

# In Home Energy Evaluation Weatherization Standards for Existing Homes

## Attic Insulation

**Applicability.** Attic and ceiling insulation shall be installed in accordance with Recommendations defined in the customer's In-Home Evaluation. Any alternate recommendation by the QCN member to that identified in the customer's Recommendation(s) shall be submitted to the participating power distributor for approval prior to installation. Without prior approval, failure to achieve Plan recommendations may result in non-payment of reimbursements or failure to qualify for financing incentives that would otherwise be available to the customer.

**Material Specifications for Blocking Materials.** The following materials shall be used to provide any required blocking around heat-dissipating objects, attic accesses, pull-down stairways, chimneys, vent pipes from gas- or oil-fired appliances, etc.:

- Mineral fiber batts
- Sheet metal
- Gypsum board (sheetrock)
- Wood
- Other materials approved by TVA prior to their installation

**Material Specifications for Insulation Support.** The following materials shall be used to support insulation, as required in the installation standards and procedures:

- Wire or nylon mesh
- Wire or nylon lacing materials
- Other materials approved by TVA prior to their installation

**Installation Requirements.** The QCN member shall be responsible for ensuring that all attic insulation materials installed comply with the insulation manufacturer's requirements and these Program Standards.

- ***Existing Conditions***—The QCN member shall be responsible for determining if the installation of additional attic or ceiling insulation will cause structural damage to the residence, such as ensuring that the ceiling will support the additional weight of the insulation. If applicable, QCN members shall notify inspectors and customers prior to installing insulation if they determine that an R-value different from that recommended should be installed.
- ***Amount of Insulation to be Installed*** — (Amount of Insulation to be installed shall be defined by **Recommendation(s)** in the consumer's In-Home Evaluation report. If multiple **Recommendations**, assure that the amount of insulation added, and location of improvement agrees with the consumer's selection of recommendations to be installed.)
- ***QCN Member Responsibilities***—The QCN member shall be responsible for completing all preparation work involving insulation materials already existing in the residence, such as uncovering recessed light fixtures, doorbell transformers, and other heat-dissipating devices that were covered with existing insulation, providing blocking around such devices when necessary, etc.
- ***Improperly Installed Vapor Barriers***—Vapor barriers on existing batt or blanket insulation that have been installed improperly shall be either turned over so they are placed toward the living area of the residence (warm side in winter), or made ineffective by slashing several times with a sharp knife.
- ***Wet or Damp Existing Insulation***—Adequate attic ventilation shall be provided when the existing insulation is found to be wet or damp, and the insulation shall be allowed to dry prior to installing additional attic insulation. If the insulation fails to dry after a reasonable period of time, it shall be replaced.
- ***Customer Responsibilities***—The customer shall be responsible for seeing that preparation work such as repairing the ceiling, roof leaks, pipe leaks, vent leaks, removing objects stored in the

attic, etc., is completed if failure to do so would adversely affect the installation of additional insulation.

- **Blocking Materials**—Blocking materials shall be installed in accordance with the following requirements:
  - Mineral fiber batts shall not be placed on the narrow edge.
  - Sheet metal used as firestopping or blocking material shall be secured in place using nails, tacks, staples, or screws.
  - Gypsum board/sheetrock or wood shall be secured in place using nails or screws. When using these materials as blocking, the clearances to both the insulation and the blocking shall be maintained.
  - Blocking materials shall be installed so that their height is above that of any surrounding loose-fill insulation material.
- **Clothes Dryer Vents**—Clothes dryers shall be vented to the outside. (Air exhausted from the home must be terminated outside the home's exterior (structural) shell and shall not be allowed to be vented into a basement, crawl space, attic or other enclosed areas of the home.)
- **Plumbing and Other Pipes, etc.**—Cracks and gaps around ceiling penetrations, such as plumbing, exhaust fans, etc., should be sealed prior to installing ceiling insulation. Do not seal any openings that would violate ventilation requirements of combustion appliances or create a potential for moisture problems.
- **Recessed Light Fixtures**—Insulation shall not be installed within 3 inches of the sides of a recessed incandescent that is not IC-rated or fluorescent light fixture (including its wiring compartment and ballast), and insulation shall not be installed over the top of such fixtures. The 3-inch air space shall be provided by utilizing acceptable blocking materials. IC-rated recessed light fixtures should be checked for air leakage and adequately sealed prior to insulation being installed over IC-rated fixtures.

