



***APPENDIX I***  
***NEBRASKA ENERGY OFFICE***  
***2009 WEATHERIZATION***  
***INSTALLATION MEASURES***  
***AND***  
***WORK STANDARDS***  
***July 1, 2009***

***Developed and Approved by the  
Nebraska Weatherization Technical Working Group***

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## HEALTH AND SAFETY

Grantee Health and Safety - Grantee weatherization staff shall not be required to work in unsafe and/or excessively unsanitary conditions. Costs related to grantee health and safety shall be charged to Administration or Training and Technical Assistance.

Crew and/or Contractor Health and Safety - Subgrantees must comply with Occupational Safety and Health Administration (OSHA) requirements in all weatherization activities. Cost incurred by subgrantees to comply with OSHA requirements may be charged to the Health and Safety budget category.

These requirements include, but are not limited to:

- respirator protection,
- techniques for safely lifting heavy objects,
- electrical equipment safety,
- ladder safety, and
- general worker protection.

Subgrantees should consult OSHA standards for further details.

Subgrantees should maintain Material Safety Data Sheets that identify potential health risks and describe the proper use, handling and storage of materials used in the weatherization program.

Personal protective equipment should be worn when appropriate. First aid measures should be available in the office and at the job site.

Client Health and Safety - Subgrantees must take all reasonable precautions against performing work on homes that would subject workers or clients to health and safety risks. Before beginning work on a home, subgrantees must take into consideration the health concerns of occupants, the condition of the dwelling and the possible effect of work to be performed on the health and medical condition of the occupants. When an occupant's health is fragile and/or the work activities would constitute a health or safety hazard, the occupants at risk may be required to leave home during these work activities.

Potential Hazard Considerations - Weatherization services should be provided in a manner that minimizes risk to workers and clients. Awareness of potential hazards is essential in providing quality weatherization services. A list of common hazards is discussed below.

Biologicals - Removal of mold, odors, viruses, bacteria, unsanitary conditions and rotting wood is not a weatherization responsibility. However, weatherization workers frequently encounter these conditions. Health and safety funds may not be used to remedy these conditions. Caution should be taken when selecting building tightness limits (BTL) for homes with these problems. If necessary, weatherization may be delayed until remedial action is taken outside of the weatherization program.

Combustion Appliances and Combustion Gases - The following procedures have been developed to address this hazard:

- Prior to weatherizing the building envelope, all eligible heating plants over two (2) years of age that have not received a safety inspection during the twelve (12) months prior to the initial inspection shall be inspected by a qualified heating technician, utility company or certified weatherization staff.

- The building envelope shall not be weatherized if the owner or client refuses a safety inspection of the heating system or until any heating system deficiency has been repaired and/or the heating plant replaced.
- A back-draft test shall be performed on all vented naturally drafting combustion appliances at the time of the initial and quality control inspections. A back-draft test shall not be performed on solid fuel burning appliances.
- A carbon monoxide (CO) test shall be performed on all naturally drafting combustion appliances at the time of the initial and quality control inspections. The CO levels shall be tested in the undiluted flue gases. If a CO test is not performed on a gas range or gas dryer, a CO alarm shall be installed. CO tests shall not be performed on solid fuel burning appliances. CO alarms shall be installed according to manufacturer's instructions.
- If CO levels exceed 200 ppm as measured in the undiluted flue gases or the ambient air at the time of the initial inspection, weatherization shall not proceed until the CO levels have been reduced. If the CO levels cannot be reduced or if the excess CO levels are identified at the time of the quality control inspection, a CO alarm shall be installed.
- Units that contain heating plants that are inoperable or red-tagged at the time of the initial inspection shall not be weatherized until the heating plant has been repaired or replaced.
- Eligible heating plants that cannot be repaired shall be replaced.
- The replacement heating plant shall be properly vented. If the new heating plant will not be vented through the masonry chimney, but the water heater will still be vented through that chimney, a properly sized flue liner shall be installed. As an alternative, a power vent may be installed on the water heater.
- If a dwelling is heated by unvented combustion space heaters and an inoperable conventional heating system is present, the conventional heating system shall be repaired or replaced to eliminate the need for unvented space heaters. If the need for unvented combustion space heaters cannot be eliminated, the subgrantee shall instruct the client regarding the dangers of carbon monoxide and excessive moisture levels, particularly if any unvented space heaters are left in the dwelling as a secondary heat source, or emergency back-up.
- If a dwelling utilizes unvented combustion space heaters as the primary heat source the unvented combustion space heaters shall be replaced with a vented combustion heating system.
- Unvented combustion space heaters may remain as secondary heat sources provided they comply with the International Residential Code (IRC) and the International Fuel Gas Code (IFGC). Specifically, any unvented gas- and liquid-fueled space heaters that remain in a completed single-family house after weatherization:
  - Shall not have an input rating in excess of 40,000 Btu/hour;
  - Shall not be located in, or obtain combustion air from sleeping rooms, bathrooms, toilet rooms, or storage closets, unless:

- Where approved by the authority having jurisdiction, one listed wall-mounted space heater in a bathroom:
  - Has an input rating that does not exceed 6,000 Btu/hour;
  - Is equipped with an oxygen-depletion sensing safety shut-off system; and
  - The bathroom meets required volume criteria to provide adequate combustion air;
- Where approved by the authority having jurisdiction, one listed wall-mounted space heater in a bedroom:
  - Has an input rating that does not exceed 10,000 Btu/hour;
  - Is equipped with an oxygen-depletion sensing safety shut-off system; and
  - The bedroom meets required volume criteria to provide adequate combustion air.
- Shall require the enforcement of minimum ventilation guidelines as determined by the greater of:
  - 15 cubic feet per minute (CFM) per person,
  - 15 CFM per bedroom plus one [(# of bedrooms + 1) x 15 CFM], or
  - .35 air changes per hour.

NOTE: The above minimum ventilation guidelines are natural ventilation rates, not with the house depressurized to -50 Pascal with a blower door.

- Units that contain unvented combustion appliances that produce more than 35 ppm of CO in the undiluted exhaust gases shall not be weatherized until the CO levels have been reduced to less than 35 ppm or a CO alarm has been installed.
- Existing unvented gas clothes dryers shall be vented to the exterior. Gas dryer vent pipe should not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.
- Existing unvented gas water heaters shall be vented to the exterior.
- Unsafe water heaters that cannot be repaired shall be replaced.
- Propane gas detectors may be installed in homes that have propane combustion appliances located in a basement or crawlspace. The gas detectors shall be permanently installed and 110 volts.
- The Manufactured Home Construction and Safety Standards require all fuel-burning, heat-producing appliances in mobile homes, except ranges and ovens, to be vented to outside. Further, all fuel-burning appliances in mobile homes, (except ranges, ovens, illuminating appliances, clothes dryers,) including solid fuel-burning fireplaces and solid fuel-burning fireplace stoves, must be installed to provide for the complete separation of the combustion system from the interior atmosphere of the manufactured home (i.e., to draw their combustion air from outside).
- Mobile homes heated by naturally drafting combustion heating and/or water heating systems that are not specifically manufactured for use in mobile homes shall not be weatherized until the heating and/or water heating system has been replaced with a heating and/or water heating system designed for use in mobile homes, a sealed combustion and direct vent condensing heating plant or an electric water heater.

Fire Hazards - Combustion appliances and their associated venting systems can present potential fire hazards. The following procedures have been developed to address this hazard:

- Insulation shall not cover the pressure relief valve, end of the drip leg, draft hood, burner air inlet, pilot light access door, thermostat control, drain valve or the top of the water heater on natural gas or propane water heaters. Insulation shall not cover the pressure relief valve, end of the drip leg, high limit switch, or drain valve on electric water heaters.
- When adding additional insulation to the attic, shielding shall be installed around heat and high-heat sources. Shielding shall be metal and kept a minimum of 3" from any heat source and a minimum of 6" from a high-heat source. Shielding shall be installed at a height to accommodate the depth of the added insulation. If a masonry chimney has an existing metal or metalbestos flue liner, the chimney does not need to be shielded.
- Weatherization materials shall not be installed over or adjacent to outlets, switches or junction boxes that contain aluminum wiring. Open wire splices shall not be covered with insulation until they have been enclosed with proper junction boxes.
- If potentially dangerous creosote buildup in chimneys or wood stoves is identified, up to \$500 may be spent to repair the unsafe solid fuel combustion heating system. Weatherization of the building envelope shall not proceed until the system has been made safe.

Existing Occupant Health Problems - Subgrantees should be aware that some individuals' health problems could be exacerbated by some weatherization activities. Prior to installing cellulose insulation, subgrantees shall ask occupants whether anyone in the home is allergic to cellulose or cellulose dust. Should this be the case cellulose insulation shall not be installed. Other occupant health problems or allergies should be dealt with on a case by case basis.

#### Indoor Air Quality

- Asbestos - General asbestos removal is not an approved health and safety cost. Slate siding that may contain asbestos may be removed and reinstalled as long as the siding material does not become friable. Removal shall comply with State and local regulations. Ductwork that has asbestos pipe wrap shall not be insulated or sealed in the area containing the asbestos.
- Radon - Where there is a previously identified radon problem, weatherization measures that would exacerbate this problem shall not be installed. Radon abatement is not an allowable activity under the weatherization program.
- Formaldehyde and Volatile Organic Compounds (VOCs) - Formaldehyde vapors may be slowly released by some new carpets, wafer board, plywood, etc. VOCs are also emitted by some household cleaning agents. Caution should be taken when selecting air tightness limits for homes with these issues.

#### Lead Paint

Ongoing Lead Safe Weatherization training will be provided to new subgrantee staff, crews and contractors during the 2009 Program Year. Subgrantees are required to follow all Lead Safe Weatherization practices and protocols developed by the Nebraska Energy Office and the U.S. Department of Energy to minimize the exposure of weatherization workers and residents to lead dust during the weatherization process in homes constructed prior to 1979.

All subgrantees doing weatherization work in pre 1979 housing must give notification to the occupant about the potential hazards of lead paint and lead paint dust. Subgrantees shall provide a copy of the Environmental Protection Agency booklet *Renovate Right: Important Lead Hazard*

Information for Families, Child Care Providers and Schools to the occupant at least seven days prior to the start of weatherization work if delivered by mail. If the EPA booklet is hand delivered, it must be delivered prior to the start of any weatherization work.

Heating, ventilation and air-conditioning (HVAC) contractors will be provided with all information and training materials necessary to implement Lead Safe Weatherization. The Nebraska Energy Office will provide Lead Safe Weatherization training to HVAC contractors upon a request from either the subgrantee or the HVAC contractor.

### Building Structure

Building rehabilitation is beyond the scope of the weatherization program. Homes whose structural integrity is in question should be referred to the U.S. Department of Housing and Urban Development. The provision of weatherization services may need to be delayed until the dwelling can be made safe for crews and occupants. Incidental repairs necessary for the effective performance or preservation of weatherization materials are allowed.

### Electrical Issues

The two primary energy-related health and safety electrical concerns are insulating homes that contain knob-and-tube wiring and identifying overloaded electrical circuits.

