



**Mass Save Residential Coordinated Delivery Standard for
Materials, Installation, and Conduct for Energy Efficiency
Measure Installation Contractors**

Initial Publication Date: May 13, 2010

Revision Date: Dec 30th, 2022

Updated: Feb 13, 2023

Version 3.0

This Standard applies to all work performed under the Mass Save Home Energy Services Program for customer contracts entered into **beginning Feb 17th, 2023**. Program Administrators will conduct a Quality Assurance to verify that work meets the requirements in this Standard. Proposed changes or additions to the Standard will be considered on a regular basis by the Program Administrators or their designee.

By Program Administrators:

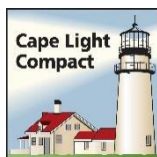


TABLE OF CONTENTS

1.0	Program Description	3
2.0	Contractor Qualifications	3
3.0	Health and Safety	7
4.0	Measure Installation Guidelines	12
5.0	Materials	12
6.0	Installation	14
7.0	Window Replacement	26
8.0	Heating System Replacement	26
9.0	Air Conditioning System Measures	27
10.0	Ventilation System Installation	27
11.0	Lighting Measures	27
12.0	Domestic Hot Water Measures	27
13.0	Quality Assurance	27
14.0	CONTRACTOR PERFORMANCE STANDARD	28
15.0	Program Sponsors	29
16.0	References	30
16.5	Appendices	31

1.0 PROGRAM DESCRIPTION

The primary objective of the Mass Save Program (the Program) is to provide residential customers with energy efficiency recommendations that enable them to identify and initiate the process of installing cost-effective energy efficiency upgrades. The Mass Save Program makes it easy, clear, and compelling for customers to participate in all comprehensive energy efficiency programs by providing information through bold outreach mechanisms, incentives, and multiple financing options.

The Program promotes a house-as-a-system approach and focuses on the home's thermal envelope (shell insulation and air leakage conditions), mechanical systems (HVAC & DHW), and lighting and appliances to identify cost-effective energy efficiency improvement and/or replacement opportunities.

This systematic approach to home improvement that addresses all aspects of building systems requires clear standards to maximize energy savings and assure customer satisfaction. It is important to note that the Mass Save Standard for Materials, Installation, and Conduct (the Standards) is primarily focused on traditional weatherization materials and strategies. The Program Administrators ("PAs") view these Standards as a "living document" that will be updated periodically as the Program continues to evolve.

Lead Vendors ("LVs") are responsible for maintenance and enforcement of these standards as directed by the PAs.

The Program will coordinate with other Massachusetts programs to develop consistent standards across programs as well as to assure consistent customer education and promotion of the house-as-a-system approach.

Future revisions of the Standards may include alternative/new technologies and approaches for new measures (e.g., spray foam in attics).

The PAs are supportive of more coordinated statewide training as a means to ensure correct installation techniques for the Program. It is expected that training requirements will increase over time in order for contractors to retain their status as an authorized program contractor. The goal is to have a sustainable and experienced workforce that is focused on achievable maximum energy savings ready and able to meet customer demand.

2.0 CONTRACTOR QUALIFICATIONS AND RESPONSIBILITIES

The term "Contractor" as used in this document applies to any individual or company performing covered work that is being performed within the Mass Save program. This applies equally to vendors working directly for the PAs and to independent contractors doing work for homeowners.

The purpose of these guidelines and associated information is to codify the requirements of weatherization contractors who participate in the Mass Save Program. They are intended as *minimum* standards for participation in the program.

2.1 LICENSES and CERTIFICATIONS

- a. CONTRACTORS must have all licenses and registrations required for their area of work by the Massachusetts Department of Public Safety. Appropriate documentation must be supplied to TheProgram upon request. Licenses include (but are not limited to): MA Home Improvement Contractor's License, MA Construction Supervisor License, and MA Lead Safe Certificate
- b. CONTRACTORS must also obtain any certifications or other recognitions required by individual PAs or LVs.

2.2 MATERIALS

- a. All materials supplied must meet applicable specifications.
- b. All materials must conform to catalog listing.
- c. Material substitutions are not allowed without a written pre-approval by the LVs.
- d. CONTRACTORS will keep a SDS on the job site for every material used.

2.3 PERFORMANCE OF WORK

- a. All labor to be performed in a workmanlike manner.
- b. All work must be performed in a lead-safe manner according to all State and/or Federal Requirements in force at the time of the work.
- c. All work must be performed in conformance with all applicable OSHA requirements and other governmental standards.
- d. All weatherization work must be performed in conformance with applicable BPI standards or other standards as identified by Mass Save.
- e. All work must be performed in compliance with all applicable state and local codes.
- f. All measures installed must be in conformance with the WorkOrder.
- g. Pre-Approved written Change Orders by the LV and initial or sign-off of completion certificate by the homeowner are required before any modifications to the original Work Order are made.
- h. CONTRACTORS *should attempt* to make acceptable repairs for all accidental damage made to a customer's property at the contractor's expense within 10 business days. Both the customer and the LV must be informed when damage occurs. The LV will make the final decision as to when acceptable repairs have been made.
- i. CONTRACTORS will be responsible for maintaining ASHRAE 62.2 airflow standards when performing shell tightening measures. Any dwelling that falls below the 70% BAS guideline after completing shell tightening measures, will require the contractor at their expense to bring the dwelling back into compliance with either mechanical ventilation or removal of installed air sealing materials.
- j. CONTRACTORS will treat homeowners and their property in a respectful and professional manner.

2.4 JOBSITE CLEAN UP

- a. CONTRACTORS are responsible for removal of all construction debris from the jobsite.
- b. CONTRACTORS are responsible for restoring every jobsite to its pre-work condition at project completion.
- c. CONTRACTORS are strongly urged to use drop cloths to protect homeowners' property/belongings

2.5 DOCUMENTATION

CONTRACTOR Documentation must conform to the requirements detailed in their program participation agreement including, but not limited to:

- a. Before Starting Work - CONTRACTORS must document that a blower door test and combustion safety testing have been performed and it is safe to continue. If tests are not able to be performed (e.g., electric heat, asbestos, etc.) it must be noted in the paperwork.
- b. After Work Completion - CONTRACTORS must submit documentation (signed by customer and contractor) that the approved Scope of Work is complete.
- c. The Completion document must include:
 - An itemized confirmation that the Program Audit recommendations were addressed.
 - An itemized list of each measure, area, R-value, etc., installed.
 - Upon project completion, documentation that post-blower door testing and post-combustion safety testing had been performed. Must be done on the day of completion.
 - Proof of approved Change Orders by CUSTOMER and LV.

2.6 COMMUNICATIONS

2.6.1 CONTRACTOR communications with CUSTOMER

- a. CONTRACTORS will be courteous to CUSTOMERS at all times.
- b. CUSTOMERS and LV must be notified as soon as possible if an appointment must be rescheduled, according to the terms of the Contractor Participation Agreement.
- c. CONTRACTORS will clearly explain all work procedures and items to be installed to the CUSTOMERS home before and during the work process.
- d. CONTRACTORS will answer all CUSTOMER questions in an honest and straightforward manner. If the CONTRACTOR does not know the answer to a question they will refer the CUSTOMER to LV for an answer.
- e. CONTRACTORS will inform CUSTOMERS of any fragile items in the work area and request that the CUSTOMER move those items to a safe location prior to start of work.
- f. CONTRACTORS will ask CUSTOMERS for permission to use a household restroom.
- g. CONTRACTORS will keep CUSTOMERS informed regarding estimated daily arrival, break, and departure times.
- h. CONTRACTORS will document any problems and unusual situations as they occur and notify their LV.

2.6.2 CONTRACTOR communications with Mass Save

- a. CONTRACTORS will respond promptly and accurately to communications from Mass Save and LVs.
- b. CONTRACTORS will document problems and unusual situations and promptly report those to LVs.
- c. CONTRACTORS will respond promptly to address problems as they occur.
- d. CONTRACTORS will notify LV of any changes to staffing that affect authorization to work in the program (certifications, background checks etc.)

2.7 CONTRACTOR ACTIONS REQUIRING Mass Save RESPONSE

2.7.1 Theft

Theft may result in immediate cancellation or suspension as a Mass Save Approved CONTRACTOR and full legal remedies including but not limited to prosecution. Theft

includes but is not limited to: Charging for materials not installed or labor not incurred.

- a. Inflating the actual cost for services provided.
- b. Misrepresenting work performed, completed or data provided to the LV or PA. Committing fraud.
- c. Unauthorized removal of CUSTOMER personal property.

2.7.2 Other Unacceptable Actions

The following CONTRACTOR actions, as examples but not limited to, may result in immediate cancellation or suspension as a Mass Save Approved CONTRACTOR.

Additional training may be required before reinstatement as a Mass Save Approved CONTRACTOR.

- a. Charging clients for services while job is open (one year period).
- b. Soliciting or performing work on a customer's home outside the scope or context of rebateable weatherization work, for customers assigned to the CONTRACTOR through the program. (Note: If the CONTRACTOR brings the customer to the program as an IIC referral or through HPC customer acquisition then this clause would not apply but additional services would be required to be on a separate non- program contract with the customer.)
- c. Providing false information to Mass Save, LV, or the CUSTOMER concerning work requirements.
- d. Failure to correct job deficiencies.
- e. Use of inferior materials.
- f. Repeatedly missing timelines.
- g. Repeatedly performing work of poor quality.
- h. Leaving the customer's property in a potentially dangerous condition.

2.8 BUILDING PERMITS

CONTRACTORS are required to obtain and to pay for all applicable permits, certificates of inspection, and license fees related to work performed through the Mass Save program.