Note: If a light fixture is intended for direct contact with insulation, it will require an **IC** rating (IC stands for "Insulated Contact"). An IC rated fixture must, by definition, "be approved for zero clearance insulation cover by an OSHA NRTL laboratory", such as Underwriters Laboratory.
- **Doorbell Transformers**—Insulation may contact the sides of but shall not cover doorbell transformers.
- **Masonry Chimneys**—All insulation and blocking materials shall be kept a minimum of 3 inches away from masonry chimneys. When loose-fill insulation material is used for ceiling insulation, acceptable blocking materials shall be used to ensure a minimum 3-inch clearance. Unfaced mineral fiber batts may provide the minimum clearance by serving as blocking for loose-fill insulation, or other types of blocking may be used to ensure the minimum clearance. The gap (crack) between the interior ceiling finish material and the masonry chimney should be firestopped and sealed in accordance with locally adopted codes and regulations.
- **Factory-Built (Metal) Chimneys**—All insulation and blocking materials shall be kept a minimum of 3 inches away from factory-built chimneys. The minimum 3-inch clearance shall be provided by utilizing acceptable blocking materials. In some installations where loose-fill insulation is installed as ceiling insulation, the sides of the chimney support box may serve as the blocking material if it provides the minimum 3-inch clearance. Insulation shall not be installed in or over the chimney support box.
- **Vent Pipes from Gas- or Oil-fired Furnaces, Water Heaters, etc.**—Insulation materials shall be installed no closer than 3 inches to a vent pipe, or the clearance specified on the vent pipe label, from a gas or oil-fired furnace, water heater, etc., where the vent pipe passes through the ceiling. When loose-fill materials are installed as ceiling insulation, acceptable blocking materials shall be used to provide the required clearance and to prevent the insulation material from falling into the cavity around the vent pipe.
- **Venting**—Range hoods and bathroom exhaust fans shall be vented to the outside in conjunction with adding attic insulation. The vent pipes shall not be vented through an existing attic ventilator unless the minimum required net free area for the attic would still exist without the use of that ventilator. If a bathroom or kitchen is not properly vented to the outside, one of the following venting methods must be used:

- The vent exhaust opening must be extended a minimum of 6 inches above the insulation level in the attic.
- Insulation or blocking materials shall not be installed within 3 inches of the side containing an exhaust opening that is not extended above the attic insulation level. This 3-inch air space shall be maintained by utilizing one of the acceptable blocking methods.
- If a bathroom or kitchen vent terminates in a dropped (suspended) ceiling cavity or soffit area and cannot, or will not, be properly vented to the outside, then the vent exhaust opening must be extended to a minimum of 6 inches above the insulation level in the attic. QCN contractor should advise consumer of potential moisture issues where this situation exists and encourage the homeowner to watch for evidence of moisture or mold problems.
- Kitchen range vents that extend through the roof shall be vented vertically with a maximum of two bends (45 degrees or less per bend) using continuous airtight metallic kitchen vent sections and connections.
- Electrical Junction Boxes—Improperly terminated wiring connections that are unprotected and will be covered with insulation shall be corrected by either of the following methods:
  - Installing a metal or approved plastic cover on the open electrical junction box
  - Installing a complete junction box where one does not exist at an electrical connection
- Knob-and-Tube Wiring—Insulation materials shall not conceal or cover knob-and-tube wiring.
  - Cellulose insulation shall not contact knob-and-tube wiring.
  - Insulation shall not in any wise restrict heat dissipation in the free air space around knob-and-tube wiring or otherwise contribute to additional heat buildup that might increase the risk of fire hazards.
  - QCN contractors should refer any questionable insulation practices with respect to knob and tube wiring to a licensed electrical contractor.
  - Mineral fiber insulation materials (fiber glass and rock wool) may contact knob-and-tube wiring, but shall not conceal or cover the wiring.
  - Blocking materials shall be used with loose-fill insulation materials when the level of the insulation will exceed the wiring height. If faced batts are used, the facing shall not contact the electrical conductors.
  - When batts or blankets with an attached vapor barrier (or other facing) are installed, the facing shall not contact the electrical conductors. Batts or blankets with double facings shall not be used for this application.
- Whole-House Attic Fans—Loose-fill insulation materials shall be prevented from falling into whole-house attic fans by installing acceptable blocking materials around the fan housing. If the fan motor is mounted outside of the fan housing and the insulation to be added could contact the motor, acceptable blocking materials shall also be installed to provide 3-inch clearance around the motor.
- Unfinished Attics—Only thermal insulation materials accepted by TVA shall be installed. Other insulation materials such as organic cellular (polystyrene, polyurethane, etc.) may be used in certain applications, such as for cathedral ceilings, if prior permission from TVA is obtained.
- Loose-Fill Insulation—When loose-fill insulation materials are installed, the installer shall leave one empty bag of each type of material used at the residence for identification by the inspector.
- Areas To Be Insulated—Insulation shall be installed above ceilings separating conditioned (heated or cooled) rooms from non-conditioned attic areas. The areas to be insulated shall be the gross area identified by using outside wall dimensions.
- Verification of Material Installed—Loose-fill insulation materials shall be installed in accordance with the manufacturer's coverage chart, at the specified weight per square foot and depth required to achieve the thermal resistance (R) value needed to meet the minimum requirements for a heat pump installation.