- Knob-and-tube Wiring – The State Electrical Board permits the covering of knob-and-tube wiring with cellulose insulation. Knob-and-tube wiring in sidewalls shall not be covered by new insulation unless the circuit has been protected by a Type S fuse or is protected by an existing circuit breaker. If knob-and-tube wiring is covered by existing insulation, additional insulation shall not be installed unless the circuit is protected. Knob-and-tube wiring in attics shall not be covered by new insulation unless the circuit has been protected by a Type S fuse or is protected by an existing circuit breaker. If knob-and-tube wiring is covered by existing insulation, additional insulation shall not be installed unless the circuit is protected.
- Serious Electrical Hazards – Serious electrical hazards exist when gross overloads such as over usage, overloaded outlets and/or oversized fuses are present. Should auditors and crews find such existing problems, they should notify the owner and note the problem in the client file. Weatherization measures that involve the installation of new equipment such as air conditioners, heat pumps, or electric water heaters can exacerbate previously marginal overload problems to hazardous levels. Rewiring of a home is outside the scope of the weatherization program.

### Refrigerant Issues

Replaced air conditioners and heat pumps must be properly disposed of and the refrigerant reclaimed in compliance with the Clean Air Act 1990, section 608, as amended by 40 CFR 82, 5/14/93. The vendor, demanufacturing center or other entity recovering the refrigerant must possess EPA-approved section 608 type I or universal certification.

### Other Code Compliance Issues

It is each subgrantee's responsibility to ensure that weatherization-related work conforms with the applicable codes in jurisdictions where the work is being performed. This includes the purchase of any required permits. The cost of the permits shall not be passed onto the client.

### Mold Related Weatherization Procedures

Subgrantees must ensure that weatherization work is performed in a manner that does not contribute to mold problems, and when the work is performed properly, may alleviate mold conditions.

If serious mold conditions are discovered during the initial inspection of the home, the home should be referred to the appropriate public or non-profit agency for remedial action. Weatherization should not be undertaken until the problems have been alleviated. However, weatherization funds may be used to correct energy-related conditions to allow for effective weatherization work and/or to assure the immediate or future health of workers and clients.

Subgrantees must include some form of notification or disclaimer to the client upon the discovery of a mold condition. The notification should include what was or will be done to the house that is expected to alleviate the condition and/or that the work performed should not promote new mold growth. The notification must be signed by the client and the owner (if the client is a renter) and placed in the client file.

The Nebraska Energy Office provided fairly extensive mold training during the 2004 program year. During the 2005 program year, all weatherization crews and subgrantee inspectors received specialized training in the recognition of conditions that promote mold growth, how best to prevent creating new mold conditions and the use of a mold procedure/checklist.

#### Moisture Control

Clothes dryers and exhaust fans shall be vented to the exterior whenever possible.

A full ground laid moisture barrier shall be installed in accessible crawl spaces and under mobile and modular homes. A full ground laid moisture barrier shall be installed whenever possible.

#### Miscellaneous

A pre-infiltration and post-infiltration blower door test shall be performed on all homes, if possible. The blower door shall be used to identify air leakage into and out of the conditioned envelope of a structure and to determine the cost effectiveness of sealing the identified air leakage and the building tightness limits (BTL). Building tightness limits (BTL) shall be followed.

Pipe wrap shall not be installed if the water heater lacks a pressure relief valve. Pipe wrap shall not be installed within 2 inches of a flue and/or draft hood.

## **DEFERRAL STANDARDS** **(Walk Away Policy)**

The decision to defer work in a dwelling is difficult but necessary in some cases. Subgrantees are expected to pursue reasonable options on behalf of clients and to use good judgment in dealing with difficult situations. Deferral conditions may include, but are not limited to:

- The building structure or its mechanical systems, including electrical and plumbing, are in such state of disrepair that failure is imminent and the conditions cannot be resolved cost-effectively.
- The house has sewage or other sanitary problems that would further endanger the client and weatherization installers if weatherization work were performed.
- The house has been condemned or electrical, or plumbing has been “red-tagged” by local or state building or enforcement officials.
- Moisture and/or mold problems are so severe they cannot be resolved under existing health and safety measures and with minor repairs.
- The client is uncooperative, abusive or threatening to the crew, subcontractors, auditors, inspectors or others who must work on or visit the house.
- The extent and condition of lead-based paint in or on the house would potentially create further health and safety hazards.
- In the judgment of the energy auditor, any condition exists which may endanger the health and/or safety of the work crew or subcontractor, the work should not proceed until the condition is corrected.
- Mobile homes that have non-mobile home combustion water heaters.
- Mobile homes that have non-mobile home solid fuel combustion heating systems.

## FOOTNOTES

Omission of a Weatherization Measure - A weatherization measure shall be omitted if the measure has been previously implemented, the measure has a SIR of less than 1 as documented by the NEAT or MHEA energy audit or undertaking the measure would subject workers to unreasonable health and/or safety hazards.

These exceptions shall be noted in the client's file and the next weatherization measure implemented.

Units Undergoing Remodeling - Units undergoing remodeling, or which have untreated remodeled areas that directly affect the weatherization process, shall not be weatherized. The client's application shall remain a part of the subgrantee's records until recertification is necessary. Weatherization of the unit may proceed if remodeling is completed to the standards of a completed dwelling unit and the client qualifies for the program at the time of that completion.

Material Standard - Only weatherization materials that are listed in the most current Appendix A - Standards of Weatherization Materials, 10 CFR Part 440, or meet or exceed the standards prescribed in Appendix A shall be installed as weatherization materials. Materials shall be installed according to state and local codes. Materials shall also be installed according to manufacturer's instructions unless specified by the State Plan.

Mobile Homes with Frame Additions - Mobile homes with frame additions shall have the additions weatherized as a site-built home.

Qualified Heating and/or Plumbing Technician - To be considered qualified; a heating and/or plumbing technician must meet the following insurance requirements:

- A basic workers' compensation policy with a 30 day written notice of cancellation requirement; and
- A general liability policy including:
- Combined property damage liability coverage, bodily injury coverage and liability coverage at a minimum of \$300,000/\$500,000; and
- Products/completed operations hazard insurance.

All licenses, insurance, permits and warranties shall be the responsibility of the heating and/or plumbing technician performing the work. The legal liability for performing the work rests with the heating and/or plumbing technician performing the work.

## AUDIT PARAMETERS

Site-Specific Energy Audit - The NEAT or MHEA audit shall be performed on all frame, masonry, modular and mobile homes. Homes with a cumulative SIR of less than 1 shall not be weatherized. When performing the NEAT audit, subgrantees must use the most current version as authorized by the Nebraska Energy Office. A copy of the audit shall be retained in the clients file.

Weather Data - Use local weather data when running NEAT and MHEA.

Fuel Costs - Use local fuel costs or average state fuel costs when running NEAT and MHEA. When obtaining the cost of propane and electricity, use average annual fuel costs updated a minimum of every 12 months. The Nebraska Energy Office will provide updated fuel costs to subgrantees on an annual basis. This info is also available at [www.neo.ne.gov](http://www.neo.ne.gov)

Material and Labor Costs - Use local material and labor costs when running NEAT and MHEA. If subgrantees cannot use actual material and labor costs, use estimated material and labor costs updated a minimum of every 12 months.

Core Sampling – A minimum of 5% of all frame homes billed each month in which insulation is installed in an enclosed cavity shall be tested by the subgrantee for proper weight and density by taking a minimum of 2 core samples. The core samples shall be taken in random locations. In sidewalls, 1 core sample shall be taken within 3 feet of the top of the wall. The results of the core samples shall be recorded on the inspection form.

NEAT Candidate Measures – The following measures are mandated for use by all subgrantees:

1. R-11, R-19, R-30, R-38 and R-49 ceiling/attic insulation
2. Fill ceiling cavity
3. Sill box insulation
4. Foundation wall insulation
5. R-11, R-19 R-30 and R-38 floor insulation
6. Wall and kneewall insulation
7. Duct insulation
8. Window sealing
9. Storm windows and doors
10. Window replacement
11. Low E windows
12. Furnace tune up
13. High eff. Furnace
14. High eff. Boiler
15. AC tune up
16. AC replace
17. Install/replace heat pump
18. Lighting retrofits
19. Water heater tank and pipe insulation
20. Low Flow shower heads
21. Water heater replacement

MHEA Candidate Measures – The following measures are mandated for use by all subgrantees:

1. Seal ducts
2. General air sealing
3. Wall fiberglass batt, loose fill cellulose and fiberglass in Additions
4. Floor loose fill cellulose and fiberglass

5. Floor loose fill cellulose and fiberglass in Additions
6. Roof loose fill cellulose and fiberglass
7. Roof loose fill cellulose and fiberglass in Additions
8. Roof loose fill cellulose and fiberglass
9. Roof loose fill cellulose and fiberglass in Additions
10. Add skirting
11. Add skirting on Addition
12. Replace marked doors (mandatory)
13. Replace wooden doors
14. Replace wooden doors in Additions
15. Storm doors
16. Storm doors in Additions
17. Window sealing
18. Window sealing in Additions
19. Replace single paned windows
20. Replace single paned windows in Additions
21. Glass storm windows
22. Glass storm windows in Addition
23. Tune heating system
24. Tune cooling system
25. Replace dx cooling equipment
26. Lighting retrofits
27. Water heater tank and pipe insulation
28. Low Flow shower heads
29. Water heater replacement
30. Replace heating system

Key Parameters and Default Parameters - The key parameters and default parameters shall be established by the Nebraska Energy Office and shall not be modified unless authorized.

Repair Costs - Repair costs shall be included in the overall SIR for the home. Repair costs are those costs that are necessary for the installation or preservation of a weatherization measure.

Multi-family Buildings - Multi-family buildings (buildings with more than four units) with a central heating system shall be weatherized as follows:

1. The building shall be weatherized according to the measures listed for frame, masonry and modular homes.
2. NEAT shall be used to establish a set of weatherization measures to be applied to all units. Weatherization measures shall be determined as follows:
  - a. An audit shall be run for each typical unit. A separate audit must be run for first floor units, units that do not have a foundation or attic, and the top floor units.
  - b. Measures determined by the audit for the typical units shall be applied to all units with the same construction.
  - c. It is not necessary to run an audit for each unit however; subgrantees must keep on file a copy of the audit(s) used to determine the allowable measures.
  - d. To determine heating system input and output, divide the input and output of the heating plant(s) by the number of units in the building.
  - e. Common areas may be weatherized according to the measures of the closest unit.
3. Multi-family buildings which have more than three stories may not be weatherized using the NEAT audit. DOE has indicated that they will rely on the EA-QUIP and

TREAT audits for these larger multi-family buildings. Subgrantees should consult the Nebraska Energy Office for technical assistance on such buildings.

### **INELIGIBLE MATERIALS/MEASURES**

The following weatherization materials/measures shall not be installed:

1. Shade screens, rigid awnings, louver systems or window films;
2. Vestibules;
3. Automatic gas ignition systems;
4. Microcomputer burner controls;
5. Stack dampers on gas or oil-fueled water heaters;
6. Desuperheater/water heaters;
7. Energy recovery equipment;
8. Gas conversion power burners for gas or oil-fueled heating systems;
9. Reduce input of burner or derate gas-fueled equipment;
10. Vent dampers for gas or oil-fueled heating systems;
11. Reduce excess combustion air by reducing vent connector size of gas-fueled appliances;
12. Industrial-grade white paint used as a heat-reflective measure on awnings, window louvers, doors and exposed, exterior ductwork;
13. Liquefied petroleum gas storage;
14. Electric freeze-prevention tape for pipes;
15. Attic, ceiling and whole-house fans;

## DEFINITIONS

### A

-Accessible Attic. An attic with a minimum 24 inch clearance measured from the bottom of the top cord or ridge board to the top of the ceiling joists.