2.9 CONTRACTOR'S INSURANCE All Mass Save CONTRACTORS shall:

- a. Provide insurance at the coverage amounts listed in the program participation agreements with respect to the work they perform within the Program;
- b. Maintain this insurance at their own expense and in full force and effect for the full term of the contract;
- c. List each Mass Save Program sponsor as "additionally insured" on insurance certificates.

All policies shall be issued by companies authorized to write that type of insurance under the laws of the Commonwealth of Massachusetts.

CONTRACTORS shall provide minimum coverage with respect to the operations performed by any employee, subcontractor or supplier, as detailed in program participation agreements.

2.10 BACKGROUND CHECKS

CONTRACTORS must comply with all background check policies required by the individual PA for which the CONTRACTOR is approved to do work. Contractors must check with each LV on specific requirements

3.0 HEALTH AND SAFETY

3.1 OVERVIEW

The health and safety of CUSTOMERS, PROGRAM staff and CONTRACTORS is of primary concern to the Mass Save Program. It is important that all personnel maintain a high level of awareness concerning the potential hazards associated with the weatherization process. The requirements set forth in this standard provide only general guidelines for health and safety concerns.

CONTRACTORS must familiarize themselves with all the health and safety issues associated with weatherization. More specific information concerning indoor air quality problems can be obtained through the U.S. Environmental Protection Agency (EPA) and the U.S. Consumer Product Safety Commission.

Detailed specifications regarding the health and safety of workers in the construction industry can be found in Construction Industry OSHA Safety and Health Standards (29 CFR 1926/1910) that is available from the U. S. Department of Labor.

The above standards are applicable to all CONTRACTORS, their employees, associated workers, and all SUB-CONTRACTORS providing services using funding under the Mass Save program.

Each home weatherized under the Mass Save program must be individually assessed to determine the existence of potential hazards to CONTRACTORS or CUSTOMERS.

CONTRACTORS, their employees, associated workers, and all SUB-CONTRACTORS are required to take all reasonable precautions against performing work on homes that will subject occupants to health and safety risks. If unsafe conditions exist that would endanger the health or safety of the CUSTOMERS or weatherization CONTRACTOR, and those conditions cannot be corrected, no Mass Save work may be started on that home.

A Mass Save energy assessment must be completed prior to CONTRACTOR'S work. It is the CONTRACTOR'S responsibility to complete Combustion Safety Testing in accordance with the Building Performance Institute (BPI) Technical Standards for the Building Analyst Professional both prior to the work commencing and after the work is completed (test in and test out).

CONTRACTORS shall maintain a copy of their Health and Safety Policy and train all employees accordingly. They shall supply Material Safety Data Sheets (MSDS) for products and materials used by their crews and have these documents available on all jobsites.

Adherence to worker health and safety and applicable OSHA standards are required for all jobs performed by CONTRACTORS their employees, associated workers, and all SUB-CONTRACTORS.

CONTRACTORS shall comply with all state and federal lead safe work policies and practices.

CONTRACTORS shall fully document and communicate to the LV all health/safety related problems and concerns that might inhibit the installation of specified measures to program standards or could result in injury or property damage.

3.2 CONFIRM COMBUSTION APPLIANCE OPERATION

A. CONTRACTORS must confirm through documentation that a Carbon Monoxide test and complete combustion appliance inspection was performed before beginning work, and that a working CO alarm is in place. CONTRACTORS will be responsible for conducting this “test in” in accordance with the BPI Technical Standards for the Building Analyst Professional and providing the documentation.

B. Before leaving the site, the CONTRACTOR shall perform combustion safety tests in accordance with the BPI Technical Standards for the Building Analyst Professional and provide appropriate documentation.

C. Individuals performing these tests shall either hold the appropriate BPI certification, as determined by the Program Administrator, shall be an employee of a BPI Accredited company, or shall have other credentials approved by Mass Save such as a combustion safety module supplementing Boot Camp Authorization.

D. Results of these tests must be reported by CONTRACTOR in the completion documentation.

E. If systems fail the combustion safety tests in the BPI Technical Standards for the Building Analyst Professional, CONTRACTOR must immediately notify occupants and the Program.

Exceptions:

Tests are not required:

- 1) On direct vent or power vented appliances. CO testing should still be done whenever the exhaust port is accessible.
- 2) Where equipment is located in an isolated mechanical room, vented attic, or vented crawlspace with all combustion air from outside. Note that all equipment in open basements must be tested.
- 3) When residents in a multi-unit dwelling are not being served by the Program, equipment belonging to those units does not need to be tested. However, visual inspection of that equipment should be made to identify potential health and safety concerns. If any potential concerns are noted, or if the results for the equipment that is tested may be adversely affected by including the other equipment, disclosures must be made to the customer and the building owner.

3.3 MOLD LIKE SUBSTANCE IDENTIFICATION

A. Complete a walkthrough of the home to identify any mold like substances before the installation of any weatherization measures

B. When a Mold Like Substance has been identified,

- Document the location and sq. ft. of the area affected.

- Determine if this will present a roadblock for weatherization measures.
- Notify the customer of its presence and location.

C. The homeowner will be educated on the following,

- The moisture sources and air pathways that are contributing to the Mold Like Substance, in the location it was identified.
- The customer will be provided with EPA information about how to better control the moisture sources and prevent mold in their home.
- The EPA has two websites where information can be found.

www.epa.gov/mold/what-are-main-ways-control-moisture-your-home.

www.epa.gov/mold/brief-guide-mold-moisture-and-your-home

D. Mold Like Substances that are identified as **100 sq. ft. or greater** will present a roadblock for the installation of weatherization measures and require the homeowner to have it evaluated and possibly remediated if it is determined to be mold, before any weatherization work can begin.

3.4 ASBESTOS

Health/Safety Concerns: The US Environmental Protection Agency's description is: "The most dangerous asbestos fibers are too small to be visible. After they are inhaled, they can remain and accumulate in the lungs. Asbestos can cause lung cancer, mesothelioma (a cancer of the chest and abdominal linings), and asbestosis (irreversible lung scarring that can be fatal).

Symptoms of these diseases do not show up until many years after exposure began. Most people with asbestos-related diseases were exposed to elevated concentrations on the job; some developed disease from exposure to clothing and equipment brought home from job sites."

Sources in Homes: Until its use was strictly limited in the 1970s asbestos was used in a large number of building products. The most common applications that could involve interaction with weatherization personnel include:

- Boiler insulation
- Furnace insulation
- Steam boiler insulation
- Pipe insulation
- Duct insulation
- Asbestos cement sidewall shingles
- Vermiculite insulation
- Floor tiles (9x9)
- Acoustical

To minimize exposure

- Learn to recognize suspected asbestos containing materials. (Joints look like a plaster cast.)
- Avoid disturbance of possible asbestos containing material that is friable. Friable asbestos is "any material containing greater than one percent asbestos by weight or volume that hand pressure can crumble, pulverize or reduce to powder when dry, or any asbestos containing materials that can reasonably be expected, as a result of the demolition or renovation to be undertaken, to become pulverized through breaking, chipping, crumbling, crushing, or other means of rendering fibers available to the ambient air."

- DO NOT CONDUCT A BLOWER DOOR TEST ON A BUILDING WHERE **FRIABLE** MATERIALS SUSPECTED OF CONTAINING ASBESTOS IS PRESENT. In the case of Steam boilers with radiators, asbestos may still be in wall cavities.
- When Asbestos Cement sidewall shingles are removed and reinstalled as part of a wall insulation procedure, the CONTRACTOR must complete the work in compliance with the requirements of the Massachusetts Department of Environmental Protection.

This information is a general program guidance for Weatherization personnel and does not provide the detailed specifications for the proper handling of possible asbestos containing material. State law concerning asbestos abatement can be found in Commonwealth of Massachusetts Department of Public Health Asbestos Abatement Regulation; CMR 410.353 and 453 CMR 6.00, THE REMOVAL, CONTAINMENT OR ENCAPSULATION OF ASBESTOS

(<http://www.alewife.org/asbestos/453cmr6.txt>)

3.5 LEAD

Health/Safety Concerns: Ingestion or absorption of lead into the blood stream is a serious health hazard causing brain damage over a period of time. This can be a particularly serious problem with small children, who may ingest paint chips or flakes, or dust contaminated with lead products. Serious learning disabilities can result from excessive lead levels in the bloodstream. Workers can be contaminated in the same way as children but are most likely to be exposed by breathing dust contaminated by sanding or planing surfaces that contain lead-based paints.

Sources in Homes: Lead paint is the primary source of lead in a home that was built prior to 1978, when lead became prohibited as an ingredient in paints. Contamination occurs when lead paint is disturbed by drilling, sanding, chipping, or flaking. Lead is also present in the solder used in plumbing pipe joints. Lead can leach into potable water, particularly when water is stagnant in the pipes for a length of time. To a lesser degree, lead contamination can result from inks used in newspapers and magazines.

To minimize risks to CUSTOMERS and Weatherization personnel:

DO NOT DISTURB LEAD PAINT UNLESS ABSOLUTELY NECESSARY AND THEN ONLY BY INDIVIDUALS CERTIFIED TO COMPLETE WORK USING LEAD-SAFE PROTOCOLS.

