An appliance that operates with negative static pressure in the vent and a temperature that is high enough to avoid condensation in vent.

Category II Gas Appliance – An appliance that operates with negative static pressure in the vent and a temperature that is low enough to cause excessive condensation in the vent.

Category III Gas Appliance – An appliance that operates with positive static pressure in the vent and a temperature that is high enough to avoid condensation in vent.

Category IV Gas Appliance – An appliance that operates with positive static pressure in the vent and a temperature that is low enough to cause excessive condensation in the vent.

CAZ – See Combustion Appliance Zone.

Cellulose Insulation – Insulation, packaged in bags for blowing, made from newspaper or wood waste, and treated with a fire retardant.

Chimney – A building component designed for the sole purpose of assuring combustion by-products are exhausted to the exterior of the building.

Chimney Flue – A passageway in a chimney intended to convey combustion gases to the outdoors.

Circuit Breaker – A device that automatically disconnects an electrical circuit from electricity under a specified or abnormal condition of current flow.

Coefficient of Performance (COP) – A heat pump or air conditioners output in Watt-hours of heat removed, divided by Watt-hours of electrical input.

Coil – A snakelike piece of copper tubing surrounded by rows of aluminum fins that clamp tightly to the tubing to aid in heat transfer.

Cold Air Return (return side): Ductwork through which house air is drawn for reheating during a furnace's cycle.

Color Rendering Index (CRI) – A measurement of a light sources ability to render colors the same as sunlight does. The CRI has a scale of 0 to 100.

Color Temperature – A measurement of the warmness or coolness of a light source in the Kelvin temperature scale.

Combustible – Susceptible to combustion; inflammable; any substance that will burn.

Combustible Gas Leak Detector – A device for determining the presence and general location of combustible gases in the air.

Combustion – The act or process of burning. Oxygen, fuel, and a spark must be present for combustion to occur.

Combustion Air – Air required to chemically combine with a fuel during combustion to produce heat and flue gases.

Combustion Analyzer – A device used to measure the steady-state efficiency of combustion heating units.

Combustion Appliance – Any appliance in which combustion occurs.

Combustion Appliance Zone (CAZ) – The closed space or area that holds one or more combustion appliances.

Combustion Chamber – The area inside a heating unit where combustion takes place.

Common Vent – The portion of the vent or chimney through which passes products of combustion from more than one appliance.

Compact Fluorescent Light (CFL) – A small fluorescent light engineered to fit conventional incandescent fixtures.

Compressor – A motorized pump that compresses a gaseous refrigerant and sends it to a condenser where heat is released.

Condense – To change from a gaseous or vaporous state to a liquid or solid state by cooling or compression.

Condenser – The coil in an air conditioning system where the refrigerant condenses and releases heat, which is then carried away by air moving across the coil.

Condensate – The liquid formed when a vapor is condensed.

Condensate Receiver – A tank for catching returning condensate water from a steam heating system.

Conductance – The quantity of heat, in Btus, that will flow through one square foot of material in one hour, when there is a one degree Fahrenheit temperature difference between both surfaces. Conductance values are given for a specific thickness of material.

Conduction – The transfer of heat energy through a material (solid, liquid, or gas) by the motion of adjacent atoms and molecules without gross displacement of the particles.

Conductivity – The quantity of heat that will flow through one square foot of homogeneous material, one inch thick, in one hour, when there is a temperature difference of one degree Fahrenheit between its surfaces.

Confined Space – A space with a volume of less than 50 cubic feet per 1,000 Btu per hour of the total input rating of all combustion appliances installed in that space.

Control Circuit – A device that opens and closes a power circuit or opens and shuts a valve.

Convection – The transmission of heat by the actual movement of a fluid or gas because of differences in temperature, density, etc.

Cooling Load – The maximum rate of heat removal required of an air conditioner when the outdoor temperature and humidity are at the highest expected level.

Cost-Effective – Having an acceptable payback, return-on-investment, or savings-to-investment ratio.

Critical Framing Juncture – An intersection of framing members and envelope components that require special attention during prep and installation of insulation.

Cross Section – A view of a building component drawn or imagined by cutting through the component.