-Accessible Ductwork/Hydronic Pipes. Ductwork or hydronic pipes with a minimum twenty-four (24) inch clearance on a minimum of two (2) sides of the ductwork or hydronic pipes.

-Accessible Foundation. A foundation with a minimum 24 inch clearance measured from the bottom of the floor joist to the ground.

-Air Infiltration Barrier. A covering that will allow moisture out and not allow air into a space or wall cavity.

-Accessible Kneewalls. A kneewall with a minimum 36 inch clearance measured from the top of the floor joist to the bottom of the rafters and a minimum 36 inch clearance measured from the kneewall to the exterior wall.

### B

-Basement. The bottom full story of a building below the first floor. A basement may be partially or completely below grade.

### C

-Certified Weatherization Staff. A subgrantee staff person who has successfully completed the Nebraska Energy Office certification requirements to perform a task in the weatherization program.

- cfm50. Cubic feet per minute of airflow at a 50 pascal pressure difference between the interior and exterior of a structure.

-Conditioned. A space that contains a source intended specifically to heat or cool that space.

-Crawl Space. A space below the first floor that is less than full story height. Ledge basements that are 6 feet or more deep are to be considered a crawl space.

### D

- Distribution System. The enclosed pathway for conditioned air to travel to and from the heating/cooling plant. It shall include but is not limited to the metal or fiber duct, panned floor cavity, designated wall cavity and the point where funnels and boots meet the wall or floor.

- Disabled/Inoperable Heating Plants. Heating plants that have had the fuel source disconnected and/or capped and the flue disconnected.

## **E**

-Eligible Heating Plant. A furnace or boiler that utilizes natural gas, propane, fuel oil or electricity as the fuel/energy source. Eligible heating plants include forced air, gravity, wall, floor, electric baseboard, mobile home furnaces, heat pumps and boilers. Gravity furnaces that have been retrofitted with a blower or that have been converted from one fuel source or another are also eligible.

-Exposed Floors. A floor that is in direct contact with the outside air. Examples are cantilevers, the floors of bay or bow windows, garage ceilings, etc.

## **H**

- Heating Plant. A boiler or furnace, not including the flue, fuel piping, thermostat, distribution system, etc.

- Heating System. A heating plant and the associated connections necessary for operation including, but not limited to, the flue, fuel piping, thermostat, distribution system, etc. This also includes the water heater, flue and fuel line.

- High Heat Source. Heat produced through the combustion process by solid fuel and/or fuel oil combustion appliances. Recessed lighting is also considered a high-heat source.

## **I**

-Inaccessible Underbellies. A mobile home underbelly with less than 24 inches clearance, measured from the weatherboard to the ground at the area to be weatherized.

## **K**

-Kneewall. A vertical wall between an attic and a conditioned space.

## **L**

-Ledged Basement. A basement constructed with a concrete or dirt ledge less than 6 feet deep around the perimeter of the foundation. The ledge may be only around a portion of the foundation wall. Ledges more than 6 feet in depth are considered a crawl space.

-Living area. An area within the conditioned envelope that is used on a regular basis for sleeping, eating, bathing etc.

## **N**

-(n) factor. A procedure for estimating natural air-leakage from measured blower door readings. See page 16

## **P**

-Pressure Treated. Lumber that has been commercially chemically treated under pressure with a wood preservative to prevent damage from moisture, insects, fungi and other forms of biological decay.

## **Q**

-Qualified Heating Technician. An individual or company that is specifically involved in the installation and/or servicing of residential heating/ cooling systems.

## **S**

- SIR (Savings to Investment Ratio). A ratio of economic performance as calculated by NEAT and MHEA audits, an SIR of 1 indicates the weatherization measure will pay for its self one time during its life.

- Spray-applied insulation. Insulation manufactured specifically to be spray applied.

- Safety Inspection An inspection performed by a qualified heating technician, a natural gas utility, a propane supplier or certified weatherization staff.

## **T**

-Tube-fill method. An insulation technique developed to install high density blown insulation in enclosed wall, ceiling and floor cavities.

-Type S Fuse. A non-removable adapter that is screwed into the fuse socket permitting only one size fuse to be installed.

## **U**

-Unconditioned. An area having no source of heat or cooling.

-Under-cut. To cut the bottom of an interior door to allow return air to flow from that area to the furnace compartment or common return.

-Unvented Combustion Space Heater. An unvented heating unit intended to supply heat to a small area.

## **W**

-Weatherboard. A covering consisting of a minimum 30 pound felt paper, exterior grade plywood, fiberboard, an air infiltration barrier or a material specifically manufactured as mobile home weatherboard installed on the underside of a mobile home to support and protect the floor insulation.

## CHARTS AND TABLES

The following table shall be used to determine the R-value of existing insulation:

<u>Loose/Blown</u>	<u>R-value per inch</u>	<u>Batt/Blanket</u>	<u>R-value per inch</u>
Fiberglass	R-2.2 per inch	Fiberglass	R-3.1 per inch
Rock Wool	R-2.9 per inch	Rock Wool	R-3.4 per inch
Cellulose	R-3.7 per inch		
Perlite	R-2.5 per inch	<u>Rigid</u>	<u>R-value per inch</u>
Vermiculite	R-2.2 per inch		
Other	R-3.1 per inch	Isocyanurate	R-7.0 per inch
		Polystyrene	R-3.2 per inch

The following table shall be used to determine the net free vent area for existing vents:

<u>Roof Vent</u>	<u>Net Free Vent Area</u>	<u>Soffit Vent</u>	<u>Net Free Vent Area</u>
8" diameter	50 square inches	4" x 16"	32 square inches
9" diameter	60 square inches	8" x 16"	64 square inches
9.5" diameter	70 square inches	4" x 8"	16 square inches
10" diameter	80 square inches		
13.5" diameter	144 square inches		
Turbine	239 square inches		

<u>Rectangular</u>		<u>Triangular</u>	
<u>Gable Vent</u>	<u>Net Free Vent Area</u>	<u>Gable Vent</u>	<u>Net Free Vent Area</u>
8" x 12"	48 square inches	30" base	82 square inches
12" x 18"	108 square inches	48" base	144 square inches
14" x 24"	168 square inches	72" base	197 square inches
18" x 24"	216 square inches		
24" x 30"	360 square inches		

The net free vent area for other size rectangular vents may be determined by using the following:

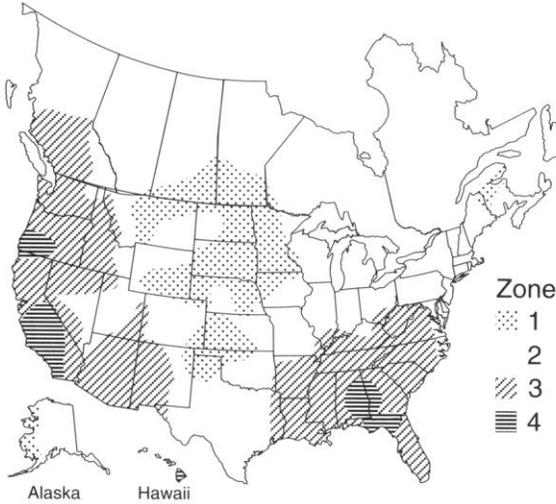
**Net Free Inches = (Width x Height) divided by 2**

The net free vent area for other size triangular vents may be determined using the following:

**Net Free Inches = (Width x Height) divided by 4**

# U.S. CLIMATE ZONES

In the mid 1980s, researchers at Lawrence Berkeley Laboratory developed a procedure for estimating natural air-leakage from measured blower-door readings. The number 20 had been used to convert 50-pascal blower-door airflows to natural airflows. The procedure outlined below gives a more accurate conversion factor "n". The formulas provided below the instructions describe how n is used. The last formula is the Building Tightness Limit (BTL) and is based on each occupant of a building needing 15 cfm of natural air exchange. This method was developed by George Tsongas using original methodology from LBL.



- Step 1: Find your climate zone on the map.**
- Step 2: Match that zone number with the same zone number on the table.**
- Step 3: Identify your site as well-shielded, normal, or exposed.**
- Step 4: Identify the column for your building's number of stories.**
- Step 5: Follow that column down to where it meets the row corresponding to your climate zone and shielding to find n.**
- Step 6: Use n to convert 50-pascal airflows to natural or vice versa.**
- Step 7: Find the building Tightness Limit (BTL), using the formula listed below.**

Zone	# of stories →	1	1.5	2	3
1	Well-shielded	18.6	16.7	14.9	13.0
	Normal	15.5	14.0	12.4	10.9
	Exposed	14.0	12.6	11.2	9.8
2	Well-shielded	22.2	20.0	17.8	15.5
	Normal	18.5	16.7	14.8	13.0
	Exposed	16.7	15.0	13.3	11.7
3	Well-shielded	25.8	23.2	20.6	18.1
	Normal	21.5	19.4	17.2	15.1
	Exposed	19.4	17.4	15.5	13.5
4	Well-shielded	29.4	26.5	23.5	20.6
	Normal	24.5	22.1	19.6	17.2
	Exposed	22.1	19.8	17.6	15.4

Step 6:

$$ACH_n = \frac{ACH_{50}}{n}$$

$$ACH_{50} = ACH_n \times n$$

$$CFM_n = \frac{CFM_{50}}{n}$$

$$CFM_{50} = CFM_n \times n$$

**Step 7: BTL(cfm50 minimum) = 15cfm x whichever of the following is greater (# of occupants or [the # of bedrooms +1] ) + (the # of naturally aspirating appliances that get combustion air from inside the building envelope) x (n) factor**

## HEALTH AND SAFETY

### 1) SAFETY INSPECTION

Prior to weatherizing the building envelope, all *eligible heating plants* over two ( 2 ) years of age that have not received a *safety inspection* during the twelve ( 12 ) months prior to the initial inspection shall be inspected by a *qualified heating technician*, utility company or *certified weatherization staff*.

Definitions:

-Certified Weatherization Staff. A subgrantee staff person who has successfully completed the Nebraska Energy Office certification requirements to perform a task in the weatherization program.

-Eligible Heating Plant. A furnace or boiler that utilizes natural gas, propane, fuel oil or electricity as the fuel source. Eligible heating plants include forced air, gravity, wall, floor, electric baseboard, mobile home furnaces, heat pumps and boilers. Gravity furnaces that have been retrofitted with a blower or that have been converted from one fuel source or another are also eligible.

-Qualified Heating Technician. An individual or company that is specifically involved in the installation and/or servicing of residential heating systems.

- Heating Plant. A boiler or furnace, not including the flue, fuel piping, thermostat, distribution system, etc.

- Heating System. A heating plant and the associated connections necessary for operation including, but not limited to, the flue, fuel piping, thermostat, distribution system, etc. This also includes the water heater, flue and fuel line.

- Safety Inspection An inspection performed by a qualified heating technician, a natural gas utility, a propane supplier or certified weatherization staff.

If the safety inspection was performed by a qualified heating technician, the need for replacement shall be confirmed by a utility company, a second qualified heating technician or certified weatherization staff.