CONTRACTORS should assume that any paint on windows and doors in homes built before 1978 contains lead unless it has been verified otherwise. **WHEN THERE IS A POSSIBILITY OF DISTURBING LEAD DURING THE WEATHERIZATION PROCESS, CONTRACTORS MUST COMPLETE THE WORK IN A LEAD-SAFE MANNER IN ACCORDANCE WITH EPA AND MASSACHUSETTS DIVISION OF OCCUPATIONAL SAFETY REGULATIONS.**

Worker Protection: Detailed specifications regarding the health and safety of workers in the construction industry can be found in Construction Industry OSHA Safety and Health Standards (29CFR 1926/1910) and the specific worker safety requirements in the EPA's "Lead; Renovation, Repair, and Painting Program" (LRRPP) Final Rule. **Also refer to Section 5.13 Lead- Safe Weatherization within the Northeast Weatherization Field Guide.**

ALL CONTRACTORS WORKING IN THE MASS SAVE PROGRAM MUST RECEIVE LEAD-SAFE WEATHERIZATION TRAINING, BECOME CERTIFIED PER USEPA REGULATIONS, AND FOLLOW ALL RELEVANT TECHNICAL AND ADMINISTRATIVE PROCEDURES

pursuant to 40CFR Part 745.225.

LEAD SAFE WEATHERIZATION INFORMATION

EPA and Massachusetts Division of Occupational Safety are the guiding authorities for Mass Save work.

When Should Lead-Safe Practices be followed?

According to the U.S. EPA, Lead-Safe practices shall be followed when all three components of the following set of criteria are met:

1. The dwelling was constructed before 1978
2. The dwelling has not been determined to be lead-based paint free, and
3. Either the amount of disturbed lead-based painted surface exceeds six square feet per room of interior surface or twenty square feet of exterior surface.

Renovation Notice About Lead Safety

Federal law requires that owners and occupants of a house or apartment built before 1978 receive the EPA pamphlet, "Renovate Right Important Lead Hazard Information for Families, Child Care Providers and Schools", prior to the start of the renovation work. A written notification of receipt from an adult resident of the home must be received. If this receipt cannot be obtained, this requirement can be satisfied by sending the occupant the pamphlet by certified mail with the receipt included in the client file.

Post Weatherization Cleanup

Clearance testing is not a requirement for weatherization work and is not an allowable expenditure of DOE funds. Cleanup at the completion of Lead-Safe Weatherization work requires the use of a HEPA vacuum, (a HEPA filter in a standard vacuum is NOT an acceptable alternative) wet cleaning methods, a visual inspection and the collection and disposition of any dust, debris or chips with the rest of the jobsite waste.

Certification

All Weatherization Crew Leads must complete a MA 454 CMR 22 approved Lead Safety training certification prior to participating in the Mass Save program. Per USEPA requirements, a certified individual must be on site to ensure proper work.

Pollution Occurrence Insurance Coverage

The following is DOE's most recent guidance concerning Lead-Safe Weatherization. While many of the mandatory regulatory requirements do not begin until April 1, 2010, DOE considers this guidance a "Best Practice" for Lead-Safe Weatherization work and the techniques outlined must be used as a guideline for working safely in homes that may contain lead.

WIRING

Safety Concerns:

- Electric shock while working around wiring in all areas of homes.
- Fire resulting from arcing between loose wiring connections.
- Fire resulting from lack of dissipation of heat due to insulation around heat producing sources (i.e. recessed light fixtures).

- Integrity and safety of knob and tube wiring.

To Minimize Risk:

- Workers must demonstrate caution when working around wiring.
- Verify proper wiring connections and proper fusing.
- Verify proper blocking out of insulation around heat producing sources.

4.0 INSTALLATION Roadblocks

Through the Mass Save program, thermal shell improvements may be installed only after a comprehensive whole house assessment is conducted by a program-approved entity and an approved Scope of Work has been developed.

While a home may benefit from thermal shell improvements in theory, there may be existing conditions that would preclude safe implementation of the possible energy saving improvements.

Examples of such conditions include, but are not limited to

- Existing moisture problems
- Mold or the appearance of mold like substance
- Structural concerns
- Knob-and-tube wiring (sign-off by a licensed electrician will be needed to proceed to ensure knob-and-tube wiring is not active)
- Existing conditions of specific building components
- Combustion safety issues
- Asbestos
- Inaccessibility
- Infestation

Correcting these conditions is outside the scope of the Mass Save program.

Conditions precluding implementation of thermal shell improvements must be documented and explained to the individual customer. If the customer corrects the noted concerns at their own expense, then the recommended thermal improvements may be able to be implemented. Such corrections must be made prior to program work and must be documented in writing to the satisfaction of the program.

Not every condition will be found before work. If any of the above is discovered during the course of approved work, the CONTRACTOR must contact the LV for instructions to:

1. Disclose and leave specific areas unaltered
2. Disclose and suspend work until alterations are made by others
3. Disclose conditions to homeowner and proceed with work
4. Disclose and alter the work scope to account for conditions

5.0 MATERIALS

All materials shall be installed according to manufacturers' instructions, the standards in this section [and follow Massachusetts Building Code \(780 CMR\), and all other appropriate codes.](#)

5.1 IMPERMEABLE AIR BARRIER MATERIALS

Materials must be durable, and restrict airflow through the material to no greater than 0.004

CFM₇₅ per square foot as tested in accordance with ASTM E283 or E2178. Such materials include:

- Plywood,
- OSB
- ½" gypsum board
- Rigid foam boards meeting ASTM C578 and ICC ES AC12
- Rigid fiberglass board with flame spread 25 FSK facing
- Sheet metal flashing and aluminum coil stock
- Foil faced bubble wrap
- Peel-and-stick flashing membranes
- Other air barrier materials as approved by LVs
- Spray applied foams that meet ICC ES AC 377 including:
 - 2-part open cell polyurethane foam (0.5pcf),
 - 2-part medium density closed cell spray polyurethane foam (2.0pcf)

5.2. SEALANTS

All caulking materials must be rated for a minimum 20-year life. Acceptable sealants used to join materials and block airflow include:

- Foam sealants that meet ICC ES 377 and ASTM C1642-07 such as:
 - 1-part urethane foam, low CFC (e.g. Great stuff, Pur-fil, Insta-foam, or equivalent)
 - 1-part urethane fire-block foam rated for sealing gaps in wood fireblocking
 - 2-part urethane foam kits 1.75pcf density, 2-part Flame Spread 25 foam kits 1.75pcf
- Siliconized latex sealants meeting ASTM C834,
- Silicone, 1-part gun grade urethane and other elastomeric sealants meeting ASTM C 920, ("Silicone" refers to 100% silicone caulk, clear or pigmented—not acrylic)
- Water based duct sealant meeting UL 181A-M, UL 181B-M ("RCD #6" or equivalent)
- Sealants rated for contact with chimneys and combustion vents such as:
 - Non-combustible fire barrier caulk or furnace cement meeting ASTM E 136
 - Silicone high temp RTV listed for use on gas vents to 500 degrees F, meeting ASTM C920

5.3 WEATHERSTRIPPING

1. All weatherstripping will be permanently installed with fasteners (tacks, staples, brads, etc.) and will make positive contact between surfaces to prevent air leakage.
2. The weatherstripping will form an airtight seal when the window is closed and latched. A small bead of caulk may be applied as necessary to prevent air leakage behind the weatherstripping
3. The weatherstripping will not interfere with the smooth operation of the door or window.
4. Attic hatch or scuttle openings
 - a. Weatherstripping will be permanently affixed to hatch or framing. Generally, "Q-lon with carrier" or equivalent is preferred.
 - b. A positive closing mechanism will be installed on the hatch if needed.
 - c. Existing access to the attic will be maintained.
 - d. In the case of drop-down folding stairs, an air tight, insulated cap will be built over the opening.
 - e. Kneewall access doors will be treated like attic hatch doors whenever possible.

5.4 ACCESSORIES AND MATERIALS RELATED TO ATTIC PREP

- Glass or mineral fiber insulation as a backer for other sealants, meeting ASTM 665,

- Backer rod (preformed closed cell foam rope) as a backer for other sealants,
- 6 mil (0.150 mm) polyethylene sheet (used for ground cover or winter-warm side application only)
- Moisture permeable air impermeable wrap material, flame spread 25 (cold side cover),
- Foil scrim kraft (FSK) facing ignition barrier per IRC 2021 R316.5.3
- Netting to hold blown insulation in open cavity,
- FSK or vinyl faced duct wrap insulation R-8 nominal 3" meeting ASTM C1290, and C1136 (facing)
- Soffit ventilation air chutes for 16 or 24 inch rafter spacing. Ventilation air chutes must extend above existing insulation, [by 1 inch or greater](#).
- Insulated flex duct 4 and 6 inch diameter for exhaust fans

5.5 INSULATION MATERIALS

- Cellulose (blown-in) loose fill insulation meeting ASTM C739, 16 CFR 1209, 1404,
- Specific Cellulose ICC ES reports required for fire rated details (e.g. ESR-1996 US Greenfiber, ESR-2217 NuWool),
- Mineral fiber batt and blanket insulation meeting ASTM 665,
- Mineral fiber (blown-in) loose fill insulation meeting ASTM C764,
- Fiberglass wool engineered for resisting airflow to less than 3.5cfm/sq ft @50pa, and tested to ASTM C522 (e.g. JM Spider, Knauf Perimeter Plus)
- Rigid foam boards meeting ASTM C578, ICC ESAC12,
- Specific foam board ICC ES reports required for uncovered use (e.g. NER-681 Thermax,

Rigid Fiberglass faced insulation boards meeting ASTM C553, C612, and C 1136 for facing

6.0 INSTALLATION

6.1 AIRSEALING

Installation of air sealing materials shall follow the manufacturers' instructions, Massachusetts Building Code (780 CMR), and all other appropriate codes.