Loose-fill insulation materials shall be installed in accordance with the coverage chart data with no adjustments made for framing, such as joists, etc.

The QCN member shall specify the following applicable information on a receipt (attic card; also referred to as the builder's statement) removed from the insulation bag or container, or an equivalent card, and posted in an easily visible location near the attic access:

- For batts or blankets or foam products - the coverage area in square feet, thickness, and R-value of the insulation installed.
- For loose-fill insulation - the coverage area in square feet, thickness, R-value, and the number of bags installed.

The attic card shall be signed and dated by the QCN member. If attic insulation is installed in more than one area of the residence, the data for each area shall be entered on the attic card or a separate attic card shall be completed for each area.

- ***Installation of Batts and Blankets***—Batts or blankets shall fit tightly against the sides of joists and fit tightly at the ends against adjoining batts, blankets, or framing materials.

Batts and blankets shall be cut and split to fit between any cross-bracing if looping over the cross-bracing will require more than one-third of the batt to extend above the attic floor joists.

Batts or blankets with an attached vapor barrier shall not be installed over existing attic insulation unless the vapor barrier facing is removed or rendered ineffective by slashing.

- ***Installation of foam insulation products*** – Insulation shall fit tightly against the sides of joists and extend over complete area to be insulated. Depth of insulation installed shall be uniform across the entire area being insulated.

- ***Insulation Contacting the Roof Sheathing***—A minimum 1-inch air space shall be maintained between insulation materials and the roof sheathing, including residences without a soffit area.

If insulation materials contact the roof sheathing, the minimum 1-inch air space between the insulation and the roof sheathing shall be provided prior to installing additional insulation materials.

- ***Suspended Ceilings and Dropped Cavities (Soffits)***—Suspended (dropped) ceilings with gypsum or plaster finish material shall be insulated in accordance with the installation requirements for unfinished attics.

Insulation installed above removable or fixed suspended ceiling tiles (panels) shall be independently supported so that no additional weight is exerted on the ceiling panels. Batt or blanket insulation only shall be used. The batt or blanket insulation shall be either unfaced or have a flame spread index of not more than 75 and a smoke-developed index of not more than 450. (If faced batt or blanket insulation is used, a fact sheet for the material shall be left with the customer for verification of the flame spread and smoke-developed ratings.) (Flame spread and smoke developed index requirements correspond to ASTM Test Method E-84, Class II materials.)