The building envelope shall not be weatherized if the owner or client refuses a safety inspection of the heating system or until any heating system deficiency has been repaired and/or the heating plant replaced.

Propane gas detectors may be installed in homes that have propane combustion appliances located in a basement or crawlspace.

### **Safety Inspection**

The safety inspection shall include all of the following that apply to the heating and/or water heating system being inspected:

- 1-a) Conduct a leakage test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance.
- 1-b) Visually inspect the venting system for proper size and horizontal pitch and determine that there is not blockage or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.
- 1-c) Inspect burners and crossovers for blockage and corrosion.
- 1-d) Determine that the pilot is burning properly and that main burner ignition is satisfactory.
- 1-e) Test the pilot safety device to determine that it is operating properly.
- 1-f) Visually determine that main burner gas is burning properly.
- 1-g) If the appliance is equipped with a high and low flame control or flame modulator, check for proper main burner operation at low flame.
- 1-h) Test for spillage at the draft hood relief opening.
- 1-i) On furnaces and console heaters, test the heat exchanger for cracks and openings and visually inspect the heat exchanger for excessive corrosion.
- 1-j) On furnaces and console heaters, check the fan control for proper operation.
- 1-k) Determine that water heaters have a pilot access door, pressure relief valve and draft hood.
- 1-l) On water heaters and boilers, inspect for evidence of water or combustion product leaks.
- 1-m) On boilers, determine that the water pumps and automatic controls are in operating condition.
- 1-n) If accessible, inspect the central air conditioner coils.
- 1-o) Check the fan and belt condition.
- 1-p) Inspect for exposed wiring.
- 1-q) The gas detectors shall be 110 volt and permanently installed.

<p><b>2) BACKDRAFT TEST</b></p> <p>A back-draft test shall be performed on all vented, naturally drafting combustion appliances at the time of the initial and quality control inspections.</p> <p>A back-draft test shall not be performed on solid fuel burning appliances.</p>	<p style="text-align: center;"><b>Backdraft Test</b></p> <p>The back-draft test shall be conducted in the following manner:</p> <p>NOTE: For appliances that share a common flue, test the smallest BTU appliance first. Place into operation the next largest appliance and test that one. Then perform a test with all appliances operating simultaneously.</p> <ul style="list-style-type: none"> <li><b>2-a)</b> Close all exterior windows and doors. If the combustion appliance/appliances are in a basement, crawl space or mechanical room, close the door to the basement, crawlspace or mechanical room.</li> <li><b>2-b)</b> Place all appliances and exhaust equipment that are vented to the outside of the heated envelope into operation.</li> <li><b>2-c)</b> Visually determine that main burner gas is burning properly: i.e., no floating, lifting or flashback.</li> <li><b>2-d)</b> Test for spillage at the draft hood relief opening after 5 minutes of main burner operation.</li> </ul>
<p><b>3) CO TEST</b></p> <p>A carbon monoxide (CO) test shall be performed on all naturally drafting combustion appliances at the time of the initial and quality control inspections.</p> <p>CO tests shall not be performed on solid fuel burning appliances.</p> <p>If a CO test is not performed on a gas range, gas dryer or gas refrigerator, a CO alarm shall be installed.</p> <p>CO alarms shall be installed whenever a combustion appliance is present.</p>	<p style="text-align: center;"><b>CO (Carbon Monoxide) Test</b></p> <p>The CO (carbon monoxide) test shall be conducted in the following manner:</p> <ul style="list-style-type: none"> <li><b>3-a)</b> Close all exterior windows and doors. If the combustion appliance/appliances are in a basement, crawl space or mechanical room, close the door to the basement, crawlspace or mechanical room.</li> <li><b>3-b)</b> Place the appliance in operation and after 5 minutes, test for CO in the undiluted flue gases. This is known as “as measured.”</li> <li><b>3-c)</b> If CO levels exceed 200 PPM as measured in the undiluted flue gases or the ambient air, a Certified Heating Technician or Qualified Heating Technician shall complete a tune and clean of the appliance to reduce the CO levels if possible.</li> <li><b>3-d)</b> CO alarms shall be installed according to manufacturer’s instructions.</li> </ul>

#### **4) REPLACE HEATING PLANT**

Eligible unsafe heating plants in frame, masonry and modular homes that cannot be repaired shall be replaced.

Units that contain heating plants that are inoperable or red-tagged at the time of the initial inspection shall not be weatherized until the heating plant has been repaired or replaced.

A NEAT or MHEA audit shall be performed on all homes that require a replacement heating plant.

With Nebraska Energy Office approval, multiple heating plants or motorized dampers may be installed to provide zone heating.

Unsafe space heaters may be replaced with a forced air system.

With Nebraska Energy Office approval, the heating plant may utilize a new fuel source.

If the replacement heating plant is installed by a sub-contractor, a service label must be installed on replacement combustion appliances and those that have had repairs or have been tuned and cleaned.

##### Mobile Home specific measures

Eligible unsafe heating plants in mobile homes that cannot be repaired shall be replaced.

Mobile homes heated by naturally drafting combustion heating systems that are not specifically manufactured for use in mobile homes shall not be weatherized until the heating system has been replaced with a heating system designed for use in mobile homes.

Mobile homes that are designed to use the underbelly area as return air shall have, with client permission, all the return registers blocked and sealed.

##### **General**

- 4-a)** Forced air furnaces shall have a minimum AFUE of 90 percent, boilers a minimum of 85 percent and wall and console heaters, a minimum of 80 percent.
- 4-b)** Efficiency ratings for forced air furnaces and boilers must be listed in the most current edition of the Gas Appliance Manufacturers Association (GAMA) Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment.
- 4-c)** Heat exchangers in all replacement heating plants shall have a minimum 10 year manufacturer's warranty.
- 4-d)** The replacement heating plant shall be competitively bid and properly sized using the post-weatherization characteristics of the home.
- 4-e)** The service label shall be placed on or near the heating plant containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed.

##### Mobile Home specific work standards

- 4-f)** Forced air furnaces shall have a minimum AFUE of 90 percent, if possible or be the highest efficiency practical.
- 4-g)** The replacement heating plant shall be specifically manufactured for use in mobile homes.
- 4-h)** If the connection between the new furnace and the trunk line will not be accessible after installation, the heating contractor shall seal the connection.

##### **Venting and Ductwork**

- 4-i)** The replacement heating plant shall use the existing distribution system, if possible.
- 4-j)** New ductwork or hydronic pipes may be installed to properly balance the system. Flexible ductwork shall be no more than 4 lineal feet per run if possible.
- 4-k)** The replacement heating plant shall be properly vented.
- 4-l)** If the replacement heating plant is installed with existing central air conditioning, the air conditioner evaporator coil should be a cased coil or be raised and made accessible for periodic service and cleaning.

- 4-m)** The condensate line shall not be drained to the exterior of the home.
- 4-n)** If a new forced-air furnace or boiler is installed that will not be vented through the masonry chimney but the water heater will still be vented through that chimney, a properly sized flue liner shall be installed.
- 4-o)** As an alternative, a power vent may be installed on the water heater.
- 4-p)** Furnace filter racks on new heating systems shall be installed in an area that is convenient and conducive for the customer to access.

**Thermostat**

- 4-q)** The thermostat shall be calibrated and adjusted and any operable accessories that were installed on the existing heating system shall be removed and reinstalled on the new heating system, if possible. If a new thermostat is installed, the wire hole in the wall behind the thermostat shall be sealed.

Mobile Home specific work standards

- 4-r)** The combustion air sleeves and air conditioner condensates to the underbelly shall not be covered.
- 4-s)** When the return air system is blocked and sealed a minimum 16 inch x 24 inch vent shall be installed in the furnace compartment door.
- 4-t)** If the vent is not installed, the mobile home floor shall be not be insulated.
- 4-u)** Interior doors may need to be under-cut to provide adequate return air to the furnace.

Definitions:

-Under-cut. To cut the bottom of an interior door to allow return air to flow from that area to the furnace compartment or common return.

- 4-v)** All fuel-burning, heat-producing appliances except ranges and ovens, shall be vented to outside.
- 4-w)** All fuel-burning appliances, (except ranges, ovens, illuminating appliances, clothes dryers,) solid fuel-burning fireplaces and solid fuel-burning fireplace stoves, must be installed to provide for the complete separation of the combustion system from the interior atmosphere of the manufactured home (i.e., to draw their combustion air from outside).

<p>Unvented combustion space heaters are not an eligible heating system and shall not be replaced with new unvented combustion space heaters</p> <p>Unvented combustion space heaters may remain as secondary heat sources provided they comply with the International Residential Code (IRC) and the International Fuel Gas Code (IFGC).</p>	<p><b>4-x)</b> Unvented gas- and liquid-fueled space heaters that remain in a completed single-family house after weatherization shall not have an input rating in excess of 40,000 Btu/hour and shall not be located in, or obtain combustion air from sleeping rooms, bathrooms, toilet rooms, or storage closets.</p> <p>Note: See Health and Safety pages 1 and 2 for more details.</p>
<p><b>5) TUNE AND CLEAN</b></p> <p>A tune and clean may be performed on eligible heating plants.</p> <p>Ductwork may be cleaned.</p>	<p style="text-align: center;"><b>Tune and Clean</b></p> <p>The tune-up and cleaning shall be conducted in the following manner:</p> <p><b>5-a)</b> Lubricate all moving parts.</p> <p><b>5-b)</b> Calibrate and adjust the thermostat.</p> <p><b>5-c)</b> Clean and replace the furnace filter, if necessary.</p> <p><b>5-d)</b> Adjust the conditioned air flow, high limit control, fan control and temperature rise.</p> <p><b>5-e)</b> Clean and adjust the burners.</p> <p><b>5-f)</b> Remove and clean the blower.</p> <p><b>5-g)</b> Clean and vacuum the return air and furnace cabinet, filter rack, exhaust port and draft hood.</p> <p><b>5-h)</b> Clean the heat exchanger.</p> <p><b>5-i)</b> Adjust the belt tension or replace the belt, if necessary.</p> <p><b>5-j)</b> On frame homes, seal the thermostat wire penetration, if necessary.</p> <p><b>5-k)</b> Test the furnace for CO and adjust or repair the furnace, if necessary.</p> <p><b>5-l)</b> Test the heating elements and sequencers on electric units.</p> <p><b>5-m)</b> Inspect the interior and exterior wiring inside the cabinet on electric units.</p> <p><b>5-n)</b> If accessible, inspect and clean the central air conditioner coils.</p>

**6) REPAIR HEATING PLANT**

In owner occupied homes, if the material and labor to correct deficiencies in eligible heating plants exceeds \$500, the unit shall be replaced. However, unique situations may be dealt with on a case by case basis.

In renter occupied homes, if the material and labor to correct deficiencies in eligible heating plants exceeds \$400, the owner shall repair or replace the heating plant. However, if replacement is made in accordance with the requirements of these installation standards, the Weatherization Assistance Program may contribute a maximum of \$500, for the replacement of the heating plant and flue liner, if one is necessary.

Weatherization of the building envelope shall not proceed until the unit has been repaired or replaced.

A maximum of \$500, may be spent to repair unsafe solid fuel combustion heating systems.

If a dwelling is heated by *unvented combustion space heaters* and an inoperable eligible heating system is present, the eligible heating system shall be repaired or replaced to eliminate the need for unvented space heaters.