Prior to installation, test results shall be provided to LV in ICC ES reports or UL listed detail where specific testing is required by code for a specific use. (For example, low density foam left exposed in an unoccupied attic space, cellulose fiber installed as an air retarder and fire-stop in a rated wall between units.) Approval by the local code authority having jurisdiction must be obtained in writing prior to installation for uses beyond the specific listing.

6.1.1 Performance Criteria

CONTRACTORS will clearly define where the pressure and thermal boundaries of the home are to be, and insure that access hatches, framing voids and chimney, plumbing and wiring chases between the conditioned space and unconditioned attics, knee walls and other buffer zones are tightly sealed.

Air sealing measures at all openings between intact building materials shall be continuous, durable, able to support all expected loads and impermeable to airflow as indicated by smoke device at a pressure difference of 50 Pascals.

6.1.2 Conditions for Materials Use

- a. Air impermeable barrier materials and sealants shall be used within their listing and installed in conformance with all applicable codes and manufacturer's recommendations.

- b. Sealant materials applied to exposed joints in interior or exterior finish shall meet all performance requirements, blend in with adjacent materials, and be acceptable to the owner.
- c. Backing shall be provided for any sealant installed in gaps wider than 3/8" whether exposed or covered and all joints shall be tooled.
- d. Rigid barriers shall be cut to friction fit openings with gaps not more than 1" for foam sealant and extra material on edges for fasteners.
 - I. Support shall be provided to prevent sagging.
 - II. Larger enclosures of rigid foam or fiberglass board barrier material for pipes, whole house fans, or fold down stairs shall be fastened and sealed at all edges with weatherstrip provided at operable joints and edges sealed to the substrate where fixed.
- e. Only non-combustible rigid barriers such as sheet metal or cement board shall be used to bridge the clearance space to heat sources such as chimneys and metal combustion vents. Rock wool may NOT be used.
- f. Only non-combustible sealants such as furnace cement or E 136 rated caulk shall contact solid fuel chimneys or oil vents; for gas vents high temp (500 F, 600F) silicone RTV approved for gas vents may be used to seal the gap between the rigid barrier and heat source.
- g. In addition to the airtight non-combustible barrier and seal at the opening, a clearance dam is required to maintain 3" or greater clearance around the chimney or vent for the full height of the insulation. Unfaced mineral fiber meets this criteria. A folded metal collar 2-4" taller than the final height of the insulation, folded into the vent to close the top space and fastened at the bottom and vertical seam is also an acceptable practice.
- h. A minimum 6" clearance to single walled metal flue pipes shall be maintained to comply with BPI standards and code requirements. This includes kitchen exhaust ducts.
- i. 1 part sealant foam is listed for sealing gaps and annular spaces around penetrations of up to 1-5/16" in width and 1.5" full depth of wood plate for firestop. *Firestop foam is combustible and not allowed for use in contact with heat sources.*
- j. 2-part sealant foam requires backing for openings from 2" to 4" wide and infill of rigid barrier material for openings wider than 4"
- k. Insulation must be kept 3" or more away from the sides of a non-IC rated recessed light fixture (including any wiring box or ballast) and no insulation is allowed above the fixture. Unless contractor provides the LV signed documentation by a licensed electrician, all recessed fixtures shall be treated as non-IC rated. (LVs that allow different treatment for IC rated fixtures will provide additional requirements for treatment and documentation.) **Exception: LED type recessed lighting, can have insulation in contact with the light provided that the current LED bulb can never be replaced with an incandescent light bulb and the manufacture has a UL rated for such contact.**
 - i. If an airtight box is installed to limit air leakage, it shall be sized for 3" clearance from the all points of the fixture, >1" taller than the adjacent insulation and made with Building Code-approved materials with a non-insulating moisture permeable top of gypsum board or equivalent material.
 - ii. The airtight box must be air sealed to the ceiling maintaining clearances
 - iii. If access does not allow installation of the box, 3" clearance from insulation is still required with no insulation allowed above.
 - iv. The gap between the fixture and ceiling may be sealed with fire rated caulking.
 - v. For air tightness and insulation continuity, replacement with an airtight IC rated fixture or infill of the opening and replacement with a flush mount fixture are

preferred recommendations.

I. Dimensional limits:

- i. Siliconized acrylic shall not be used in openings or cracks over 3/16" without a backer, and generally should not be used in openings or cracks more than 3/8".
- ii. Pure silicone shall not be used in openings or cracks over 3/8" without a backer, and generally should not be used in openings or cracks more than 1/2".
- iii. Foam shall not be used to span gaps or openings more than 1 1/2" without a backer material.
- m. Flexible air barrier or other sheeting materials approved for air sealing use shall not span gaps larger than 24" without the use of framing for support.
- n. Foam sealant will not be used where exposed to sunlight or other ultraviolet sources. It will not be used near any heat producing device unless a clearance of 3" can be maintained for double walled flue pipes and masonry chimneys, and 6" for single walled flue pipes.

6.1.3 Typical Air Sealing Locations

In every specified work area: locate, uncover and seal all building air leakage pathways between conditioned and unconditioned areas, as defined by each LV.

These areas can include accessible attics, side attics, crawlspaces, attached garages, unconditioned basement ceilings, and leakage from semi-conditioned basements to outside; gaps, penetrations and fixture openings that allow interior air into inaccessible roofs, slants and outside wall cavities; and major direct openings between conditioned space and outside.

Basements are typically semi-conditioned spaces. Air sealing between the basement and the living space is not warranted when the basement has not been determined to be outside the conditioned space.

6.1.4 Common air leakage details include but are not limited to:

- Dropped soffits, dropped ceilings and ceiling height changes
- Plumbing wet walls, duct chases, duct seams, joints and boot leaks
- Chimney and combustion vent chases
- Openings behind and under tubs, showers, and tub/shower enclosures
- Wall tops open into attic, gaps between gypsum ceiling and wall plates
- Annular space at wiring, pipe penetrations through plates, and at ceiling fixtures
- Floors open under kneewalls, walls open at level changes and gable ends
- 2nd story floors open to attached roofs over porches and additions or garages
- Inside framing open into attic stairs and landings,
- Pocket door framing open into floor above and exterior walls
- Seams and openings in walls and ceilings between attached garages and house
- Non-IC recessed light fixtures
- Bath and kitchen fans venting into the attic
- All joints, seams, and penetrations in surfaces without an air retarding membrane
- All openings allowing air between conditioned space and attic are sealed
- Gaps in tongue in groove paneling where angles change at hips, valleys, and where walls meet slants and ceilings.
- Acoustical tile and suspended ceilings with no gypsum
- Missing gypsum behind decorative ceiling light trays; built in cabinets in kneewalls
- Missing gypsum or open joints above decorative ceiling beams
- Gaps below baseboard and behind carpet nailing strip at subfloor joint to

exterior wall

- Common wall openings between dwelling units
- Attic access openings, operable doors and hatches without tight weatherstrip
- Pull down attic access stair covers
- Interior Ceiling mounted Whole House Fan
- Rim joist junctions and gaps between sill and foundation.
- Utility penetrations and direct openings through foundation walls
- Openings in gypsum board above suspended ceiling and behind cabinets
- Openings between window and door assemblies and their respective jambs and framing

6.1.5 Effective Attic Air Sealing Requirement

When air sealing an attic, all accessible air leakage pathways shall be air sealed. Air leakage pathways under floored areas may be effectively air sealed by densepacking the joist bays. If floored areas cannot be densepacked, the flooring shall be removed to air seal, at a minimum, all major bypasses such as chimney chases, plumbing chases, wet walls, dropped soffits, etc. Effective air sealing requires at a minimum 60% of the attic area to be air sealed along with all major bypasses.

6.1.6 Confirmation of Air Sealing Effectiveness

Confirmation that air sealing is continuous across all openings in a specified area shall be performed by visual inspection of air leakage locations, and one of the following methods:

- Visual inspection aided by a smoke device test during blower door operation,
- Whole building air leakage test.
 - Whole building air leakage test results as specified by LV. The air leakage test shall be made following equipment manufacturer's instructions and in conformance to Standard CAN/CGSB 149.10-1986, ASTM E-1827- 07, or ASTM E-779-03, or
- Infrared inspection of the area aided by blower door operation.
 - When performed on a specified area or whole house, infrared inspection shall be done when there is at least an 18° inside to outside temperature difference in accordance with ASTM C1060 (1997) and air leakage pathways determined using ASTM E1186 (2009).

6.2 DUCT SEALING/ DUCT INSULATION

Duct sealing and insulation improvements are currently approved measures through the Mass Save program. **See Appendix 16.5.**

6.2.6 General

Duct sealing has many benefits including the potential for improved comfort, indoor air quality and better humidity control. Unlike a house or building, there is no lower boundary of air tightness for a duct system. When sealing ducts, it makes the most sense to seal leaks close to the air handler where the pressure is greatest first and then work to the extremities of the system. Any un-insulated section of the duct system located in unconditioned space should be insulated to current code requirements. Ducts should be sealed before being insulated. Existing duct insulation may be carefully pulled back using the procedure described in section 6.2.6 #6 to expose connections and joints that may then be sealed with duct mastic.