Adequate ventilation shall be provided between the insulation material and the original ceiling. Ventilation openings (holes) shall be cut in the original ceiling when necessary to ventilate the space between the insulation and the original ceiling. The openings shall provide the minimum required ventilation net free area for the suspended ceiling area and shall be located in the original ceiling adjacent to opposite exterior walls of the suspended ceiling area to provide adequate cross-ventilation. A minimum of two holes shall be required for each room where partitions extend to the original ceiling.

- ***Dropped Cavities (Soffit)***—Dropped cavities that are open in the attic (above built-in cabinets, showers, etc.) shall be insulated by either of the following methods:

- Using an R-19 batt on the sides and the bottom of the cavity
- Providing necessary blocking around any heat-dissipating objects and completely filling the cavity with loose-fill insulation

**WARNING:** If the dropped cavity (soffit) is not open in the attic and contains a heat dissipating object (recessed light, etc.), then insulation shall not be installed above the cavity.

- Installing boards or a piece of plywood across the top of the cavity in order to support the insulation to be added

**WARNING:** This method shall not be used for cavity containing recessed light fixtures or other heat-dissipating devices.

- Permanent Stairways—Accessible wall and sloped ceiling areas of permanent stairways separating conditioned areas from non-conditioned areas shall be insulated with batt or blanket insulation using support material described in these standards.
- Furnaces Mounted in the Attic—When ceiling insulation is installed in a residence with an attic-mounted furnace, the insulation shall not block the combustion air to the furnace. This shall be accomplished by providing a 3-inch clearance between the insulation material and the furnace housing. When loose-fill insulation is installed, acceptable blocking materials shall be installed around the furnace.
- Attic Accesses and Pull-Down Stairways—Attic access coverings (panels) located in conditioned areas shall be insulated with batts or blankets and weather-stripped. The insulation batt or blanket shall be stapled or glued to the top of the access covering. When loose-fill insulation is used to insulate the ceiling, suitable blocking materials shall be placed around the perimeter of the access opening. Cracks between wood trim or molding and ceiling finish materials around the perimeter of the opening shall be caulked.

Mineral fiber batts shall be placed around the perimeter of the opening of an attic pull-down stairway when the ceiling is insulated with loose-fill materials. The opening shall be weather-stripped and caulked similar to attic access panels.

- Unfinished Floored Attics—The installation requirements for unfinished attics shall also apply to unfinished attics that are floored with the following exception:
  - Beneath flooring - Insulation installed beneath the flooring material shall completely fill each joist cavity, either (1) beneath and above flooring (installing insulation above and beneath the flooring material) or (2) above flooring only (installing insulation above the flooring material only).
- Finished Attics (Conditioned Areas Within an Attic)
  - Vertical Walls, including Attic Kneewalls – The framing cavities of vertical walls and kneewalls built inside an attic area shall be insulated with batts, blankets, or other non-collapsing insulation, and a rigid insulation board, such as a foam insulation board, shall be installed on the exterior surface of the wall, covering both the cavity insulation as well as the framing components of the wall. If the installed rigid insulation board includes a reflective radiant barrier surface, the reflective surface must be installed such that it faces a non-obstructed air space for the product to be effective. The installed rigid insulation board shall serve to provide both a continuous insulation value as well as an air infiltration barrier. Sealing gaps between sections of rigid board insulation is recommended unless the conditioned attic space is likely to experience high humidity.
  - The combined insulation value of the cavity insulation and rigid insulation board shall be at least R-18 unless the rigid insulation board is installed with an effective radiant barrier, in which case, the combined insulation value shall be at least R-15.
  - Sloped Ceilings - Batt or blanket insulation shall be installed above the sloped ceiling areas. A minimum 1-inch air space shall be provided in each cavity between the insulation and the roof sheathing for ventilation. The residence shall have a combination high and low ventilation system. Continuous ridge and eave/soffit vents may be required in some cases to adequately ventilate each joist or rafter cavity.
  - Horizontal Ceilings - Batt, blanket, or loose-fill insulation shall be installed above the horizontal ceiling area provided the installation requirements for unfinished attics are also met.
  - Adjacent Areas - Insulation installed in unfinished attic floors adjacent to conditioned areas within an attic shall extend a minimum of 1 foot beyond the vertical walls of the conditioned areas.
  - Vapor Barrier - If a vapor barrier does not exist in the conditioned area within the attic, one shall be added by either installing a vapor barrier separately or installing batts or blankets with an attached vapor barrier with the vapor barrier facing the conditioned area (warm side in

winter). Insulation with the vapor barrier installed facing away from the conditioned area is acceptable, if it is made ineffective by slashing, or if the facing is completely removed.