CFM – Cubic Feet per Minute – A measurement of air movement in cubic feet per minute past a certain point or through a certain structure.

CFM_{50} – The number of cubic feet per minute of air flowing through the fan housing of a blower door when the house pressure is 50 Pa (0.2 inches of water column). This figure is the most common and accurate way of comparing the tightness of buildings that are tested using a blower door.

CFM_{nat} – The number of cubic feet of air flowing through a house from indoors to outdoors during typical, natural conditions. This figure can be roughly estimated using a blower door using the LBL (Lawrence Berkeley Labs) infiltration model.

- D -

Degree-days (DD) – A measure of outdoor temperature produced by summing the temperature differences between the inside (65°F) and the daily average outside temperature for a one-year period.

Demand – The peak need for electrical energy.

Density – The weight of a material divided by its volume, usually measured in pounds per cubic foot.

Depressurize – To lower the pressure in an enclosed area with respect to a reference pressure.

Design Temperature - A high or low temperature used for designing heating and cooling systems when calculating the building load.

Dilution Air – Air that enters through an opening where the chimney joins to an atmospheric-draft combustion appliance.

Dilution Device – A draft diverter, draft hood, or barometric draft control on an atmospheric-draft combustion appliance.

Direct-Vent Appliance – A combustion appliance for which all combustion gases are vented to the outdoors through an exhaust vent pipe and all combustion supply air is vented to the combustion chamber from the outdoors through a separate, dedicated supply-air vent.

Distribution System – A system of pipes or ducts used to distribute energy.

DHW – Domestic Hot Water.

Dormer – A framed structure projecting above a sloping roof surface, and normally containing a vertical window.

Downdraft – Air flow from a chimney or venting system into an enclosed building space.

Draft – A pressure difference that causes combustion gases or air to move through a vent connector, flue, chimney, or combustion chamber

Draft Diverter – A nonadjustable device built into an appliance or a part of the vent connector that is intended to 1) provide for escape of flue gases if blockage or backdraft occurs, 2) prevent a downdraft of outdoor air from entering the appliance, 3) neutralize the effect of stack action of the chimney, and 4) lower the dew point temperature of the flue gas by the infusion of room air.

Draft Fan – A mechanical fan used installed in a vent connector to augment the natural draft in gas- and oil-fired appliances.

Draft Hood – See draft diverter.

Draft Regulator – A self-regulating damper attached to a chimney or vent connector for the purpose of controlling draft. A draft regulator can reduce draft; it cannot increase draft.

Drywall – Gypsum interior wallboard used to produce a smooth and level interior wall surface and to resist fire. Also called gypsum wallboard and sheetrock.

Dry Bulb Temperature – Normal ambient air temperature measured by a thermometer.

Duct Blower – A blower door-like device used for testing duct leakiness and airflow.

Duct Zone – A building space or cavity that contains heating or cooling ducts.

- E -

Eave – The part of a roof that projects beyond its supporting walls. See also soffit.

Efficiency – The ratio of output divided by input.

Efficacy – The number of lumens produced by a watt used for lighting a lamp. Used to describe lighting efficiency.

Electric Service – The electric meter and main switch, usually located outside the building.

Emittance – The rate that a material emits radiant energy from its surface. Also called emissivity.

Encapsulation – Any covering or coating that acts as a barrier between the hazard (e.g., lead-based paint) and the environment, the durability of which relies on adhesion and the integrity of existing bonds between existing layers (e.g., paint) and the substrate.

Enclosure – The use of rigid, durable construction materials that are mechanically fastened to the substrate to act as a barrier between the hazardous material (e.g., lead-based paint) and the environment.

Energy – A quantity of heat or work.

Energy Consumption – The conversion or transformation of potential energy into kinetic energy for heat, light, electricity, etc.

Energy Efficiency – Term describing how efficiently a building component uses energy.

Energy Efficiency Ratio (EER) – A measurement of energy efficiency for room air conditioners. The EER is computed by dividing cooling capacity, measured in British Thermal Units per hour (Btuh), by the watts of power. (See also Seasonal Energy Efficiency Rating – SEER)

Enclosure – The building envelope or shell. The exterior walls, floor, and roof assemblies of a building.

Environmentally Sensitive – Highly susceptible to adverse effects of pollutants.