6.2.2 Duct Sealing Materials Requirements

The following materials are approved for duct sealing:

1. Water based (latex) mastic conforming to UL-181A-M
2. Tapes listed and labeled in accordance with UL-181A-P for pressure sensitive or UL-181A-H for heat sensitive tape UL-181B-M.(Example: BUTYL mastictape)

3. Aluminum Foil Tape (only for use with metal duct work to plenum connections)
4. 2" roll mesh tape (for openings in the duct system greater than 1/4")

6.2.3 Duct Sealing Installation Requirements

1. All joints, seams and connections should be sealed with duct mastic or approved duct sealing tape when no duct insulation is present or will be removed and replaced as part of the work scope.
2. Any seam or hole in the duct system greater than 1/4" will be sealed with approved duct sealing tape or backed with mesh tape and sealed with duct mastic.
3. Flex duct connections should be made with hard duct connectors, held in place with a vinyl tension strap. The connection between the inner liner and the hard duct it is connected to should be sealed with duct mastic.
4. Filter Slot door should have an operable door that closes securely and is reasonably tight. If present filter slot does not have a door or one that will close properly then Aluminum tape should be used as a temporary blocker and the customer should be notified to install a more permanent solution.
5. Boot to floor, wall or ceiling connections for supplies and returns should be treated as part of air sealing work scope.
6. Systems with existing insulation should have the insulation peeled back to expose connections and joints only. Joints and or connections occur wherever two pieces of duct were connected by installers. Joints and or connections in straight duct can be located by compressing the duct insulation until joints are felt. Once they are located the insulation should be cut neatly and peeled back far enough to expose the joint for mastic application. Once the ducts have been sealed, the duct insulation should be replaced back in its original location with no voids in insulation coverage. All insulation that was cut should be put back in place using approved tape to seal area that was opened to expose the connections or joints. If insulation was removed completely to better access joints and connections, then additional materials such as cable (zip) ties or staples should be used to additionally support insulation to prevent insulation from becoming disengaged from ducts.

6.2.4 Duct Insulation Materials Requirements

1. Duct wrap with an R-value of 8 will be used to insulate ducts located in unconditioned spaces.
2. Tape made specifically for use on duct insulation (e.g. FSK Facing Tape, Aluminum Foil/Fiberglass Scrim or Polyethylene Coated Kraft Paper).
4. Plier stapler and staples
5. 10-14" cable (zip) ties

6.2.5 Duct Insulation Installation Requirements

1. Duct insulation will be installed by wrapping insulation around ductwork and attaching neatly using a plier stapler. Two inches should be added to the width of the duct wrap to provide the excess wrap needed to create a neat tight seam that can be stapled without compressing the insulation. Do not pull the insulation too tight as this will compress it and decrease its R-value. Seams should be stapled every two inches. No fiberglass will be left exposed. All seams and tears in the vinyl vapor retarder will be sealed using program approved tape (FSK Facing Tape, Material Aluminum Foil/Fiberglass Scrim or Polyethylene Coated Kraft Paper).
2. Flex duct insulation connections should be made with hard duct connectors, held in place with a vinyl tension strap.
3. No part of the duct system will be left un-insulated, including supply and return boots.

4. Floor joist bays used as return ducts will have duct insulation wrapped around 3 sides and secured near the top of each joist or to the subfloor on each side. Duct insulation must be in substantial contact with all sides of duct area.

6.3 ATTIC INSULATION

Cellulose Insulation

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 a mix of ammonium sulfate and boric acid or boric acid only (termed "borate only"). Mass Save currently accepts both grades.

Installation must meet or exceed the Massachusetts State and Local Building Codes.

Criteria for the installation of insulation include but are not limited to the additional standards set forth below.

6.3.1 Attic Air Sealing Confirmation

Before insulating the attic, the CONTRACTOR will confirm that attic air sealing is complete per section 6.1 above. If these areas are not properly sealed, CONTRACTOR must notify program to determine next steps before proceeding.

Recessed light fixtures shall be protected from contact with insulation as noted in section 6.1. 2.. Reference section 6.1.2

6.3.2 Attic Preparation

Confirm attic prep per ASTM C1015-06 including:

- a. Clearance dams that maintain 3" space confirmed installed at all masonry or double walled metal combustion venting systems. Clearance dams must maintain 6" space confirmed installed at all single wall pipe combustion venting systems.
- b. Clearance dams installed at attic access, bath fans, air handlers and between blown and storage areas.
- c. Permanent damming shall be installed around all attic hatch covers in a manner that will not interfere with the opening of the hatch cover, and that when opened will prevent insulation from falling into the living area, and that will allow safe access into the attic.
 - i. The dam shall be made of ½" thick or greater wood and be tightly sealed at the base and seams, or fiberglass batt laid flat on all four sides around the hatch, or other materials approved by PA designee.
 - ii. Insulation surrounding the dam must equal the R-value of the rest of the attic space.
- d. Install vent chutes at all soffit vents and provide wind baffles with blocker under chutes that extend out past the exterior wall top plate to allow insulation to provide proper coverage.
- e. Ensure that all exhaust equipment ducting is terminated to the outside of the structure.
- f. Provide insulation thickness markers 1/300 sq ft for open blow area.

6.3.3 Attic Access Doors

- a. Insulate and tightly weather-strip all attic access doors.
- b. Fasten rigid insulation to access hatches. If infeasible, fiberglass batts may be used.
- c. Provide minimum R-14 to hatches and walkup doors and R-10 enclosure at pull downstairs with air seal gasket, (e.g., insulated attic stair cover)
- d. Rigid foam used shall be rated for exposed use in attics on ICC ES report and meet Sections R-316.5.4 and 316.6 requirements of IRC 2015.
- e. Provide latch, hook fastener, or other mechanical closure on vertical access doors

to keep them tight against weatherstrip when closed.

When ready access to the attic is not available through an existing opening, access to attic areas should be gained from the exterior through attic vent openings when possible. If this is not feasible, then the following criteria shall be used for access openings:

- a. Surface Openings: Cut existing wall board halfway on two studs (preferably through a closet). When closing the opening, the new materials must be flush with existing wall material and taped and covered with one coat of joint compound.
- b. Plywood Openings: Cut existing wall between two studs. Close opening with 1/2 plywood (G1S/AC) with four (4) or more 1 1/2" x 8 flat head wood screws secured into studs.
- c. Finish Openings: Cut existing ceilings. Head off opening. Install 2 1/2" casing around rough opening. Allow a 3/8" reveal into opening to receive 1/2" plywood (G1S/AC) to complete opening. Plywood cover to be weather-stripped and insulated. Casing to be mitered neatly.

6.3.4 Attic Venting

- a. Reference section 6.4

6.3.5 Flat Attic Insulation

- a. Blow in attic insulation level over entire area specified at the depth required to give the required settled R-value.
- b. Install batt or blanket insulation to:
- c. Maintain 3" clearance from non-IC rated lights and heat sources, none placed above
- d. Use the number of bags to meet listed coverage per manufacturers' specifications.

Program recommends attic information card per ASTM C1015-06 and 16CFR 460 be posted in an easily visible location (on the electrical panel or a framing member adjacent to the attic access) showing the following information:

- i. Insulation material installed,
- ii. Installed thickness,
- iii. Coverage area,
- iv. Installed R-value,
- v. Number of bags used, or pounds installed per FTC Rule 16 CFR 460.

6.3.6 Sloped Ceiling Insulation

Sloped ceilings (between kneewall and upper attic flat) may be dense packed per section 6.5.3 using cellulose. Use fiberglass or polyiso to block the base of the attic slopes so that the program requirement of dense packing can be met.

6.3.7 Open Cavity Insulation

- a. Install mineral fiber batt or blanket insulation in all open wall cavities or open floors to R- value in work scope.
- b. Installation of blanket or batt insulation shall conform to ASTM C1320 with cavities completely filled with no voids, gaps or compressions.
- c. Batt insulation MUST always be installed in full contact with the warm side air barrier.
- d. Batt insulation installed in walls MUST always have a solid air barrier on all six sides of the cavity when access allows.
- e. Loose fill insulation (cellulose or mineral fiber) is allowed in open walls, floors open to below, when sprayed in or blown behind netting, rigid foam, drywall, or other

barriers.

6.3.8 Rigid Foam Board

Where rigid foam board is installed over mineral fiber batt insulation or on another attic surface, use rigid foam board listed for uncovered use in attic. As an alternative, install a thermal barrier or prescriptive ignition barrier per IRC 2015 R316.5.3 and MA code. In all cases follow manufacturer's installation requirements including covering exposed foam core edges with tape rated for use in locations that will be exposed.

6.3.9 Floor Blocking

Where present, the kneewall floor joist opening from the attic floor to conditioned space under the kneewall shall be blocked airtight with a barrier sealed in place below the interior face of the kneewall. If this isn't possible, dense pack insulation may be used as described in Section 6.3.10.

6.3.10 Dense Pack Floor Insulation

At floored areas inaccessible to air sealing using barrier materials, CONTRACTOR shall densepack to retard airflow. Acceptable materials include:

- a. Cellulose insulation at 3.5 lbs/cu ft or greater density.
- b. Fiberglass wool tested for air resistance at 2.2 lbs/cu ft or greater density. If fiberglass wool is used, a product information cut-out from the bag must be included with the certificate to verify that material was tested to ASTM C522.

Methods can include lifting one floorboard to gain access to each cavity and inserting a 2 to 2-1/2" insulation hose into the floor for faster production. Material use shall be confirmed to match bags used per unit area to achieve density targets.

Flooring that has been removed for access to install insulation shall be replaced to match original site condition. Flooring that has been drilled shall be repaired with wooden plug matching the hole diameter and set flush to the top of the floor.

6.4 ATTIC VENTING

Do not install insulation in an attic space unless adequate and permanent ventilation is installed.

NOTE: Although the use of window vents is allowed, the vents must be permanently fixed and must meet the minimum requirements for free vent area.