- Supporting - The insulation shall be supported by acceptable supporting materials as described in these standards.

- Types of Insulation Support Materials - Wire staves shall not be used to support batt or blanket insulation when installed in vertical walls of a conditioned room in an attic. Acceptable methods for supporting the batt insulation shall be (1) stapling the vapor barrier through the thickness of the insulation, providing the insulation does not remain compressed; (2) nailing or stapling the flange to the studs (reverse flange batts only); (3) attaching approved netting directly to the side of studs using approved staples; or (4) lacing back and forth between nails or staples placed in the bottom of the studs to adequately support the insulation; or (5) rigid insulation board attached to the wall studs.

- Cathedral Ceilings—Cathedral ceilings shall be insulated by installing either a suspended (dropped) ceiling or by insulating the sloped ceiling.

Insulating Beneath the Cathedral Ceiling.

- Approval - Prior approval for this installation must be obtained from the TVA Consumer & Small Business design staff and the Participant.

- Materials - Cathedral ceilings shall be insulated by installing new ceiling finish material on the bottom of the rafters and installing batt, blanket, or rigid board insulation between the roof sheathing (old ceiling) and the new ceiling, or by fastening rigid board insulation to the bottom of the rafters. When organic cellular rigid board insulation (polystyrene, polyurethane, etc.) is used, it shall be protected by an interior finish material having a finish rating of at least 15 minutes, such as 1/2-inch gypsum board.

- Ventilation - A minimum 1-inch air space shall be maintained in each cavity between the insulation and the roof sheathing for ventilation, and there shall be high and low ventilation for each joist cavity. Continuous ridge and eave/soffit vents may be required in some cases to adequately ventilate each cavity.

- Vapor Barrier - A vapor barrier, attached to either the insulation or the finish material, shall be used. If a vapor barrier is attached to the insulation and more than one layer of insulation is installed, all vapor barriers except the one adjacent to the finish material shall be removed (peeled off).

- Installing Suspended (Dropped) Ceilings—Cathedral ceilings may be insulated by installing a horizontal suspended (dropped) ceiling and insulating above it provided the requirements for suspended ceilings in unfinished attics are met. If removable panels are used in the dropped ceiling, batt or blanket insulation shall be used. Adequate ventilation shall be provided above the dropped ceiling.

- Exterior Roof Insulation Systems—An exterior roof insulation system may be installed above a cathedral ceiling. Ventilation between the insulating sheathing and the roof decking need not be provided when this type of insulation system is installed.

- Vaulted Ceilings—The installation requirements for unfinished attics shall also apply to vaulted ceilings. In some instances (to ensure adequate ventilation in steep sloped ceilings, etc.), batt or blanket insulation materials shall be required.

- Flat Roofs—A suspended ceiling may be installed and insulation added above it. The installation requirements addressed in the suspended ceiling section for unfinished attics shall apply to insulating the suspended ceiling.

- Uninsulated Walls of Multilevel Dwellings Separating Conditioned Areas From Non-conditioned Attics—Uninsulated walls shall be insulated using batts or blankets, if the wall is accessible. For installation requirements for this type wall, refer to the vertical wall sections for finished attics.

## Attic Ventilation

The attic shall be properly ventilated to prevent the possible occurrence of condensation or moisture damage to the insulation materials or structure.