Evaporation – The process of being changed into a vapor or gas at a temperature usually below the boiling point. Evaporation is a cooling process.

Evaporative Cooler – A device for cooling homes in dry climates. It cools the incoming air by the evaporation of water.

Evaporator – The heat transfer coil of an air conditioner or heat pump that cools the surrounding air as the refrigerant inside the coil evaporates and absorbs heat.

Excess Air — Air supplied to a burner in excess of the amount needed for complete combustion.

Exfiltration – Air flowing out of a building from its conditioned space through holes, leaks, or cracks in the shell.

- F -

Fahrenheit – A temperature scale for which water boils at 212° and freezes at 32°.

Fan-Assisted Combustion – A combustion appliance with an integral fan to draw combustion supply air through the combustion chamber.

Fan Control – A bimetal thermostat that turns the furnace blower on and off as it senses the presence of heat.

Fan-Off Temperature – In a furnace, the supply air temperature at which the fan control shuts down the distribution blower.

Fan-On Temperature – In a furnace, the supply air temperature at which the fan control activates the distribution blower.

Feeder Wires – The wires connecting the electric meter and main switch with the main panel box indoors.

Fiberglass – A fibrous material made by spinning molten glass.
Fill Tube – A plastic or metal tube used for its stiffness to blow insulation inside a building cavity and allow the insulation to be delivered at the extreme ends of the cavity.

Fire Stop – Framing member, usually installed horizontally between studs, designed to stop the spread of fire within a wall cavity.

Furring – Thin wood strips fastened to a wall or ceiling surface as a nailing base for finish materials.

Flame Safety Control – A device that prevents fuel delivery in the event the ignition does not work.

Flammable/Inflammable – Combustible; readily set on fire.

Flashing – Waterproof material used to prevent leakage at intersections between the roof surface at walls or penetrations.

Floor Joists – The horizontal framing members that support the floor.

Flue – A vent for combustion gases.

Foam Board – Plastic foam insulation manufactured most commonly in 4' x 8' sheets in thicknesses of ½" to 3".

Foot-Candle – A measure of light striking a surface.

Footing – The part of a foundation system that transfers the weight of the building to the ground.

Forced Draft – A venting system for which a fan installed at the combustion appliance moves combustion gases to the outdoors with positive static pressure in the vent pipe, which is required to be airtight.

Friable –Easily broken into small fragments or reduced to powder, e.g., as with asbestos.

Frost Line – The maximum depth of the soil where water will freeze during the coldest weather.

Furnace – A space heating appliance that heats air with hot combustion gases.

- G -

Gable – The triangular section of an end wall formed by the pitch of the roof.

Gable Roof – A roof shape that has a ridge at the center and slopes in two directions.

GAMA – Gas Appliance Manufacturers Association.

Gasket – Elastic strip that seals a joint between two materials.

Glazing – Glass installation. Pertaining to glass assemblies or windows.

Glazing Compound – A flexible, putty-like material used to seal glass in its sash or frame.

Ground Fault Circuit Interrupter (GFI or GFCI) – An electrical connection device that breaks a circuit if a short occurs. These are required for all exterior use of electrical equipment, or when an electrical outlet is located near a water source.

Gypsum Board – A common interior sheeting material for walls and ceilings, made of gypsum rock powder, pressed between two sheets of heavy building paper. Also called sheetrock, drywall, gyprock, or gypboard.

- H -

Habitable Space – A building space intended for continual human occupancy. Examples include areas used for sleeping, dining, and cooking, but not bathrooms, toilets, hallways, storage areas, closets, or utility rooms. See occupiable space and conditioned space.

Hazardous Condition – A situation that is causing a danger to the customer/crew/contractor that exists before, is created by, or is exacerbated by, weatherization. For example, a dwelling could have a moisture problem that is allowing biological hazards (molds, viruses, bacteria, etc.) to flourish. Another example would be fiberglass to entering the conditioned space due to improperly fastened or sealed ductwork.

Hazardous Material – A particular substance that is considered a danger to the customer/crew/contractor.

Heat Anticipator – A very small electric heater in a thermostat that causes the thermostat to turn off before room temperature reaches the thermostat setting, so that the house does not overheat from heat distributed after the burner shuts off.