Definitions:

-Unvented Combustion Space Heater. An unvented heating unit intended to supply heat to a small area.

If the need for unvented combustion space heaters cannot be eliminated, the subgrantee shall instruct the client regarding the dangers of carbon monoxide and excessive moisture levels, particularly if any unvented space heaters are left in the dwelling as a secondary heat source, or emergency back-up.

**General**

- 6-a)** All repairs shall be performed by a qualified heating technician, utility company or certified weatherization staff.

<p><b>7) REPAIR CENTRAL AIR CONDITIONER</b></p> <p>Air conditioner evaporator coils of operable units may be replaced if they cannot be repaired or will not fit the new heating plant.</p> <p>Drip pans in poor condition may be replaced.</p> <p>A maximum \$500 may be spent to repair heat pumps and central air conditioners</p> <p>Heat pumps and central air conditioners that cannot be repaired may be replaced if cost justified by the NEAT or MHEA audit.</p> <p>In renter occupied homes if the cost to repair the central air conditioner or heat pump exceeds \$500, the owner may repair or replace the unit. However if the central air conditioner or heat pump is replaced in accordance with the requirements of these installation standards the Weatherization Assistance Program may contribute a maximum of \$500.</p> <p>All replacement heat pumps and central air conditioners must be cost justified by the NEAT or MHEA audit and may not be charged to the health and safety line item.</p>	<p style="text-align: center;"><b>General</b></p> <p><b>7-a)</b> Replacement central air conditioners shall be a minimum 14-SEER (Seasonal Energy Efficiency Factor) and use environmentally friendly Freon.</p> <p><b>7-b)</b> Replacement heat pumps shall be a minimum 14-SEER and 8.2-HSPF (Heating Seasonal Performance Factor) and use environmentally friendly Freon. Heat pumps must be installed with ramp-up type thermostats especially designed to bring backup heat in stages, and only when the heat pump can no longer keep up with demand, and must be able to differentiate between a demand call and a 'return from setback' call for heat.</p> <p><b>7-c)</b> The replacement central air conditioner or heat pump shall be properly sized using the post-weatherization characteristics of the home.</p> <p><b>7-d)</b> Replacement central air conditioners and heat pumps shall be replaced by a Qualified Heating Technician.</p> <p><b>7-e)</b> A service label shall be placed on or near the furnace plenum containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed</p>
<p><b>8) WATER HEATERS</b></p> <p>Existing unvented gas water heaters shall be vented to the exterior.</p> <p>Unsafe water heaters that cannot be repaired shall be replaced.</p> <p>With Nebraska Energy Office approval, replacement water heaters may utilize a new fuel source.</p> <p>A maximum of \$250 in material and labor may be spent to correct deficiencies in water heaters. If the material and labor exceeds \$250, the unit shall be replaced in owner occupied homes.</p> <p>In renter occupied homes, the owner shall repair</p>	<p style="text-align: center;"><b>General</b></p> <p><b>8-a)</b> New gas water heaters shall have a minimum efficiency of .60 and new electric water heaters shall have a minimum efficiency of .91.</p> <p><b>8-b)</b> All repairs shall be performed by a qualified heating or plumbing technician, utility company or certified weatherization staff.</p> <p><b>8-c)</b> Replacement water heaters shall be installed by a qualified heating or plumbing technician.</p> <p><u>Mobile Home specific work standards</u></p> <p><b>8-d)</b> Replacement gas water heaters in mobile homes shall be specifically designed as mobile home water heaters.</p> <p><b>8-e)</b> A service label shall be placed on or near the</p>

<p>or replace the water heater. If replacement is made in accordance to these installation standards the Weatherization Assistance Program may contribute a maximum of \$150.</p> <p>Weatherization of the building shall not proceed until the water heater has been repaired or replaced.</p>	<p>water heater containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed.</p>
<p><b>9) CLOTHES DRYERS</b></p> <p>Existing unvented gas clothes dryers shall be vented to the exterior.</p> <p>Electric clothes dryers shall be vented to the exterior whenever possible.</p> <p><u>Mobile Home specific measures</u></p> <p>Existing unvented gas clothes dryers shall be vented to the exterior and through the skirting, if necessary.</p>	<p style="text-align: center;"><b>Dryer Venting</b></p> <p><b>9-a)</b> Dryer vent pipe should not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.</p> <p><b>9-b)</b> Acceptable fasteners include clamps, straps and duct mastic with mesh tape.</p> <p><b>9-c)</b> Dryer vent pipe shall be metal and the termination cap shall be dampered and attached with rust proof fasteners.</p> <p><b>9-d)</b> Dryer vent ductwork shall be smooth surfaced and whenever possible, not exceed 14 feet in length.</p> <p><b>9-e)</b> No more than two 90 degree elbows may be used in the vent system.</p> <p><b>9-f)</b> Relocation of dryers may need to be considered to meet this vent pipe length limitation.</p> <p><b>9-g)</b> Flexible metal vent pipe may be used if it does not exceed 6 feet in length. The dryer vent pipe shall not be installed with sheet metal screws, rivets or other intrusive fasteners that will collect lint.</p>
<p><b>10) EXHAUST FANS</b></p> <p>Kitchen and bathroom exhaust fans shall be vented to the exterior whenever possible.</p>	<p style="text-align: center;"><b>Exhaust Fan Venting</b></p> <p><b>10-a)</b> Exhaust vent pipe shall be fastened at all connections with sheet metal screws or rivets.</p> <p><b>10-b)</b> Horizontal runs and elbows should be avoided if possible.</p> <p><b>10-c)</b> If the exhaust vent is terminated through the soffit, caution must be taken to avoid moisture collecting in the vent pipe.</p> <p><b>10-d)</b> When vented to the exterior, the exhaust vent pipe shall be metal and the termination cap shall be dampered.</p>

<p><b>11) ELECTRICAL</b></p>	<p style="text-align: center;"><b>S-Fuse Sizing</b></p> <p><b>11-a)</b> Type S fuses must be sized according to the smallest gauge of wire in the circuit to be protected. The following gauge wire requires the following size fuse:</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;"><u>Wire Gauge</u></th> <th style="text-align: left;"><u>Fuse Size</u></th> </tr> </thead> <tbody> <tr> <td>12 gauge wire</td> <td>20 amp fuse</td> </tr> <tr> <td>14 gauge wire</td> <td>15 amp fuse</td> </tr> </tbody> </table>	<u>Wire Gauge</u>	<u>Fuse Size</u>	12 gauge wire	20 amp fuse	14 gauge wire	15 amp fuse
<u>Wire Gauge</u>	<u>Fuse Size</u>						
12 gauge wire	20 amp fuse						
14 gauge wire	15 amp fuse						
<p><b>12) SHIELDING</b></p> <p>When adding additional insulation to the attic, shielding shall be installed around heat and high-heat sources.</p>	<p style="text-align: center;"><b>General</b></p> <p><b>12-a)</b> Shielding shall be metal and kept a minimum of 3 inches from any heat source and a minimum of 6 inches from a high-heat source.</p> <p><b>12-b)</b> Shielding shall be installed at a height to accommodate the depth of the added insulation.</p> <p><b>12-c)</b> If a masonry chimney has an existing metal or metalbestos flue liner, the chimney does not need to be shielded.</p> <p style="color: red;"><u>Mobile Home specific work standards</u></p> <p><b>12-d)</b> If a mobile home has a double sleeve flue, the chimney does not need to be shielded.</p>						
<p><b>13) MOISTURE BARRIER</b></p> <p>A full ground laid moisture barrier shall be installed whenever possible.</p>	<p style="text-align: center;"><b>General</b></p> <p><b>13-a)</b> The moisture barrier shall be a minimum 6-mil polyethylene and extend up the walls and the support columns at least 12 inches and the joints shall overlap a minimum of 12 inches.</p> <p><b>13-b)</b> In the event the entire floor cannot be covered, all accessible areas shall receive a moisture barrier.</p> <p><b>13-c)</b> When installing insulated skirting without adequate clearance to install a full ground laid moisture barrier, the moisture barrier shall extend a minimum of 24 inches beyond the insulation, if possible.</p>						

<p><b>14) SIDING REMOVAL</b></p> <p>Slate siding that may contain asbestos may be removed as long as the siding material does not become friable.</p>	<p style="text-align: center;"><b>General</b></p> <p><b>14-a)</b> Removal shall comply with State and local regulations.</p>
<p><b>15) FIBERGLASS INSULATION</b></p> <p>Fiberglass batt insulation installed in a <i>living area</i> shall be covered with paneling, plywood, chipboard, hardboard or drywall, with the exception of sill box insulation.</p> <p>Definitions:</p> <p>-<i>Living area.</i> An area within the conditioned envelope that is used on a regular basis for sleeping, eating, bathing etc.</p>	<p><b>15-a)</b> If the covering is drywall, the drywall shall be taped and receive 1 coat of joint compound.</p> <p><b>15-b)</b> If plywood, chipboard or hardboard is installed, the joints shall be caulked.</p> <p><b>15-c)</b> If paneling is installed, the paneling shall be a minimum 3/16 inch and the joints shall be caulked.</p> <p><b>15-d)</b> The vapor barrier on sill box insulation shall completely cover the insulation to prevent fibers from entering the basement.</p>
<p><b>16) BLOWER DOOR TEST</b></p> <p>A pre-infiltration and post infiltration blower door test shall be performed to determine the building tightness limits (BTL) of the home.</p> <p>If using the blower door would compromise the health and safety of the occupants of the home or the agency staff, crews or contractors, the blower door tests and air sealing shall not be done.</p>	<p style="text-align: center;"><b>BTL (Building Tightness Limit)</b></p> <p><b>16-a)</b> The building tightness limit (BTL) or minimum cfm50 for any structure shall be calculated as follows:</p> <p style="padding-left: 40px;">BTL(cfm50 minimum) = 15cfm x whichever of the following is greater (# of occupants or [the # of bedrooms +1] ) + (the # of naturally aspirating appliances that get combustion air from inside the building envelope) x <i>(n) factor</i></p> <p>Definitions:</p> <p><i>(n) factor.</i> A procedure for estimating natural air-leakage from measured blower door readings. See page 16.</p>
<p><b><u>GENERAL HEAT LOSS</u></b></p>	
<p><b>17) MECHANICAL SYSTEMS</b></p> <p>Accessible openings, tears and joints in the <i>distribution system</i> shall be sealed.</p> <p>Uninsulated, <i>accessible</i> distribution systems located in spaces intended to be unconditioned shall be sealed and insulated.</p> <p>Definitions:</p> <p>- <i>Distribution System.</i> The enclosed pathway for conditioned air to travel to and from the heating/cooling plant. It shall include but is not limited to the metal or fiber duct, panned floor cavity, designated wall cavity and the point where funnels and boots meet the wall or floor.</p> <p>- <i>Accessible Ductwork/Hydronic Pipes.</i> Ductwork or hydronic pipes with a minimum twenty-four (24) inch clearance on a minimum of two (2) sides of the ductwork or hydronic pipes.</p> <p>All misaligned or disconnected ductwork and floor registers shall be realigned or reattached</p>	<p style="text-align: center;"><b>Duct Sealing</b></p> <p><b>17-a)</b> Tears and joints shall be sealed using nontoxic and water-resistant mastic.</p> <p><b>17-b)</b> Mesh tape shall be used when openings and tears are over 1/16 of an inch.</p> <p><b>17-c)</b> Butyl tape may be used when the installation of mastic is not feasible.</p> <p><b>17-d)</b> The butyl tape shall have a minimum 2 mil aluminum backing and a minimum 15 mil adhesive.</p> <p style="text-align: center;"><b>Duct Insulation</b></p> <p><b>17-e)</b> Ductwork shall be insulated with a minimum R-8 insulation secured with cord, wire, plastic or nylon bands.</p> <p><b>17-f)</b> The insulation shall have a vapor barrier installed to the exterior and the joints shall be</p>