Ventilation should be improved wherever reasonable and practical to meet current code requirements when attic insulation is installed. The details of the types of vents and where they may be practically installed on each specific house varies. Consideration should be given to the type and location of vents to provide as much cross ventilation as possible for the specific application depending on existing conditions and retrofit options.

Provide attic venting per code when the attic is being treated and ventilation is needed. Venting can provide access openings to inaccessible attics where feasible.

Follow all manufacturer's instructions and applicable codes for flash properly, seal and fasten to maintain roof and cladding drainage.

CONTRACTOR shall provide documentation showing the manufacturer's net free air rating for any products used.

Bath fan venting

- All unvented bath fans that terminate in unconditioned space where work will be performed must be vented to exterior.
- Preferred termination point is shortest distance to the roof or gable
- Use appropriately sized insulated hose or duct work to vent the fan

Insulation Baffles

1. When soffit vents are installed or existing, baffles shall be installed in the space connected to the soffit vents in such a way that the top plate can be insulated. Where possible, a clearance of 2" from the top of the baffle to the underside of the roof sheathing shall be provided in accordance with local building codes. Rigid blocking should be permanent, mechanically fastened at sides and at bottom, and ensure the free movement of air through soffit vents into the attic, but not allow the air to "wind wash" the insulation and reduce its effectiveness. It should be rigid enough to restrain loose-fill insulation from congesting the soffit vents at the eaves and obstructing ventilation.
2. Vent chutes should be installed per work scope. These should allow air to flow from soffit or kneewall area into peak. Baffles must be mechanically fastened at sides and at bottom and be carefully fit with insulation packed in place at the bottom to prevent wind intrusion into or under insulation. Flexible Styrofoam vent chutes may be used for very low pitch roof areas.

6.5 CLOSED SIDEWALL INSULATION

6.5.1 Performance criteria

In existing closed cavities where air sealing is not feasible, densepack insulation into every cavity to prevent settling with no voids or escape routes for heat and get an extra benefit of reduced hidden airflow and protection that wraps around the whole house and connects to the airtight attic.

6.5.2 Pre-Work Inspection Criteria

1. Pre inspections are to be performed in compliance with ASTM C 1015 and MA Insulation Authorization. Inspect all walls for pre-existing hazards. These problem areas must be identified and addressed prior to working on that area. Examples of some problem areas are recessed radiators, duct work in wall cavities, recessed bookshelves, stairways on exterior walls, loose or cracked plaster on walls, poor siding, pocket doors, chimneys, etc. Check wall areas for wall hangings that should be removed prior to working on walls.

Inspect cavity or framing detail for wiring, piping or ductwork. Do not densepack ductwork or space containing unsealed ductwork, or isolate plumbing from house – provide a sealed barrier continuous to adjacent airtight cavities or building element. Provide wood or foam plugs in sheathing. Repair openings made in weather barrier with housewrap tape or sheathing tape. If weather barrier is not present, seal plugs with caulk or cover plugs with housewrap tape or sheathing tape. Replace and refasten siding with matching or larger fasteners. Touch up nail holes with weather resistant sealant.

The process and the work that is to be performed should be explained to the CUSTOMER. Any potential problems discovered should be discussed with a CUSTOMER before commencing work.

2. Installation Procedures

- a. All wall insulation shall be installed through holes with minimum diameters of 2 1/8" or greater, i.e. large enough to accommodate a fill tube. Exception: wall cavities less

- than 12" in height.
- b. Use of a fill tube to ensure consistent insulation coverage and density is strongly encouraged. Usually, one hole is required per cavity, located to allow the fill to reach both ends of the cavity, with additional holes required if there are obstructions in the wall cavity.
 - c. Contractor shall only use equipment compatible with the insulation material used or an all-fiber machine. Contractor shall follow the manufacturer's recommendations for air pressure and density to achieve dense pack standards. Most small airlock machines are suitable if designed and maintained to provide at least 80 inches of water column or 2.9 PSI static air pressure when operated at full air with the outlet blocked and no feed. Dense pack requires at least 3.5 pounds per cubic foot or higher with a cavity depth over 4".
 - d. Keep a record of the number of bags used to ensure the installed insulation conforms to the manufacturer's recommended coverage shown on the material label, 1 pound per square foot for 2x4 wall framing.
 - e. Do not leave open holes in wall overnight. Any holes must be plugged before Contractor leaves work site. All drilled wood surfaces must be plugged with a wooden plug. Other drilled holes may be plugged with Styrofoam plugs.
3. Drill and Plug (D&P) Applications.
- a. Exterior drill and plug applications on painted surfaces must be completed in the following manner:
 - i. After installation, a plug must be inserted so it is flush or slightly (1/16") recessed. At edge irregularities apply one or two coats of an exterior rated filler
 - ii. This procedure also applies to drill and plug applications on windowsills, frieze boards, and entrances. Note: drilling window sills creates a serious water intrusion risk if not made watertight and should not be performed where a pan flashing or sill wrap is in place. Do not drill sills on homes built since 1990. Foam or urethane sealant below the surface plug may reduce water entry but cannot return integrity of pan flashing.
 - b. Exterior drill and plug applications on stained surfaces must be completed in the following manner:
 - a. After installation, insert a plug so that it is flush with the existing siding. The plug should be installed by placing a block of wood over the plug and tapping it until the plug is flush with the siding.
 - c. Interior drill and plug applications must be completed in the following manner:
 - a. After installation, insert a plug so that it is (1/8") recessed. Apply 1-2 coats of setting joint compound, or equal, patching material or a plaster repair product filling just flush to the existing surface.
 - b. Some examples of this application would be exterior walls (not done from the outside), stairway walls, garage ceilings, and slopes.

6.5.3 Wall Cavity Confirmation

Confirm cavity pack is effective and the machine adjustment is within limits by:

- a. Testing airflow at 50 pa with smoke at a completed but uncovered installation hole, or
- b. Testing airflow with smoke device at first application hole in completed cavity while blowing adjacent cavity.

6.5.4 Inspection

- a. Void areas greater than 10 sq. ft. per 1000 sq. ft. of achievable wall area, as determined by Program quality assurance procedures, shall be filled by the CONTRACTOR at no additional cost to the homeowner or the program. When instructed to do so by the Program inspector, the CONTRACTOR will contact the

customer to correct job deficiencies within 14 days of notification.

6.6 FLOOR INSULATION

Floor systems that are determined to be the thermal boundary will be insulated and air sealed in accordance with Massachusetts Building Code.

Locate and note the pathways that plumbing, wiring, heat runs, air return runs and gas lines take through the enclosed floors. Also note any recessed light fixtures in these floors or in nearby floor areas which share the same joist cavities. Take steps to ensure that the installation of insulation will not damage or in any way hinder the normal function of those services. In some cases, cavities or groups of cavities may have to be left uninsulated. Insulation should be blown into enclosed floors to capacity. When the drill and plug method is used on garage ceiling, the holes must be plugged and finished with a spackle type compound flush with the ceiling. When the drill and plug method is used on exterior floor overhangs, the holes must be plugged and finished with an exterior wood filler flush with the exterior surface.

6.6.1 Performance criteria

An air barrier shall be created across subfloor by sealing large gaps and openings including any ducts in unconditioned space. Floor insulation shall cover all exposed subfloor to level specified for as continuous a thermal barrier as possible.

6.6.2 Preparation

- a. Air sealing of a crawlspace or basement ceiling shall be performed per section 6.1 above.
- b. Inspection before installation shall be made in conformance with ASTM C1320-09.
 - i. Inspect the attic, crawlspace, or other area to be insulated, postpone installation until:
 - Potentially faulty wiring is corrected and confirmed OK by a licensed electrician
 - Moisture damage and/or entry is corrected, and sources controlled
 - Ground cover is in place over exposed soil in crawlspaces wherever accessible with interior seams sealed with approved tape. (ex. 3M 8087CW) Mastic or adhesive is acceptable. Foam is not acceptable. Perimeter: Seal the GMB to the foundation with mastic, adhesive sealant or one-part foam. Areas uncovered by the ground cover must be disclosed to customer.

Exception:

- If an accessible dirt floor area is vented per code, a vapor barrier is not required.
- No Vapor Barrier required if installing rigid foam board on a crawl space ceiling or existing closed cell foam (not open cell foam) is present and has no communication to the basement area.
- No Vapor Barrier required, if entire crawl space is inaccessible with no existing moisture issues having been identified in any other areas of the home. If moisture issues are present than a moisture evaluation must be completed to rule out the crawl space as a contributing source before continuing with work.

Definition of inaccessible

- Less than 2.5ft of head room across the entirety of the crawl space.
- Obstructions to the access point to the extent it makes the access impassable.

- c. Confirm that caulk, gasket, or other sealant is installed at penetrations of the

interior wall or floor including plumbing, electrical, heat registers, and grills.

6.6.3 Installation

- a. Installation of mineral fiber batt or blanket insulation in open cavities shall be made in conformance with ASTM C 1320 and MA code.
- b. Installation of cellulose or fiberglass blowing wool into closed cavities shall be made in conformance with attic floor insulation methods above 6.3.11 or wall insulation in 6.5.
 - Access shall be gained into every cavity with least damage possible and lead safe process in place for painted surfaces in homes built prior to 1978.
 - material use per unit area shall match weight required to give target densities of 3.5lbs/cu. ft. for cellulose and 2.2lbs/cu. ft. for fiberglass wool tested for airflow resistance
 - Completely fill every cavity to required depth or more
 - Where double layers are installed over floors, cross the layers with no gaps between layers
- c. Where batt fiberglass is installed beneath floors, insulation shall be in full contact with floor above using wire, screen, nylon mesh fastened in place
 - Fit to length and placed snug to edges without gaps, voids or compressions
 - Cut and fit around all cross-bracing, outlets, wiring, into narrow cavities
 - No exposed facings rated higher than flame spread 25
 - Where vapor retarder is installed, place to warm-in-winter side
 - Never place insulation between piping and the warm surface, to prevent freezing.