Heat Capacity – The quantity of heat required to produce a degree of temperature change.

Heat Exchanger – The device in a heating unit that separates the combustion chamber from the distribution medium and transfers heat from the combustion process to the distribution medium.

Heat Loss – The amount of heat escaping through the building shell during a specified period.

Heat Pump – A type of heating/cooling unit, usually electric, that uses a refrigerant fluid to heat and cool a space.

Heat Rise – In a furnace, the number of degrees of temperature increase that air is heated as it is blown over the heat exchanger. Heat rise equals heated air temperature minus air return temperature.

Heating Degree Day (HDD) – Each degree that the average daily temperature is below the base temperature (usually 65°F) constitutes one heating degree day.

Heating Load – The maximum amount of heat needed by a building during the very coldest weather to maintain the desired inside temperature.

Heating Seasonal Performance Factor (HSPF) – Rating for heat pumps describing how many Btus they transfer per kilowatt-hour of electricity consumed.

HVAC – Heating, Ventilating, Air-Conditioning.

High Limit – A bimetal thermostat that turns the heating element of a furnace off if it senses a dangerously high temperature.

Hip Roof – A roof with two or more contiguous slopes, joined along a sloping "hip."

Home Energy Index – The number of Btus of energy used by a home, divided by its area of conditioned square feet and by the number of heating degree days during one year.

Home Performance Assessment (HPA) – A comprehensive analysis of a home to determine its existing performance by visual inspection, measurement, and performance testing, and whereby improvement measures and repairs covered within the scope of this Standard are identified.

Home Performance Assessor – A person qualified to conduct a home performance analysis and who has demonstrated his or her qualifications by meeting the requirements for certification outlined by a certification organization accredited to ISO 17024.

House Pressure – The difference in pressure between the inside and outside of the house.

Humidistat – An automatic control that switches a fan, humidifier, or dehumidifier on and off based on the relative humidity at the control.

Humidity Ratio – The absolute amount of airs humidity measured in pounds of water vapor per pound of dry air.

HVI – Home Ventilating Institute.

Hydronic System – A heating system using hot water or steam as the heat transfer medium. Commonly called a hot-water heating system.

- I -

Illumination – The light level measured on a horizontal plane in foot-candles.

Incandescent light – The common light bulb found in residential lamps and light fixtures and sold in stores everywhere and is known for its inefficiency.

IAQ – Indoor Air Quality

Inches of Water Column (also IWC) – A non-metric unit of pressure difference; one IWC is equal to about 0.004 Pascals.

Induced Combustion – See Fan-Assisted Combustion.

Induced Draft – A venting system for which a fan, installed at or very near the termination point of the vent pipe, moves the combustion gases to the outdoors with negative static pressure in the vent pipe.

Infiltration – The uncontrolled movement of non-conditioned air into a conditioned air space.

Infrared – Pertaining to heat rays emitted by the sun or warm objects on earth.

Ingestion – Ingestion is the process by which a substance enters the body by swallowing. The best defense against ingesting harmful materials is to wash hands before eating or putting fingers in the mouth, keeping hazardous materials out of reach of small children, and guarding against hazardous materials splashing into your mouth.

Input Rating – The designed capacity of an appliance, usually specified in Btus or units of energy.

Insulating Glass – Two or more glass panes spaced apart and sealed in a factory, and having a higher R-value than a single pane of glass.

Insulation – A material used to retard heat transfer.

Intermittent Ignition Device (IID) – A device that lights the pilot light on a gas appliance when the control system calls for heat, thus saving the energy wasted by a standing pilot.

Internal Gains – The heat generated by bathing, cooking, and operating appliances. At times, internal heat gains must be removed during the summer to promote comfort and they can reduce the heating demand in the winter.

Interstitial Space – Space between framing and other building components.

Isolated Outdoor Air Supply – A vent pipe through which outdoor combustion supply is ducted to an oil burner.

- J -

Joist – A horizontal wood framing member that supports a floor or ceiling.

Joule – A unit of energy. One thousand joules equals 1 Btu.

- K -

Kilowatt – One thousand watts. A unit of measurement of the amount of electricity needed to operate given equipment.