<p>using sheet metal screws.</p> <p>Missing or damaged ductwork and floor registers shall be replaced and sealed.</p> <p>Fiberglass duct liner insulation shall not be installed.</p> <p>Disposable furnace filters may be replaced.</p> <p>Furnace filter racks may be moved and/or installed in an area that is convenient and conducive for the customer to access.</p> <p>Programmable thermostats may be installed.</p> <p>Mercury thermostats may be replaced with digital thermostats.</p> <p>Switchplate thermometers may be installed.</p> <p>Plenums adjacent to <u>high heat sources</u> shall not be insulated.</p> <p>Definition:</p> <p>- <u>High Heat Source</u>. Heat produced through the combustion process by solid fuel and/or fuel oil combustion appliances. Recessed lighting is also considered a high-heat source.</p> <p><u>Hydronic pipes</u> located in spaces intended to be unconditioned shall be insulated.</p> <p>Definition:</p> <p>-<u>Hydronic pipes</u>. Water lines used to distribute water or steam for water or steam boilers.</p> <p>Water lines that have asbestos pipe wrap shall not be insulated or sealed in the area containing the asbestos.</p> <p>Water lines shall be insulated.</p> <p>Water heaters shall be insulated.</p> <p>Insulation shall not be installed on water heaters if doing so voids the warranty of the unit or if the water heater is lacking a pilot access door or pressure relief valve.</p> <p>Pipe wrap shall not be installed if the water heater lacks a pressure relief valve.</p> <p>Low flow showerheads and low flow sink aerators may be installed.</p>	<p>sealed with butyl tape, caulking or mastic.</p> <p><b>Replacement Thermostats</b></p> <p><b>17-g)</b> Mercury thermostats shall be properly disposed of.</p> <p><b>Hydronic Pipe Insulation</b></p> <p><b>17-h)</b> Hydronic pipes shall be insulated with 1 inch material having a minimum R-4 pipe insulation specifically manufactured as hydronic pipe insulation. Joints and elbows shall be insulated.</p> <p><b>Water Heater and Water Line Insulation</b></p> <p><b>17-i)</b> Water heater insulation shall be a minimum R-5 blanket secured with tape and bound with a minimum of 2 wire, cord, plastic or nylon bands on the tank.</p> <p><b>17-j)</b> Water lines shall be insulated a minimum of 18 feet of hot and 3 feet of cold in all directions from the water heater, using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.</p> <p><u>Mobile Home specific work standards</u></p> <p><b>17-k)</b> All accessible water lines in the water heater compartment shall be insulated using properly sized preformed pipe wrap or insulation specifically designed as pipe wrap.</p> <p><b>17-l)</b> Electric water heaters shall have the top insulated and the thermostat control access panels accessible or marked and labeled.</p> <p><b>17-m)</b> Each section of preformed pipe wrap shall be fastened with a minimum of 3 wire, cord, plastic or nylon bands.</p> <p><b>17-n)</b> Joints and elbows shall be insulated.</p> <p><b>17-o)</b> Duct tape may not be used as the only means of fastening the pipe wrap.</p> <p><b>17-p)</b> Insulation shall not cover the pressure relief valve, end of the drip leg, draft hood, burner air inlet, pilot light access door, thermostat control, drain valve or the top of the water heater on natural gas or propane water heaters.</p>
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<p>Existing inefficient water heaters in owner occupied homes may be replaced if cost justified by the NEAT or MHEA audit.</p> <p>In renter occupied homes if inefficient water heaters are replaced in accordance with these installation standards the Weatherization Assistance Program may contribute a maximum of \$150.</p> <p>Existing furnaces, central air conditioners and heat pumps in owner occupied homes may be replaced if cost justified by the NEAT or MHEA audit.</p> <p>In owner occupied homes the replacement of furnaces, water heaters, central air conditioners or heat pumps for energy efficiency reasons may not be charged to the Health and Safety line item.</p> <p>In renter occupied homes if furnaces, central air conditioners or heat pumps are replaced for efficiency reasons in accordance with these installation standards the Weatherization Assistance Program may contribute a maximum of \$500. These expenditures may not be charged to the Health and Safety line item.</p>	<p><b>17-q)</b> Insulation shall not cover the pressure relief valve, end of the drip leg, high limit switch, plumbing pipes or drain valve on electric water heaters.</p> <p><b>17-r)</b> Pipe wrap shall not be installed within 2 inches of a flue and/or draft hood.</p> <p style="text-align: center;"><b>Replacement Water Heater</b></p> <p><b>17-s)</b> New gas water heaters shall have a minimum efficiency of .60 and new electric water heaters shall have a minimum efficiency of .91.</p> <p><b>17-t)</b> A service label shall be placed on or near the water heater containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed</p> <p style="text-align: center;"><b>Replacement Heating Plant</b></p> <p><b>17- u)</b> Forced air furnaces shall have a minimum AFUE of 90 percent, boilers a minimum of 85 percent and wall and console heaters, a minimum of 80 percent.</p> <p><b>17-v)</b>Efficiency ratings for forced air furnace and boilers must be listed in the most current edition of the Gas Appliance Manufacturers Association (GAMA) Consumer’s Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment.</p> <p><b>17- w)</b>Heat exchangers in all replacement heating plants shall have a minimum 10 year manufacturer’s warranty.</p> <p><b>17- x)</b> The replacement heating plant shall be competitively bid and properly sized using the post-weatherization characteristics of the home.</p> <p><b>17-y)</b> The service label shall be placed on or near the heating plant containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed.</p> <p><u>Mobile Home specific work standards</u></p> <p><b>17-z)</b> Forced air furnaces shall have a minimum AFUE of 90 percent, if possible or be the highest efficiency practical.</p> <p><b>17-1a)</b>The replacement heating plant shall be specifically manufactured for use in mobile homes.</p>
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**17-1b)** If the connection between the new furnace and the trunk line will not be accessible after installation, the heating contractor shall seal the connection.

**Central Air Conditioners and Heat Pumps**

17-1c) Replacement central air conditioners shall be a minimum 14-SEER (Seasonal Energy Efficiency Factor) and use environmentally friendly Freon.

17-1d) Replacement heat pumps shall be a minimum 14-SEER and 8.2-HSPF (Heating Seasonal Performance Factor) and use environmentally friendly Freon. Heat pumps must be installed with a ramp-up type thermostats designed to bring backup heat in stages, and only when the heat pump can no longer keep up with demand, and must be able to differentiate between a demand call and a 'return from setback' call for heat.

17-1e) The replacement central air conditioner or heat pump shall be properly sized using the post weatherization characteristics of the home.

17-1f) Replacement central air conditioners and heat pumps shall be replaced by a Qualified Heating Technician.

17-1g) A service label shall be placed on or near the furnace plenum containing the name, business address and phone number of the company performing the work, any repairs that were completed and the date the work was performed.

**Venting and Ductwork**

**17-1h)** The replacement heating plant, central air conditioners or heat pumps shall use the existing distribution system, if possible.

**17-1i)** New ductwork or hydronic pipes may be installed to properly balance the system. Flexible ductwork shall be no more than 4 lineal feet per run if possible.

**17-1j)** The replacement heating plant shall be properly vented.

**17-1k)** If the replacement heating plant is installed with existing or new central air conditioning, the air conditioner evaporator coil should be a cased coil or be raised and made accessible for periodic service and cleaning.

	<p><b>17-1L)</b> The condensate line shall not be drained to the exterior of the home.</p> <p><b>17-1m)</b> If a new forced-air furnace or boiler is installed that will not be vented through the masonry chimney but the water heater will still be vented through that chimney, a properly sized flue liner shall be installed.</p> <p><b>17-1n)</b> As an alternative, a power vent may be installed on the water heater.</p> <p><b>17-1o)</b> Furnace filter racks on new heating systems shall be installed in an area that is convenient and conducive for the customer to access.</p> <p style="text-align: center;"><b>Thermostat</b></p> <p><b>17-1p)</b> The thermostat shall be calibrated and adjusted and any operable accessories that were installed on the existing heating system shall be removed and reinstalled on the new heating system, if possible. If a new thermostat is installed, the wire hole in the wall behind the thermostat shall be sealed.</p> <p><u>Mobile Home specific work standards</u></p> <p><b>17-1q)</b> The combustion air sleeves and air conditioner condensates to the underbelly shall not be covered.</p> <p><b>17-1r)</b> When the return air system is blocked and sealed a minimum 16 inch x 24 inch vent shall be installed in the furnace compartment door.</p> <p><b>17-1s)</b> If the vent is not installed, the floor shall be not be insulated.</p> <p><b>17-1t)</b> Interior doors may need to be <u>under-cut</u> to provide adequate return air to the furnace.</p> <p>Definitions:</p> <p><b>-Under-cut.</b> To cut the bottom of an interior door to allow return air to flow from that area to the furnace compartment or common return.</p>
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## 18) AIR INFILTRATION

All direct penetrations to the exterior of the heated envelope shall be sealed.

A maximum of \$40 in material and labor per 100 *cfm50* reduction in air leakage may be spent.

Definitions:

- *cfm50*. Cubic feet per minute of airflow at a 50 pascal pressure difference between the interior and exterior of a structure.

The *cfm50* reductions shall be checked at the end of each measure to determine its cost effectiveness.

### Mobile Home specific measures

Exterior water heater compartments shall be sealed and isolated from the interior of the home, if possible.

Water heater compartment doors that are deteriorated or damaged may be replaced.

Exterior doors that are beyond repair shall be replaced

With the client's permission, a peephole or door light may be installed.

Vinyl, wood or aluminum combination storm doors may be installed.

Door insect screens may be repaired or replaced.

Outlet and switchplate insulators may be installed on exterior and interior walls. If the outlet or switch has aluminum wiring, insulators shall not be installed.

Weather-strips, thresholds, door bottoms and sweeps may be replaced, if necessary.

### General

**18-a)** All materials used to seal direct penetrations shall form a permanent and airtight seal.

### Caulking and Air Sealing Materials

**18-b)** Caulking shall be paintable and shall be clear or a color complementary to the surface to which it is applied.

**18-c)** Caulking installed around heat-producing sources shall be specifically manufactured for installation around heat sources.

**18-d)** Openings wider than ¼ inch shall be packed with material specifically designed as a packing material prior to caulking.

**18-e)** Packing material shall be compatible with the type of caulking used.

**18-f)** Expanding and non-expanding foam sealant may be used as an air sealing material except in mobile home water heater compartments.

**18-g)** If mortar or mortar patch is used, it shall be a color complementary to the surface to which it is applied and be textured to match the surrounding surface as close as possible.