6.6.4 Rim Joist Insulation

- a. When approved within the scope of work, rim joist framing determined as the thermal boundary shall be insulated to a minimum of R-14 with 6-inch fiberglass batt and 1 part foam. When limited shelf space prevents 6-inch fiberglass from being installed, 2-inch fire rated foam board can be installed.
- b. CONTRACTOR will confirm no insulation is placed between piping and the warm side of the rim joist framing to prevent freezing without proper sign off from the customer.

6.7 FOUNDATION INSULATION

When approved within the scope of work, foundation walls that are determined as the thermal boundary may be insulated to a minimum of R-10 and be sealed as defined in the air sealing section of this document. Prior to application, confirm that roof runoff, surface water, and ground water are drained properly.

6.7.1 Performance criteria

Crawlspace can be brought inside the thermal/pressure boundary by installing rigid insulation at inside of foundation wall, sealed from subfloor to below grade if crawlspace ceiling cannot be treated.

6.7.2 Preparation

Primary air leakage shall be substantially reduced by sealing gaps at the rim joist, sill and surface of the foundation wall.

6.7.3 Installation

For crawlspaces attach minimum of R-10 or higher foam board rated for uncovered use in

crawlspaces to foundation wall, to grade; and cut and fit pieces to fit into rim and across sill. Seal gaps in foam board edges at rim and sill and tape seams in foam board on wall.

6.8 WEATHERSTRIPPING

Approved window weatherstripping shall be attached as per manufacturers' instructions to meeting rail, sill & sash channels. (Note: if applicable, PF-524-AB may be stapled to the sash itself instead of sill & sash channels.) Door weatherstripping installed on interior doors will be Qlon with carrier securely fastened to 3 sides of door framing. . Approved door sweeps shall be attached as per manufacturers' instructions to bottom of door.

6.9 Caulks and Sealants

1. Locations and use of caulks and sealants are governed by cost-effectiveness standards and procedures. The proper caulk will be matched to the location where it is applied. Consideration will be given to durability, paintability, adherence, color, toxicity, flammability, etc.
2. Siliconized acrylics will generally only be used in interior locations or where paintability is important. When used in visible areas, customer must approve the application, and see a sample before continuing. Clear acrylics, due to their shiny appearance, must be used only where appropriate, and should be approved by the customer prior to use in visible areas. Clear acrylics should be avoided where possible due to greater shrinkage.
 - Exterior grade paintable caulks must be used in exterior applications
 - Pure silicone will be used anywhere that sealants are needed between wood and metal, wood and concrete, or other materials with differential expansion as moisture and temperature vary, or where greater flexibility is needed.
3. Caulking is performed on the interior of the dwelling for general air leakage and to prevent moisture penetration into wall cavities.
4. Caulking is performed on the exterior of the dwelling to prevent bulk moisture from entering the envelope of the building and to seal areas of air leakage.
5. When appropriate, windows will be caulked along the full perimeter of the interior (or exterior), including sill area, side stops, apron, and casings.
6. When appropriate, doors will be caulked along the interior (or exterior) casings and door jambs/stops.

7.0 WINDOW REPLACEMENT

Windows shall be installed according to manufacturer's instructions to assure proper operation and moisture protection. Rough openings shall be air sealed to be airtight prior to installation of casings and sills. Newly installed windows shall be inspected and verified for proper operation of all hardware and locking mechanisms.

Refer to EPA guidelines and local codes for requirements for retrofit window installations in locations where lead and/or asbestos may be present.

8.0 HEATING SYSTEM REPLACEMENT

The furnace or boiler that is to be installed must meet the minimum AFUE ratings set by the Mass Save program. Installation is to be completed in accordance with the manufacturers'

instructions while following the State and Local Codes. Any questions should be communicated with the PROGRAM and/or Authority Having Jurisdiction.

9.0 AIR CONDITIONING SYSTEM MEASURES

The air conditioning system that is to be installed must meet the minimum energy ratings set by the Mass Save program. Installation is to be completed in accordance with the manufacturers' instructions while following the State and Local Codes. Any questions should be communicated to the LV and/or Authority Having Jurisdiction.

10.0 MECHANICAL VENTILATION

Contractor is responsible for ensuring that the house meets ASHRAE 62.2 2010 standards for fresh air ventilation.

11.0 LIGHTING MEASURES

The lighting unit that is to be installed must meet the maximum energy use set by the Mass Save program. Installation is to be completed in accordance with the manufacturers' instructions and fixture restrictions.

12.0 DOMESTIC HOT WATER MEASURES

The domestic hot water unit that is to be installed must meet the minimum Energy Factor ratings or energy efficiency ratings set by the Mass Save program. Installation is to be completed in accordance with the manufacturers' instructions while following the State and Local Codes. Any questions should be communicated with the PROGRAM and/or Authority Having Jurisdiction.

13.0 QUALITY ASSURANCE

Quality Assurance (In-field Quality Assurance Inspections)

- Customer Discussion
- Visual Inspections and Diagnostic Tests
- Inspection Documentation
- Contractor Follow-up

The program has the goal of performing on-site in-process and post installation quality assurance inspections where major measures have been installed.

Any issues identified during on-site inspections will need to be successfully addressed prior to release of CONTRACTOR payment.

Contractor Evaluation

CONTRACTORS will be evaluated on an ongoing basis throughout the Program Year based on work quality, customer service, and quality of program documentation. CONTRACTORS should expect random and unannounced quality control evaluations on a minimum of 10% of their jobs. This is in addition to the standard Final Inspections performed on all work. Evaluations will be performed by Final Inspectors, Field Supervisors, Program Managers, and/or the Quality Control Department, using a standard evaluation format.

CONTRACTORS who repeatedly perform poorly on evaluations, and CONTRACTORS who repeatedly receive fails (excluding Assessor fails) on jobs, are subject to probationary actions

and additional training as determined by the LV. CONTRACTORS who fail to improve after their probationary period are subject to suspension and/or termination as UTILITY Approved CONTRACTOR.

In addition, CONTRACTORS who repeatedly fail to meet timelines, generate an undue number of CUSTOMER complaints, and fail to adequately fulfill warranty obligations are eligible for suspension and/or termination.

14.0 CONTRACTOR PERFORMANCE STANDARD

All Home Energy Services Program representatives to follow.

- Before Arriving on Site
 - Vehicle Identification Requirement - The company name should be included on all company vehicles.
 - Provide a confirmation to all customers before arriving on site. This could be an email, letter or phone call confirming the appointment.
- Crew Chief Requirements - Crew Chief should be the first and last interactions with the customer
 - Crew Chief should introduce himself/herself to the customer showing some form of identification: business card, ID badge or other identification that associates the Crew Chief as the Mass Save Participating Contractor. The Crew Chief should also be providing an overview of the work that is going to be performed and where they will be doing work.
 - At the end of each day, the Crew Chief should conduct a walk-through of the home making sure the customer is satisfied with the cleanliness of the home and to review the work completed. The Crew Chief should also provide a contact number for additional questions.
 - Crew Chiefs should inform the customer that they may request an Inspection of the work and may be contacted to participate in surveys or inspections following the completion of the work.
- General Contractor Crew Requirements
 - Smoking - Contractor should be out of direct sight of the customers. This could include smoking in the company vehicle, personal vehicle or across the street.
 - All cigarette waste should be properly disposed of and removed from the property each day.
 - Crew Clothing - Shirt and pants are required to be worn at all times while on site.
 - Shirt will not contain vulgar or offensive language/pictures.
 - All clothing and general appearance should be representative of the high standards of the Mass Save Home Energy Services

Program.

- Shoes
 - Always comply with OSHA requirements for footwear.
 - Set customer's expectations for wearing footwear in the home, including:
 - Wearing booties to eliminate tracking dirt into house when necessary.
 - Properly protect travel areas from foot traffic.
 - Ask homeowner for permission before using the restroom facilities.
 - The crew should not eat food in the customer's home. The crew may eat in the driveway/truck and should clean up after themselves.
 - Phone usage inside the home should be limited to work related calls only. Each company is responsible for maintaining their own employee requirements regarding phone use but should not interfere with their work or customer service.
 - Each member of the crew is expected to refrain from any language or actions that could be construed as offensive, harassing, intimidating, and/or demeaning while at a customers' property.
- Customer/Condition of House
 - No trash will be left on property (neither inside nor outside home)
 - Leave customer's property in the same condition as when the work started.
 - No graffiti will be permitted on the customer's property at any time.
 - Working Hours - Unless authorized by the customer, crews will work during normal business hours and all crews must follow all local ordinances
 - Customers should not be in the general area when work is being completed.