Kilowatt-Hour – The most commonly used unit for measuring the amount of electricity consumed over time; one kilowatt of electricity supplied for one hour.

Kinetic Energy – Consisting of, or depending on, motion; distinguished from potential energy.

- L -

Lamp – A light bulb.

Latent Heat – The amount of heat energy required to change the state of a substance from a solid to a liquid or from a liquid to a gas, without changing the temperature of the substance.

Lath – A support for plaster, consisting of thin strips of wood, metal mesh, or gypsum board.

Lead-Safe Work Practices – Work practices required by the DOE for pre-1978 homes when the weatherization work will disturb more than 2 square feet of painted surface in an interior room, 10% of a small component such as a baseboard or door casing, and/or when the work will disturb more than twenty square feet of painted exterior surface.

Light Quality – The relative presence or absence of glare and brightness contrast. Good light quality has no glare and low brightness contrast.

Limited Energy Auditor Technician – A limited license issued by the Maine Oil and Solid Fuel and Propane and Natural Gas Boards to properly trained and certified BPI BAI and Maine energy auditor personnel. These limited licenses allow holders to perform combustion safety testing (draft testing, CO testing) and steady-state efficiency testing on systems. Adjustments to systems are NOT allowed with this limited license. Interested individuals holding BPI BA1 certification in the MaineHP Program must apply for these limited licenses from both the Oil and Solid Fuel Board and the Propane and Natural Gas Board.

Living Space Return System – In a mobile home, a forced warm air circulation system where air returns to the air handler through the living space, rather than through ductwork or through the mobile home belly.

Low-Water Cutoff – A float-operated control for turning the burner off if a steam boiler is low on water.

Lumen – A unit of light output from a lamp.

Low-E – Short for "low emissivity", which refers to having a metallic glass coating to resist the flow of radiant heat.

- M -

Main Panel Box – The electric service box containing a main switch, and the fuses or circuit breakers located inside the home.

MaineHP – Maine Home Performance with ENERGY STAR® Program.

Maine Home Performance Program – Maine Home Performance with ENERGY STAR® Program.

Maine Home Performance with ENERGY STAR® Program – A market-based program for existing homes started in Maine in 2006 by the Governors Office of Energy Independence and Security, now operated by Efficiency Maine. The mission of MaineHP is to create a sustainable market throughout the State of Maine for diagnosis and treatment of homes to make them healthy, comfortable and energy efficient.

Make-Up Air – Air supplied to a space to replace exhausted air.

Manifold – A tube with one inlet and multiple outlets, or multiple inlets and one outlet.

Manometer – A differential gauge used for measuring pressure.

Masonry – Stone, brick, or concrete block construction.

Mastic – A thick, creamy substance used to seal seams and cracks in building materials, and especially useful on ductwork.

Mechanical Draft – A combustion appliance with induced draft of forced draft. (Based on NFPA 54).

Mitigate – To reduce, lessen, decrease, make less harmful or problematic.

Mortar – A mixture of sand, water, and cement used to bond bricks, stones, or blocks together.

MSDS – Materials Safety Data Sheet.

- N -

Natural Draft – A venting system that relies on natural draft (gas buoyancy) to move combustion gases to the outdoors.

Natural Ventilation – Ventilation using only natural air movement, without fans or other mechanical devices.

NBS – The National Bureau of Standards, renamed by the Department of Commerce as the National Institute of Standards and Technology (NIST).

NEMA – National Electrical Manufacturers Association

NFPA – National Fire Protection Association.

Net Free Vent Area (NFVA) – The area of a vent, adjusted for the restrictions caused by insect screen, louvers, and weather coverings. The free area is always less than the actual area.

Nozzle – An orifice designed to change a liquid like oil into a mist to improve the combustion process.

- O -

O_2 – Oxygen.

Occupants – People of any age living in a dwelling. Animals are not defined as occupants.

Occupiable Space – An enclosed space inside the pressure boundary of a room or house, and intended for human activities including, but not limited to, all habitable spaces, bathrooms, closets, halls, storage and utility areas, and laundry areas. See habitable space and conditioned space.

Ohm – A unit of measure of electrical resistance. One volt can produce a current of one ampere through a resistance on one ohm.