**18-h)** Spray applied insulation may be used as an air sealing material.

### Mobile Home specific work standards

**18-i)** All openings from the water heater compartment into the heated space shall be sealed with metal or 5/8" fire code drywall if possible.

### Doors

**18-j)** Replacement doors shall be solid core, wood insulated or pre-hung metal insulated doors. Pre-hung metal doors and insulated doors shall be R-4 or greater.

**18-k)** Existing locksets may be reinstalled on the new door.

**18-l)** If a new lockset is installed, 2 keys shall be provided to the client.

**18-m)** Any safety lock installed on the existing door shall be removed and reinstalled on the new door, if possible.

	<p><b>18-n)</b> The existing casing may be reinstalled but if new casing is needed, the casing shall match the existing in design and dimension, as closely as possible. The cavities around the door frame shall be insulated or sealed with non-expanding foam sealant.</p> <p><b>18-o)</b> Door lights with uninsulated glass shall not exceed 1 square foot.</p> <p><b>18-p)</b> Door lights with insulated glass shall not exceed 2 square feet in size.</p> <p><b>18-q)</b> All door casings shall be caulked.</p> <p><b>18-r)</b> Doors shall conform to the thickness of the existing jamb.</p> <p><b>18-s)</b> Solid core doors shall have 3 hinges.</p> <p><u>Mobile Home specific work standards</u></p> <p><b>18-t)</b> The replacement doors shall be a mobile home door, a solid core, a wood insulated or a prehung metal insulated door.</p> <p><b>18-u)</b> On new doors, a gutter, flashing or a drip cap shall be installed.</p> <p style="text-align: center;"><b>Below and Grade-Level Doors</b></p> <p><b>18-v)</b> Custom made below-grade doors shall be constructed of ¾ inch exterior grade plywood.</p> <p><b>18-w)</b> The door shall be reinforced with 1x4 inch common lumber and insulated with a minimum R-7 rigid insulation and framed with pressure treated wood, redwood or cedar.</p> <p><b>18-x)</b> The door shall be attached with a minimum of 2 hinges and a minimum of 1 latching mechanism, weather-stripped and the bottom of the door sealed.</p> <p><b>18-y)</b> The door shall have a handle on both the interior and exterior of the door.</p> <p><b>18-z)</b> Thresholds shall be wood or aluminum and be caulked at the sill.</p> <p><b>18-1a)</b> If trimming the bottom of the door is necessary, the door shall be trimmed at a 5 degree angle.</p> <p><b>18-1b)</b> Weather-strips, thresholds, door bottoms and sweeps shall have a vinyl or silicone insert.</p> <p><b>18-1c)</b> Weather-strips and sweeps shall have the last fastener or screw no more than 2-1/2 inches from the end.</p>
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Broken or missing door glass shall be repaired or replaced

Mobile Home specific measures

All operable windows in mobile homes shall have either an operable primary window or an interior one-light or self-storing storm window.

If the mobile home exterior walls will accept house type replacement windows they may be installed.

**18-1d)** Minor door adjustments such as tightening the hinges or adjusting the strike plate, shall be completed.

**Door Glass**

**18-1e)** Replacement door glass shall not be less than “B” grade single strength.

**18-1f)** Door glass over 40 inches in either dimension shall not be less than “B” grade double strength, if possible.

**18-1g)** Door glass over 1 sq. ft. shall be safety glass.

**18-1h)** Door glass shall be secured with glazing points and glazing compound, if necessary and shall completely cover the channel.

**18-1i)** Decorative door glass shall be replaced with a standard glass pane.

**18-1j)** If the client refuses a standard door glass pane, the door glass shall be repaired with clear silicone caulk or a material specifically designed to repair glass.

**18-1k)** If the existing door glass is a thermal pane or insulated glass and the interior or exterior pane is cracked, the cracked door glass shall be repaired.

**18-1l)** If the interior and/or exterior panes of door glass are broken, the door glass shall be replaced with a standard glass pane, if possible.

**Windows**

Mobile Home specific work standards

**18-1m)** Windows, the existing putty tape shall be removed and new putty tape or caulking installed.

**18-1n)** A drip cap shall be installed above non-mobile home replacement windows, if necessary.

**18-1o)** One-light storms shall be fastened with clips, full-length magnetic strips or other means that completely seal the window and allow for easy attachment and/or removal.

**18-1p)** Self-storing storms shall be aluminum frame combination windows.

**18-1q)** If the primary window lacks a screen, the storm window shall be installed with a screen insert.





<p>Open wall cavities shall be covered and insulated with batt, blown or spray-applied insulation.</p> <p><u>Accessible kneewalls</u> that will not be covered shall be insulated with batt or spray-applied insulation.</p> <p>Definitions:  <u>-Accessible Kneewalls.</u> A kneewall with a minimum 36 inch clearance measured from the top of the floor joist to the bottom of the rafters and a minimum 36 inch clearance measured from the kneewall to the exterior wall.</p> <p>Kneewalls that will be covered may be insulated with batt or blown insulation.</p> <p>The floor cavities at the base of the kneewalls shall be tightly packed with batt, blown, rigid or spray-applied insulation.</p> <p>Accessible kneewalls shall have a minimum of 1 access.</p> <p>If new accesses are needed, the access door shall be located in an area agreeable to the client and conducive to the installation of the insulation.</p>	<p style="text-align: center;"><b>Open Wall Cavities and Kneewalls</b></p> <p><b>19-k)</b> If the covering is drywall, the drywall shall be taped and receive 1 coat of joint compound.</p> <p><b>19-l)</b> If plywood, chipboard or hardboard is installed, the joints shall be caulked.</p> <p><b>19-m)</b> If faced batt insulation is installed, the vapor barrier shall be installed to the warm side and fit snugly between the studs and wall.</p> <p><b>19-n)</b> The insulation shall be held in place with staples, twine, wire, hex netting or wire expanders and shall be covered with an <u>air infiltration barrier</u>.</p> <p>Definitions:  <u>-Air Infiltration Barrier.</u> A covering that will allow moisture out and not allow air into a space or wall cavity.</p> <p><b>19-o)</b> If batt insulation is used to seal the base of the kneewalls, the batt shall be sealed in an enclosed vapor barrier.</p> <p><b>19-p)</b> Materials used shall form an airtight seal.</p> <p><b>19-q)</b> If spray-applied insulation is used, an air infiltration barrier is not needed.</p> <p style="text-align: center;"><b>Accesses</b></p> <p><b>19-r)</b> Accesses adjacent to conditioned areas shall be weather-stripped and insulated with R-11 batt or a minimum R-7 rigid insulation attached to the access door.</p> <p><b>19-s)</b> The trim of the access shall be caulked with clear caulking or caulking that is a color complementary to the surface to which it is applied.</p> <p><b>19-t)</b> The access shall be properly framed and be a minimum of 13 inches wide and 20 inches in height.</p> <p><b>19-u)</b> The access cover or door shall be a minimum ¾ inch plywood and attached with a minimum of 2 hinges and a latching mechanism.</p> <p><b>19-v)</b> The access shall be finished to match the wall or trim where installed as closely as possible.</p>
<p><b>20) CEILING INSULATION</b></p> <p>All ceiling insulation shall be installed at the</p>	<p style="text-align: center;"><b>General</b></p> <p><b>20-a)</b> Sealing and repair materials shall match the existing surfaces as closely as possible.</p>

<p>level recommended by the NEAT or MHEA audit.</p> <p>The ceilings must be inspected to insure that the weight of the added insulation will be supported.</p> <p>Leaks in the roof and penetrations in the ceilings shall be repaired prior to insulating the attic.</p> <p>Blown insulation specifications shall be stapled near the attic access of each accessible attic.</p> <p>Cellulose insulation should be installed over existing batt insulation.</p> <p>Enclosed ceilings shall be insulated the full cavity depth.</p> <p>Shielding shall be installed around attic accesses, exhaust fans, soffit vents and uninsulated attics adjacent to insulated attics.</p>	<p><u>Mobile Home specific work standards</u></p> <p><b>20-b)</b> Interior entry holes shall be sealed with wood or plastic plugs.</p> <p><b>20-c)</b> The plugs shall be caulked in place.</p> <p><b>20-d)</b> Exterior entry methods shall form a permanent and watertight seal.</p> <p><b>20-e)</b> Flat roofs or roofs that do not have adequate slope to insure proper drainage shall not be penetrated to install the insulation.</p> <p><b>20-f)</b> If a minimum R-11 of additional insulation cannot be installed, the ceiling shall not be insulated.</p> <p><b>20-g)</b> All insulation installed should extend over the top of all exterior plates and be the full R-value, if possible.</p> <p><b>20-h)</b> The insulation specifications shall include the insulation brand name, thermal resistance chart and certification that the insulation conforms to federal specifications.</p> <p><b>20-i)</b> The specifications shall also include the name of the company that installed the insulation, the date the insulation was installed, the number of bags of insulation installed, the square footage installed and the R-value of the added insulation.</p> <p><b>Insulating Over Existing Batt Insulation</b></p> <p><b>20-j)</b> If additional batt insulation must be installed, the new batt should be unfaced and installed perpendicular to the existing batt insulation.</p> <p><b>Insulating Enclosed Ceilings</b></p> <p><b>20-k)</b> Insulation shall be installed using the tube-fill method to a minimum of 3.4 pounds per cubic foot.</p> <p><b>Shielding</b></p> <p><b>20-l)</b> Attic accesses shall be shielded with 1 inch common lumber or ¾ inch plywood.</p> <p><b>20-m)</b> Exhaust fans that cannot be vented to the exterior shall be shielded with 1-inch common lumber or ¾ inch plywood or metal.</p> <p><b>20-n)</b> If a standpipe is installed, insulation may be installed over the exhaust fan.</p> <p><b>20-o)</b> The standpipe shall be attached with screws.</p> <p><b>20-p)</b> Fiberglass batt, foam board, fiberboard, treated cardboard, plywood or common lumber shall be used as shielding or damming areas adjacent to insulated attics.</p>
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	<p style="text-align: center;"><b>Attic Accesses</b></p> <p><b>20-1d)</b> The hatch shall be properly framed and should have a minimum opening of 13 inches x 20 inches and boxed with 1 inch thick common lumber or ¾ inch plywood at a height to accommodate the added insulation.</p> <p><b>20-1e)</b> New and existing attic accesses adjacent to conditioned areas shall be weather-stripped and insulated with R-19 batt and the insulation shall fit snug to the damming boards. The insulation shall be attached to the access door.</p> <p><b>20-1f)</b> The hatch casing shall be caulked with a paintable clear caulk or with a color complementary to the surface to which it is applied.</p> <p><b>20-1g)</b> The hatch cover shall be constructed of ¾ inch plywood or particle board.</p> <p><b>20-1h)</b> If a walk up attic access is present, the access shall be weather-stripped and insulated with R-19 batt or R-14 rigid insulation.</p> <p><b>20-1i)</b> Walk-up attic access shall be hinged, if possible</p> <p><b>20-1j)</b> Batt insulation shall overlap the opening.</p> <p><b>20-1k)</b> The access shall be caulked with a paintable clear caulking or with a color complementary to the surface to which it is applied</p> <p><b>20-1l)</b> The access shall be finished to match the ceiling or trim where installed as closely as possible.</p>
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## 21) FOUNDATION INSULATION

All floor, foundation wall and sill box insulation shall be installed at the levels recommended by the NEAT audit. Basement walls may be insulated, if possible.