15.0 Program Sponsors

Berkshire Gas
Cape Light Compact
Eversource
Liberty National
Grid Unitil

16.0 REFERENCES:

Documents Published by the Canadian General Standards Board (CGSB)
Place du Portage, III, 6B1Gatineau,
Québec, K1A 1G6 Canada
Telephone: (819) 956-0425; Fax: (819) 956-5740; www.pwgsc.gc.ca/cgsb
CAN/CGSB 51.71-2005 Depressurization Test

Documents Published by the National Fire Protection Association
(NFPA) 1 Batterymarch Park
Quincy, MA 30169-7471
Telephone: (617) 770-3000; Fax: (617) 770-0700; www.nfpa.org
NFPA 54-2006, ANSI Z223.1-2006 National Fuel Gas Code

Documents Published by the International Code
Council 500 New Jersey Avenue, NW, 6th Floor
Washington, DC 20001
Telephone (888) 422-7233; Fax: (202) 783-2348; www.iccsafe.org
International Residential Code - 2006

4.1 INFORMATIVE APPENDICES

- 4.2 Health and Safety Guidance
- 4.3 Contractor Performance Standard
- 4.4 K & T Form 2008
- 4.5 Application Details
- 4.6 Duct Sealing and Duct Insulation Guidance

These Appendices provides general information about safety issues for the Contractor and homeowner, as well as sample documentation that contractors may use.

APPENDIX 16.5

APPLICATION GUIDANCE

This Appendix is provided for additional guidance to the Contractor and offers general information about materials and installation procedures. It is provided for informational purposes.

DUCT SEALING AND DUCT INSULATION GUIDANCE

16.5.1 DUCTED AIR DISTRIBUTION

The forced-air system consists of an air handler (furnace, heat pump, air conditioner) with its heat exchanger along with attached ducts. The annual system efficiency of forced-air heating and air-conditioning systems depends on the following issues.

- Duct leakage
- System airflow
- Blower operation
- Balance between supply and return air
- Duct insulation levels
- System location

16.5.2 Duct Sealing Eligibility Sequence of Operations

The evaluation and improvement of ducts has a logical sequence of steps.

- **Determine whether more than 30% of the ducts are located outside of the conditioned space**
 - Only duct systems located more than 30% outside of conditioned space are eligible for duct sealing
- **Evaluate the ducts visually for air leakage/condition and decide whether duct-sealing is eligible**
 - Only duct systems with an evaluated leakage category of “some observable leaks” or “significant leaks”. These terms are defined in Section 16.5.3.
 - Only duct work that has properly attached connections and whose air flow has not been compromised due to crushed ducts.

NOTE: If the duct system has ducts that are crushed or improperly attached/disconnected to the point that the Energy Specialist believes that the

system cannot be adequately sealed without first fixing ductwork, then refer the customer to a program approved list of HVAC contractors to evaluate the duct systems condition.

- **Contractor may choose to determine if the system airflow meets program requirements for proper flow.**
 - Only systems with airflow CFM falling within program recommended airflow rates are eligible for duct sealing.
 - Only Duct systems with accessible filter slots or single return grilles will have its' airflow measured using the True Flow Plates
 - Duct airflow can be assessed using the **Temperature Rise** method provided that the system is **HEATING ONLY**. All systems with **COOLING** must have a TRUE-FLOW test in order to qualify to be duct sealed.
 - See section 16.5.5 for details on performing airflow measurements with True Flow Plates or the temperature rise method.

Additional duct systems that should not be evaluated for duct sealing opportunities are as follows:

- Duct board systems are not eligible for duct sealing under this program
- High velocity systems are not eligible for duct sealing under this program
- Systems insulated with radiant bubble wrap are not eligible for duct sealing under this program, unless the bubble wrap is deemed by the energy specialist to have an effective R-value of under R-3. In which case, the bubble wrap would be removed, and the ducts would be insulated to R-8.
- Any repair work requiring the use of HVAC industry tools and materials other than a cable tie (Zip Tie) tensioner will be referred to program approved list of HVAC contractors

16.5.2.1 Determine the Distribution System Efficiency (DSE) by visually evaluating the three duct characteristics below. Use the Building Performance Institute's 'Distribution Efficiency Look-Up Table' and the results of the duct system evaluation below to lookup the DSE. Alternately, enter inputs required by the program-approved energy modeling software, then the software will evaluate the system's distribution system efficiency and energy savings from any duct weatherization.

1. Percentage of duct work located outside of the conditioned space
2. Duct leakage evaluation
3. Duct insulation evaluation

The DSE should be determined before duct sealing and insulation, and after duct sealing and insulation. The increase in DSE due to duct weatherization will be used to calculate the energy savings as outlined in the ENERGY SAVING CALCULATIONS section 16.5.5 below.

16.5.3 Evaluating Duct Air Leakage

Duct leakage is a major energy-waster in homes where the ducts are located outside the home's thermal boundary in a crawl space, attic, attached garage. When these intermediate zones remain outside the thermal boundary, duct sealing is usually cost-effective.

Ducts in unconditioned space with **some observable leakage** will be eligible for duct sealing.

- **Some observable leakage:** Joints are not sealed with an approved sealant and there are gaps at most of the seams. Duct insulation shows discoloration at most field joints.

NOTE: Duct leakage within the thermal boundary or in Semi Conditioned Spaces like basements will not qualify to be duct sealed.

16.5.4 Specifying Duct Sealing Hours.

Duct sealing man hours will be determined based on liner footage of existing ridged duct work and existing duct insulation.

- 4 Hrs. (un-insulated rigid ducts less than 200 liner feet.)
- 6 Hrs. (un-insulated rigid ducts greater than 200 liner feet.)
- 8 Hrs. (insulated rigid ducts less than 200 liner feet.)
- 12 Hrs. (insulated rigid ducts greater than 200 liner feet.)

16.5.5 Airflow Measurement Tests (optional)

- For systems with cooling, **CFM per ton should be at or above 200.**
- For heat only fossil fuel/Electric Furnaces, the measured Heat Rise must be within manufacturer's recommended range. A default maximum temperature rise of 80F can be used when manufacture data is not available.

NOTE: When completing Flow test on cooling equipment the thermostat should be set on cooling mode for the most accurate air flow results. When outside temperatures are below 60 deg. F. cooling equipment should not be turned on, use fan only mode.

1. Duct systems with accessible filter slot at the air handler or accessible single return filter grille should use True Flow Plates to measure system airflow. Instructions for installing the True Flow Plates and correctly measuring system airflow can be found here:
<http://dev.energyconservatory.com/wp-content/uploads/2014/07/TrueFlow- Manual-DG700.pdf>

NOTE: When the model number for the cooling equipment cannot be obtained to determine the required system airflow eligibility, the following can be used as a default.

- 300 cfm per 500 sq. ft of conditioned cooling space.


2. Heating only systems will use the Temperature Rise method to assess system airflow. This method is described here:

- a. Drill a ¼ inch hole in a straight section of the **supply plenum** or trunk. Be sure the

hole is around at least one duct bend. The temperature probe should not have direct "line of sight" with the heat exchanger.

- b. Drill a ¼ inch hole in a straight section of **return plenum** or trunk.
- c. Insert a temperature probe into each drill hole in the Return and Supply. Be sure the probe extends into the middle of the duct and not along the sides.
- d. Turn the system on and allow it to run for 10 minutes or until the supply and return side temperatures stabilize.
- e. Read and record the supply and return side temperatures. Subtract the return side temperature from the supply side temperature. This is the systems' temperature heat rise.
- f. Compare the measured heat rise from steps a-e to the manufacturer's acceptable heat rise range for the system data plate (red box).

HEIL-QUAKER CORPORATION
LEWISBURG, TENNESSEE, USA

 MODEL NO. NUGK125AK01
SERIAL NO. H544 30412
MFR. NO. NUGK125AK01

ANS.Z21.47 1983 CENTRAL FURNACES NAT. GAS

INPUT RATING BTU/HR. 125,000 OR BTU/HR. 100,000

MANIFOLD PRESS. INCHES W.C. 3.5 MIN. SUPPLY PRESS. INCHES W.C. 4.5 MAX. SUPPLY PRESS. INCHES W.C. 14.0

TEMP. RISE OF FROM 35 F° TO 65 F° DESIGNED MAX. OUTLET AIR TEMPERATURE 170 F°

FORCED AIR FURNACE - 115VOLTS. 60 HZ. 1PH. 11.9 MAX TOTAL AMPS INPUT

FOR INDOOR INSTALLATION IN BUILDING CONSTRUCTED ON SITE
EXTERNAL STATIC PRESSURE WHEN EQUIPPED AS TABULATED BELOW

MAX. EXT. STATIC PRESS. IN. H ₂ O	TYPE BLOWER DRIVE	SIZE BLOWER	MOTOR H.P.(W)
.20	DIRECT	DD12-11AT	3/4 (1168)
.50	DIRECT	DD12-11AT	3/4 (1158)

IN ALL CORRESPONDENCE AND WHEN ORDERING REPLACEMENT PARTS, ALWAYS SPECIFY MODEL, SERIAL AND MANUFACTURER NUMBERS.

613535

g. If the measured heat rise falls within the manufacturer's projected range the airflow is acceptable.

Example: A 60, 000 btu/HR. output furnace has a supply side temperature of 120 degrees and the return side of 70 degrees. The difference between the two measurements is 50 degrees. The acceptable temperature rise as read from the data plate is 35-65 degrees. 50 degrees falls between 30-60 degrees and passes the heat rise test.

16.5.6 Evaluating Existing Duct Insulation

Duct systems with an **effective** R-value of 3 or greater are not eligible to be insulated. When determining the effective R-value of existing duct insulation to be upgraded to R-8 take the following into consideration.

- Effective R-value of 2 or less regardless of install quality is eligible.
- Duct insulation with compression of insulation to less than 1 inch is eligible
- Ducts that have poorly installed insulation that is falling off or not properly fastened with multiple exposed ducts.
- Existing Duct insulation that will be compromised during duct sealing to the point that it will not be able to be re-installed due to its poor deteriorated condition.

NOTE: Duct insulation can only be recommended when Duct Sealing will be part of the work scope.