Orifice – A hole in a nozzle where gas exits to be mixed with air in a burner before combustion in a heating device. The size of the orifice will help determine the flow rate.

Output Capacity – The useful heat or work that a device produces after accounting for the energy wasted in the energy conversion process.

Oxygen Depletion Sensor (ODS) – A safety device for unvented (vent-free) combustion heaters that shuts off gas when oxygen is depleted.

- P -

Parts per Million (ppm) – The unit commonly used to represent the degree of pollutant concentration, where the concentrations are small.

Pascal (Pa) – A metric unit of measurement of air pressure difference equivalent to one Newton per square meter. 2.5Pa = 0.01 inches of water column.

Payback Period – The number of years that an investment in energy conservation will take to repay its cost in energy savings.

Perimeter Pull – A technique used in attics previously insulated with batt insulation. The batts are cut back two feet from the eaves and the area is insulated with blown insulation to ensure coverage over the outer wall top plate, and to prevent wind washing of the insulation under the existing batts.

Perlite – A heat-expanded mineral used for insulation.

Perm – A measurement of how much water vapor a material will let pass through it, per unit of time, under a specified pressure difference. See Vapor Barrier and Vapor Retarder.

Pilot Tube – A device for measuring fluid velocity. An instrument placed in a moving fluid and used along with a manometer to measure fluid velocity.

Plaster – A mixture of sand, lime, and Portland cement spread over wood or metal lathe to form the interior surfaces of walls and ceilings.

Plate – A framing member installed horizontally to which the vertical studs in a wall frame are attached.

Plenum – The section of ductwork that connects the air handler to the main supply duct.

Plywood – Laminated wood sheeting with layers cross-grained to each other.

Polyethylene – A plastic made by the polymerization of ethylene, used in making translucent, lightweight, and tough plastics, films, insulations, vapor retarders, air barriers, etc.

Polyisocyanurate – Plastic foam insulation sold in sheets, similar in composition to polyurethane insulation.

Polystyrene Insulation – rigid plastic foam insulation, usually white, blue, pink, or green in color.

Polyurethane – versatile plastic foam insulation, usually yellow in color.

Potential Energy – Energy in a stored or packaged form.

Power Burner – A burner for which air is supplied at a pressure greater than atmospheric pressure, including most oil-fired burners and gas burners used as replacements for oil burners.

Power Draft – See Mechanical Draft.

Power Vented – A category III or IV combustion appliance that is constructed and installed using a fan or blower to push all the products of combustion directly to the outdoors through independent sealed vents connected directly to the appliance.

Pressure – A force that encourages movement by virtue of a difference in some condition between two areas. High pressure moves to low pressure.

Pressure Diagnostics – The practice of measuring pressures and flows in buildings to control air leakage, and to ensure adequate heating, cooling, and ventilation.

Pressure Pan – A device used to block a duct register while measuring the pressure behind it.

Pressure Relief Valve – A safety component required on a boiler and water heater, designed to relieve excess pressure buildup in the tank.

Pressuretrol – A control that turns a steam boilers burner on and off as steam pressure changes.

Primary Window – The main window installed on the outside wall. Not to be confused with a storm window.

- R -

R-value – A measurement of thermal resistance.

Radiant Barrier – A foil sheet or coating designed to reflect radiant heat flow. Radiant barriers are not mass insulating materials.

Radiant Temperature – The average temperature of objects in a home, including walls, ceiling, floor, furniture, and other objects.

Radiation – Heat energy that is transferred by electromagnetic energy or infrared light, from one object to another. Radiant heat can travel through a vacuum and other transparent materials.

Radon – A radioactive gas that decomposes into radioactive particles.

Rafter – A beam that gives form and support to a roof.

Reflectance – The ratio of lamination or radiant heat reflected from a given surface to the total light falling on it. Also called reflectivity.

Refrigerant – Any of various liquids that vaporize at a low temperature, used in mechanical refrigeration.

Register – A grille covering a duct supply outlet used to diffuse the airflow and sometimes control the flow.

Relative Humidity – The percent of moisture present in the air compared to the maximum amount possible at that given temperature. Air that is saturated has 100 percent relative humidity.