Accessible foundation walls in conditioned crawl spaces and ledge basements shall be insulated.

Floor insulation shall be installed in crawl spaces that are unconditioned.

If there is a wall between an unconditioned crawl space and a conditioned basement, the wall shall be insulated.

Definitions:

-Basement. The bottom full story of a building below the first floor. A basement may be partially or completely below grade.

-Accessible Foundation. A foundation with a minimum 24 inch clearance measured from the bottom of the floor joist to the ground.

-Conditioned. A space that contains a source intended specifically to heat or cool that space.

-Crawl Space. A space below the first floor that is less than full story height. Ledge basements that are 6 feet or more deep are to be considered a crawl space.

-Ledged Basement. A basement constructed with a concrete or dirt ledge less than 6 feet deep around the perimeter of the foundation. The ledge may be only around a portion of the foundation wall. Ledge's more than 6 feet in depth are considered a crawl space.

-Unconditioned. An area having no source of heat or cooling.

All accessible crawlspaces shall have an access, if possible.

New crawl space accesses shall be located in an area agreeable to the client.

Existing exterior accesses shall be weather-stripped and insulated

Accesses adjacent to conditioned areas shall be weather-stripped and insulated.

## Basement Walls

**21-a)** Insulation shall be a minimum R-11 batt, spray applied or a minimum R-10 foam board.

**21-b)** If batt insulation is used the wall shall be framed to adequately support the insulation.

**21-c)** If foam board is used the insulation shall be attached to the foundation wall with construction adhesive or masonry nails or a combination of the two.

**21-d)** Batt, spray applied and foam board insulation shall be covered with plywood, paneling or drywall.

**21-e)** Basement wall insulating systems shall be installed according to manufacturer's instructions and be a minimum R-11.

## Crawl Space and Ledge Basement Walls

**21-f)** Crawl space and ledge basement wall shall be insulated with a minimum R-11 faced batt or a minimum R-10 foam board.

**21-g)** The insulation shall fill the sill box, extend down the foundation wall and lay a minimum of 24 inches on top of a ground laid moisture barrier.

**21-h)** To ensure there are no gaps in the wall insulation, 24 inch wide batts should be used in areas of 16 inch floor joist spacing and 16 inch batts should be used in areas of 24 inch joist spacing.

**21-i)** Spray-applied insulation may be used.

**21-j)** If faced batt insulation is installed, the vapor barrier shall be to the warm side and the insulation shall be supported with twine, wire, hex netting or wire expanders.

## Accesses

**21-k)** New exterior accesses shall be constructed of ¾ inch pressure treated plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism and be weather-stripped and insulated with R-11 batt or a minimum R-7 rigid insulation.

**21-l)** Any new framing shall be pressure treated, redwood or cedar.

**21-m)** New floor accesses shall be properly supported.

**21-n)** If floor insulation is installed, the floor access shall be weather-stripped and insulated with R-11 batt or a minimum R-7 rigid insulation.

<p>A new access cover and/or hardware shall be installed if necessary.</p> <p><u>Exposed floors</u> that are accessible shall be insulated.</p> <p>Definition:  <u>-Exposed Floors.</u> A floor that is in direct contact with the outside air. Examples are cantilevers, the floors of bay or bow windows, garage ceilings, etc.</p> <p>The ceilings of garages must be inspected to insure that the weight of the added insulation will be supported.</p> <p>If exposed floors are un-insulated and inaccessible, insulated skirting shall be installed.</p>	<p><b>21-o)</b> Existing exterior accesses shall be weather-stripped and insulated with R-11 batt or a minimum R-7 rigid insulation.</p> <p><b>21-p)</b> Hardware may be added if necessary.</p> <p style="text-align: center;"><b>Floors</b></p> <p><b>21-q)</b> Floors shall be insulated with batt or blown insulation and covered with exterior grade plywood, drywall or tar impregnated fiberboard.</p> <p><b>21-r)</b> Plywood joints and seams shall be caulked.</p> <p><b>21-s)</b> Fire code drywall shall be installed on open floor cavities over garages. The drywall shall be taped and receive 1 coat of joint compound or the joints and seams shall be caulked to form an airtight seal.</p> <p><b>21-t)</b> Accessible exposed floors that have an existing covering shall be insulated with blown insulation installed at a minimum of 3.4 pounds per cubic foot and the entry holes shall be sealed with wood or plastic plugs.</p> <p style="text-align: center;"><b>Insulated Skirting</b></p> <p><b>21-u)</b> The skirting shall be metal, vinyl or <u>pressure treated</u> plywood supported by a wood frame and insulated with a minimum R-11 faced batt or a minimum R-10 foam board.</p> <p>Definitions:  <u>-Pressure Treated.</u> Lumber that has been commercially chemically treated under pressure with a wood preservative to prevent damage from moisture, insects, fungi and other forms of biological decay.</p> <p><b>21-v)</b> The frame shall have a pressure treated, redwood or cedar bottom plate and the vertical studs should be placed on a minimum 24 inch centers.</p> <p><b>21-w)</b> Insulation shall cover the top plate and extend a minimum of 24 inches on top of a ground laid moisture barrier.</p> <p><b>21-x)</b> All seams and joints in the skirting shall be caulked.</p> <p><b>21-y)</b> A minimum of 1 access shall be installed.</p> <p><b>21-z)</b> The access shall be constructed of ¾ inch pressure treated plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism and be weather-stripped and insulated with R-11 batt or a minimum R-7 rigid insulation.</p>
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<p>Sill box insulation shall be installed in all accessible cavities with a depth of 2 inches or more.</p>	<p style="text-align: center;"><b>Sill Box</b></p> <p><b>21-1a)</b> Sill box insulation shall be a minimum R-10.</p> <p><b>21-1b)</b> If batt insulation is installed the vapor barrier shall be to the warm side and fit snugly between the floor joists, sill plate and subflooring.</p> <p><b>21-1c)</b> Where the insulation runs parallel with the floor joists, it shall be stapled in place, if necessary.</p> <p><b>21-1d)</b> The vapor barrier shall completely cover the insulation to prevent fibers from entering the basement.</p> <p><b>21-1e)</b> Spray-applied insulation may be used and left uncovered.</p> <p><b>21-1f)</b> Rigid insulation may be left uncovered and shall fit snugly between the floor joists, sill plate and subflooring.</p>
<p><u>Mobile Home specific measures</u></p> <p><b>22) UNDERBELLY INSULATION</b></p> <p>Prior to weatherizing the underbelly, the owner shall repair plumbing leaks that will directly affect the weatherization of the underbelly.</p> <p>All underbelly insulation shall be installed at the level recommended by the MHEA audit. Underbellies that have 2 inches or less of existing insulation are considered uninsulated and shall be insulated with batt or blown insulation, if possible.</p> <p>When 50% or less of the existing insulation is missing, deteriorated or damaged the damaged areas shall be repaired.</p> <p>When more than 50% of the existing insulation is missing, deteriorated or damaged, the entire underbelly shall be reinsulated.</p> <p>Existing insulation in undamaged areas does not need to be removed, but additional blown insulation shall be installed.</p>	<p><u>Mobile Home specific work standards</u></p> <p style="text-align: center;"><b>General</b></p> <p><b>22-a)</b> Insulation shall be installed the full cavity depth whenever possible.</p> <p><b>22-b)</b> Replace all deteriorated or damaged insulation with unfaced R-19 batt and replacing the <i>weatherboard</i> or by first replacing the weatherboard and then using blown insulation.</p> <p>Definition:</p> <p>-<i>Weatherboard</i>. A covering consisting of a minimum 30 pound felt paper, exterior grade plywood, fiberboard, an air infiltration barrier or a material specifically manufactured as mobile home weatherboard installed on the underside of a mobile home to support and protect the floor insulation.</p> <p><b>22-c)</b> The weatherboard must form an airtight seal and adequately support the insulation.</p> <p><b>22-d)</b> If plywood is used as weatherboard, the plywood shall be exterior grade.</p> <p><b>22-e)</b> If insulation is installed through the rim joist, a rigid tube shall be used.</p> <p><b>22-f)</b> Entry holes in the rim joist shall be plugged with wood plugs and glued in place.</p> <p><b>22-g)</b> If insulation is installed through the weatherboard, the entry holes shall be covered with plastic plugs or 30# felt paper. Both should be sealed with caulking.</p> <p><b>22-h)</b> Rim joists that are 2 inches x 4 inches or less in construction shall not be drilled.</p>

A full ground laid moisture barrier shall be installed on mobile homes with relatively tight skirting or when insulated skirting is installed, whenever possible.

A full laid moisture barrier may be omitted if run off or rain water is likely to collect on it. The moisture barrier shall be installed under the insulation installed on the ground.

A minimum of 2 manual or thermatic foundation vents may be installed when the skirting is tight.

Inaccessible underbellies that are uninsulated, or with more than 25% of the existing insulation missing, deteriorated or damaged may be weatherized using insulated skirting.

Definition:

-Inaccessible Underbellies. A mobile home underbelly with less than 24 inches clearance, measured from the weatherboard to the ground at the area to be weatherized.

A minimum of 1 access shall be installed.

**22-i)** Special care needs to be taken so as not to isolate water pipes outside the envelope.

**22-j)** If a minimum R-11 of additional insulation cannot be installed, the underbelly shall not be insulated.

#### **Moisture Barrier**

**22-k)** The moisture barrier shall be a minimum 6 mil polyethylene and extend up the exterior walls at least 12 inches and the joints shall overlap a minimum of 12 inches.

**22-l)** In the event the entire floor cannot be covered, all accessible areas shall receive a moisture barrier.

**22-m)** When installing insulated skirting without adequate clearance, the moisture barrier shall extend a minimum of 24 inches beyond the insulation, and a minimum of 2 manual or thermatic foundation vents may be installed.

#### **Venting**

**22-n)** When vents are installed, the venting ratio shall be a minimum of 1 square foot of net free vent area for every 1500 square feet of underbelly.

**22-o)** All exhaust vents and combustion air vents shall be vented through the skirting.

#### **Insulated Skirting**

**22-p)** The skirting shall be metal, vinyl or pressure treated plywood supported by a wood frame and insulated with a minimum R-11.

Definition:

-Pressure Treated. Lumber that has been commercially chemically treated under pressure with a wood preservative to prevent damage from moisture, insects, fungi and other forms of biological decay.

**22-q)** The frame shall have a pressure treated, redwood or cedar bottom plate and the vertical studs should be placed on 24 inch centers.

**22-r)** Insulation shall cover the top plate and extend a minimum of 24 inches on top of a ground laid moisture barrier.

#### **Accesses**

**22-s)** The access shall be constructed of ¾ inch pressure treated plywood, be a minimum of 20 inches in width, be attached with 2 hinges and a latching mechanism and be weather-stripped and insulated with R-11 batt or a minimum R-7 rigid insulation.

**ELECTRIC BASELOAD**

**23) ELECTRIC BASELOAD**

Compact fluorescent bulbs shall be installed in light fixtures that will accept them and will be used more than 15 hours per week.

Incandescent light fixtures may be replaced with fluorescent light fixtures that will be used more than 15 hours per week.

Electro-luminescent night lights may be installed to replace existing incandescent night lights.

**23-a)** Lumen output should be matched as closely as possible to the incandescent that was removed.