**Ventilation Requirements.** The amount of ventilation shall comply with Section 604-4.2 of the U.S. Department of Housing and Urban Development (HUD)/Federal Housing Administration (FHA) Minimum Property Standards for One- and Two-Family Dwellings. This section specifies that the ratio of total ventilation net free area (NFA) to ceiling area (the entire attic floor area over both conditioned and non-conditioned spaces) shall not be less than 1 square foot of ventilation net free area for each 150 square feet of attic floor area (1:150). This ratio may be reduced to one square foot of ventilation net free area for each 300 square feet of attic floor area (1:300) provided one of the following two requirements is met:

- High and/or Low Ventilation With Vapor Barrier—An effective vapor barrier having a moisture transmission rate of 1.0 perm or less is installed next to the living or conditioned area (the warm side in winter) of the ceiling in combination with ventilators located in the upper portion of the attic space to be ventilated (high ventilation) or in the lower portion of the attic space to be ventilated (low ventilation), or both.
- High and Low Ventilation—At least 50 percent of the required net free area can be provided by ventilators located in the upper portion of the attic space to be ventilated at least 3 feet vertically above eave or cornice vents. The remaining 50 percent of the required net free area can be provided by ventilators located in the lower portion of the attic space to be ventilated, usually in the eave or cornice areas of the attic. This ventilation system is described as a high-low combination system.

**Material Specifications.** A ventilator shall be constructed from a durable material (preferably metal), contain rain louvers designed to restrict the entrance of weather elements (rain, snow, etc.) into the attic area, and shall contain a screening material with openings not larger than 1/4 inch to restrict the entrance of insects, birds, and small animals into the attic area. The screening material may be omitted if louvered slit-type openings not larger than 1/4 inch serve as an insect barrier.

If there is evidence that more than the minimum ventilation requirements are needed, additional ventilation may be added to an area of the attic even though the total existing vent area meets the minimum standard/required NFA.

Ventilators (roof, ridge, gable, or eave) shall be positioned for maximum effectiveness without causing damage to the house structure or reducing the performance of the ventilator. The location of the vents shall be selected so that the natural air flow through the vents will not be restricted.

### **Ventilation Installation Requirements**

- General—Static roof ventilators are recommended when additional attic ventilation is necessary but cannot be achieved by the addition of soffit, ridge, or gable vents.
- Installation on Sloped Roofs—Roof vents shall be installed so that at least 50 percent of the upper half and sides of the flashing (flange) is positioned under the roofing material and is securely nailed to the roof. Caution: If a new roof has been installed over one or more old roofs, the flashing (flange) shall be installed under the outermost roof. All flashings for vents or rain deflectors shall extend beyond the rain grooves on the top side.

The lower part of the flashing shall be positioned over the roofing material and securely nailed to the roof deck at each corner and mid-span if required. The underside of the flashing shall be sealed along the top edge and two sides using a high-quality mastic or sealant (roofing cement or a caulking material with a minimum 10-year life expectancy) to prevent leaks; however, the bottom edge of the flashing shall not be sealed. Nails located on the top and sides of the flashing shall be positioned under the roofing material, not through the material. Nail heads shall have a neoprene washer or be covered with a waterproof mastic or sealant.

- Roof Vents in Lieu of Soffit Vents—If low ventilation cannot be achieved by installing soffit vents, static roof vents shall be located as low as possible on the roof line to meet ventilation requirements.
- Rain Deflectors—When static roof vents are installed low in the roof or are installed on a high-pitched roof having a slope of 45 degrees or greater, a rain deflector device shall be installed from 4 to 10 inches above the vent cap if the vent does not contain a built-in provision on the upper side that prevents water from entering the vent (e.g., rectangular vents with no louvers or openings on the upper side). The rain deflector shall have a minimum height of 4 inches, a width equivalent to that of the vent flashing, and shall have a "curl" at the top to prevent water splash-over. The base of

the rain deflector shall extend beyond the rain grooves in the outermost roofing shingles immediately on top of the deflector base.

- ***Installation on Flat Roofs***—Flanges shall be installed over the top layer of roofing and sealed around the entire perimeter with a high quality sealant as described above. Vents shall not be installed on corrugated or graveled roofing systems.
- ***Ridge Vents***—Ridge vents shall be installed whenever possible to achieve high ventilation. Manufacturer instructions concerning end-on-end connections, caps, sealants, etc., shall be carefully followed to prevent leaks.
- ***Soffit Vents***—Soffit vents shall be installed with the sloped louvers pointing toward the house.