Relay – An automatic, electrically operated switch.

Reset Controller – A device that adjusts fluid temperature or pressure in a central heating system according to outdoor air temperature.

Resistance – The property of a material resisting the flow of electrical energy or heat energy.

Return Air – Air circulating back to the furnace or central air conditioning unit from the house, to be heated or cooled and supplied back to the living area.

Rim Joist – The outermost joist around the perimeter of the floor framing.

Rocking on the High Limit – Refers to the gas burner being shut down by the high limit switch on a furnace, instead of being properly activated by the fan-on/fan-off control.

Room Air Conditioner – An air conditioning unit installed through a wall or window, which cools the room by removing heat and releasing it outdoors.

- S -

Sash – A movable or stationary part of a window that frames a piece of glass.

Savings-to-Investment Ratio (SIR) – For an energy saving measure, the ratio of the savings divided by the investment (cost), including the discounted investment value and escalation of fuel costs. See SIR below.

Scope of Work – See Work Scope.

SIR – Savings-to-Investment Ratio. The equation used for SIR is below. The life of a measure is sometimes discounted with factors published by the Department of Energy every April.

Sealed-Combustion Appliance – An appliance that draws combustion air from outdoors and has a sealed exhaust system. Also called a direct-vent appliance.

Seasonal Energy Efficiency Ratio (SEER) – A measurement of energy efficiency for central air conditioners. The SEER is computed by dividing cooling capacity, measured in Btuh, by the Watts (see also Energy Efficiency Rating).

Sensible Heat – The heat required to change the temperature of a material without changing its form.

Sequencer – A bimetal switch that turns on the elements of an electric furnace in sequence.

Service Wires – The wires coming from the utility transformer to the service equipment of the building.

Sheathing – Structural sheeting, attached on top of the framing, underneath the siding and roofing of a building. Any building material used for covering a building surface.

Shell – The buildings exterior enclosure – the walls, floor, and roof of a building.

Shingle – A roofing component installed in overlapping rows.

Short Circuit – A dangerous malfunction in an electrical circuit, where electricity is flowing through conductors and into the ground without going through an electric load, such as a light or motor.

Sill – The bottom of a window or doorframe.

Sill Box – The area bounded by the rim joist, floor joists, sill plate, and floor.

Sling Psychrometer – A device holding two thermometers, one wet bulb and one dry bulb, which are slung through the air to determine relative humidity.

Slope – The roof section of an attic with the roof and ceiling surfaces attached to the rafters.

Soffit – The underside of a roof overhang or a small lowered ceiling, as above cabinets or a bathtub.

Solar Gain – Heat from the sun that is absorbed by a building.

Solar Heat Gain Coefficient (also SHGC) – The fraction of normal incident solar radiation striking the exterior of a fenestration system that is transmitted as heat to the interior of a building.

Solenoid – A magnetic device that moves a switch or valve stem.

Space Heating – Heating the habitable spaces of the home with a room heater or central heating system.

Spillage – The temporary flow of combustion gases from a dilution device.

Stack Effect – The tendency for warm buoyant air to rise and leak out of the top of the house and be replaced by colder outside air entering from the bottom of the house.

Steady-State Efficiency (SSE) – The efficiency of a heating appliance, after an initial start-up period and while the burner is operating, that

states how much heat crosses the heat exchanger. The steady-state efficiency is measured by a combustion analyzer.

Steam Trap – An automatic valve that closes to trap steam in a radiator until it condenses.

Steam Vent – A bimetal-operated vent that allows air to leave steam pipes and radiators, but closes when exposed to steam.

Stud – A vertical framing member used to build a wall.

Subfloor – The sheathing over the floor joists and under the flooring.

Supply Air – Air that has been heated or cooled and is then moved through the ducts and out the supply registers of a home.

Suspended Ceiling – Modular ceiling panels supported by a hanging frame.

- T -

Therm – A unit of energy equivalent to 100,000 Btus or 29.3 kilowatt-hours.

Thermal Break – A piece of relatively low-conducting material between two high conducting materials, installed to reduce heat flow through the assembly.

Thermal Bridging – Rapid heat conduction resulting from direct contact between thermally conductive materials like metal and glass.

Thermal Boundary – A ceiling/roof, wall, floor, window, or door that separates the habitable, occupiable, and conditioned spaces from the outdoor weather. The thermal boundary should be air sealed and/or insulated if it is cost effective to do so. Exterior doors are always examples of thermal boundaries. An attic floor is most often an example of a thermal boundary.

Thermal Bypass – An indirect penetration that tends to reduce the effectiveness of insulation by allowing air to move out of or into a structure.

Thermal Conductance – A materials ability to transmit heat; the inverse of the R-value (see U-factor).

Thermal Enclosure – See Thermal Boundary.

Thermal Resistance – R-value; a measurement expressing the ability to retard heat flow.

Thermocouple – A bimetal-junction electric generator used to control the safety valve of an automatic gas valve.

Thermostat – A device used to control a heating or cooling system to maintain a set temperature.

Transformer – A double coil of wire that reduces or increases voltage from a primary circuit to a secondary circuit.

Truss – A braced framework usually in the shape of a triangle to form and support a roof.

- U -

U-factor – The total heat transmission in Btus per square feet per hour with a 1°F temperature difference between the inside and the outside; the thermal conductance of a material.

Ultraviolet Radiation – Light radiation having wavelengths beyond the violet end of the visible spectrum; high frequency light waves.

Underlayment – Sheeting installed to provide a smooth, sound base for a finish material.

UL – Underwriters Laboratory

- V -

Vapor Barrier – A material that retards the passage of water vapor. Generally has a perm rating less than one.

Vapor Diffusion – The flow of water vapor through a solid material.

Vapor Retarder – A vapor barrier. Generally has a perm rating between one and ten.

Vaporize – To change from a liquid to a gas.

Vent Damper – An automatic damper powered by heat or electricity that closes the chimney while a heating device is off.

Ventilation – The movement of air through an area to remove moisture, air pollution, or unwanted heat.

Venting – The removal of combustion gases by a chimney.

Vent Connector – The pipe that connects a combustion appliance to a vent or chimney.

Venting System – A continuous passageway from a combustion appliance to the outdoors through which combustion gases can pass.

Vermiculite – A heat-expanded mineral used for insulation. Sometimes contains asbestos fibers.

Volt – A unit of electromotive force. It is the amount of force required to drive a steady current of one ampere through a resistance of one ohm. Electrical systems of most homes in the United States have 120-volt systems.

- W -

Watt (W) – A unit measure of electric power at a point in time, as capacity or demand. One Watt of power maintained over time is equal to one joule per second.

Watt-hour – One Watt of power extended for one hour. One thousandth of a kilowatt-hour.

Weatherization – The process of reducing energy consumption and increasing comfort in buildings by improving the energy efficiency of the building and maintaining health and safety.

Weatherstripping – Flexible gaskets, often mounted in rigid metal strips, for limiting air leakage.

Weep Holes – Drilled holes that allow water to drain out of an area of a building component where it may accumulate.

Wet Bulb Temperature – The temperature of a dampened thermometer of a sling psychrometer used to determine relative humidity.

Window Frame – The sides, top, and sill of the window, which form a box around window sashes and other components.

Work Scope – A set of written recommendations detailing repairs and improvements to the performance of a building; a work scope may include pre- and post-work performance testing and acceptance criteria.

Worst-Case Depressurization – A condition created when 1) all exhaust appliances (bathroom exhaust, kitchen exhaust, vented dryers, etc.) are operating, 2) the interior doors of a house are in a position that causes the greatest negative pressure in the Combustion Appliance Zone, and 3) the furnace air handler is operating (if such operation causes increased negative pressure in the Combustion Appliance Zone).

Worst-Case Draft Test – A test that creates Worst-Case Depressurization in a Combustion Appliance Zone (CAZ). This test is used to determine if combustion appliances will vent properly under these worst-case conditions.

- Z -

Zone Pressure Diagnostics (ZPD) – Measurement of pressures and flows with a blower door through two pressure boundaries (air barriers) to determine relative and absolute leakage through the pressure boundaries. ZPD testing is often done before and after weatherization to determine the effectiveness of air sealing. These testing procedures are also done to help determine the location of air leakage in a building.

ZPD – See Zone Pressure Diagnostics.