## **Caulking, Sealants, and Glazing Materials**

**Applicability.** The installation of caulks, sealants, and glazing materials is applicable when no effective caulk, sealant, or glazing material exists where needed or where installed around the inside and outside perimeter of a prime window, storm window, door, or other non-movable cracks or opening separates conditioned areas from non-conditioned areas.

**Material Specifications.** Oil and resin base (clay base) caulking materials have a much shorter life expectancy and shall not be used. Also, rope caulk shall not be used.

### **Installation Requirements.**

- ***General (Caulks and Glazing Materials)***—Any preparation work required to repair the window sash, repair of the lock at the meeting rail, replacement of window or door frame, painting or removal of paint prior to caulking or glazing, replacement of cracked or missing glass panes, etc.) shall be completed prior to installing caulking or glazing materials.

When preparing for caulking or glazing, the surface must be completely free of moisture, since most caulks will not adhere to a damp surface. The ambient temperature at the time of application shall be between 40°F and 100°F or as otherwise specified by the manufacturer on the cartridge or can.

All existing caulking or glazing materials around the window or glass pane shall be removed. All particles of dirt and debris shall be brushed out with a wire brush and the area rubbed with a clean cloth.

When specified by the manufacturer of the caulking or glazing material to be used, porous surfaces shall be primed with the type of primer recommended by the manufacturer.

When caulking and glazing has been completed, all caulks and sealants or other stains resulting from work performed under this section shall be removed from glass and adjoining areas.

- ***Caulking***—Generally, the depth of caulks shall not be greater than the width of the joint. Joints or spaces deeper than one-half inch shall be built up to a depth of three-eighths inch below adjacent surfaces with approved filler and backup materials prior to caulking.

Filler and backup materials shall be polyurethane foam, oakum, untreated jute, pointing mortar, or other oil-free materials.

One-component polyurethane foam sealants used as filler materials or as caulks shall be protected from direct sunlight by a cover material or by painting exposed surfaces, and installed in accordance with the manufacturer's instructions and all applicable local building codes.

Thresholds shall be caulked on the inside edges when installed, and excess caulk shall be removed after the threshold is set.

All caulking and sealing work shall follow the recommendations or printed instructions of the manufacturer.

If the caulk being installed is a non-paintable type, it shall be color-coordinated with the existing caulking and exterior of the residence. Glazing Materials for Sealing Glass Panes.

- Pliable Glazing Compounds. If the existing putty or glazing compound is ineffective on only one side of the window pane, it shall be replaced on that side of the window pane only with glazing compound.

Glazing points shall be spaced no further than 12 inches apart with a glazing point inserted within 3 inches of each corner of the glass pane. A minimum of four glazing points (one on each side) shall be required for very small glass panes.

Back-bedding compound or glazing tape used as a bed between the wood sash and the glass pane shall be optional.

Painting of the glazing compound after its application shall be as recommended by the manufacturer but is not within the scope of the program and will be the customer's responsibility.

– Rigid and Flexible Vinyl Glazing Materials. When rigid or flexible vinyl glazing materials are used around the perimeter of a glass pane in a metal window sash or insert, a back-bedding compound or glazing tape shall also be installed in accordance with the manufacturer's instructions to seal around the perimeter of the glass pane.

Back-bedding compound or glazing tape shall not be required when channel glazing is used. A glass adhesive or sealant shall be used when the wrap-around (metal) glass molding method is used to reglaze a window.

## Weatherstripping and Thresholds

**Applicability.** The installation of weatherstripping materials is applicable when no effective weatherstripping exists in cracks around operable portions of windows, doors, attic accesses, and other operable openings separating conditioned areas from non-conditioned areas, or when the existing weatherstripping has deteriorated, in which case, the old weatherstripping shall be completely removed prior to replacing it with new weatherstripping.

**Material Specifications for Window and Door Frame Weatherstripping.** Weatherstripping materials shall consist of narrow strips of material placed over or in the movable joints of windows, doors, or other areas of the residence to reduce the passage of air and moisture.

Weatherstripping materials shall be high-quality and durable, with a minimum installed life expectancy of 10 years. Products that will deteriorate within this time when subjected to sunlight, moisture, other weather conditions, or normal use shall not be used.

A weatherstripping material appropriate for the type of opening shall be used. Spring strips, V-strips, and replacement pile may be used in compression or friction (sliding) joints.

**Material Specifications for Thresholds/Door Sweeps.** Thresholds shall be of a permanent type that will effectively seal the bottom of an exterior door against air infiltration when the door is closed. Thresholds shall be of the following types:

- A metal body with a vinyl insert that contacts the bottom of the door for the entire length of the threshold or width of the door.
- A metal saddle with a door shoe on the bottom of the door.

Door sweeps may be used on interior doors that separate conditioned areas from non-conditioned areas where thresholds are deemed to be unsafe.

### Installation Requirements

- Any required preparation work shall be completed prior to installing weatherstripping. The QCN member shall be responsible for completing preparation work of a minor nature, such as removing defective weatherstripping, dirt, and loose paint.
- The Participant shall be responsible for ensuring that all major preparation work such as carpentry work required to repair or replace window and door frames, priming and painting surfaces prior to installing weatherstripping, and repair or replacement of hinges is completed before weatherstripping is installed.
- Weatherstripping materials shall be installed in accordance with the manufacturer's instructions as printed on (or supplied with) the package.
- Surface-mounted weatherstripping materials shall be installed by closing the door, window, attic access, etc., and installing the weatherstripping material in or over the crack so that the weatherstripping is slightly compressed. The weather-strip shall sufficiently contact both surfaces and the crack shall be adequately sealed.

- Metal prime windows are often fitted with pile weatherstripping consisting of a short, bristle-like material on a backing. Cheaper piles often shrink after exposure to moisture and weather, and the window sashes may become loose fitting and inadequately weather-stripped. It is sometimes possible to remove the defective pile weatherstripping and replace it with new pile. The new pile and its backing shall be made of a material, such as polypropylene, that will not shrink. If the new pile cannot be inserted into its slot (or track) in the window, a knife may sometimes be used to force it into place. For easier replacement and a proper seal, ensure pile of the correct size (width of backing and height of pile) is used for each specific window.
- The inside perimeter of casement and other hinged windows shall be weather stripped when an efficient seal does not already exist. Spring metal and vinyl strips, V-strips, and certain vinyl strips with a small flexible bulb may be used on these windows. They are attached to the jamb running alongside the window stops to ensure a proper seal when the window is shut.
- Door sweeps, thresholds, and replacement vinyl inserts shall be installed in accordance with the manufacturer's instructions.

When applicable, the vinyl insert shall be replaced rather than installing a complete threshold. If the existing threshold is damaged beyond repair or one does not exist, a complete threshold, either a vinyl bulb threshold or a door shoe, should be installed.

The following requirements should be observed when installing a vinyl bulb threshold:

- The door shall be removed and the door bottom trimmed to achieve a 1/8-inch bevel. The bevel shall be cut in the direction to allow opening and closing of the door.
- The threshold shall be cut to the required width so that the complete length of crack at the bottom of the door will be sealed.
- The threshold shall be shimmed to the height required to achieve a good seal and shall be secured in place using screws.
- The inside edge of the threshold shall be embedded in caulk when the threshold is installed.
- Screws, bolts, or other anchoring devices shall be used to secure the threshold.

After installation, the door shall open and close properly and the bulb shall achieve a proper seal.

The following requirements shall be observed along with the manufacturer's installation instructions when installing a door shoe:

- ⇒ The door panel shall be removed to allow full access to the sill.
- ⇒ The threshold shall be installed if one does not already exist or if the existing threshold will not seal properly with the new door shoe. The threshold shall be shimmed to achieve the proper height.
- ⇒ The threshold shall be embedded in caulk along the interior intersection with the flooring and along the two ends at the door jambs.
- ⇒ The door panel should be measured and the bottom edge shall be trimmed to provide a weathertight seal with the threshold.
- ⇒ The door shoe shall be cut the same length as the width of the door panel and secured to the bottom of the panel with screws.
- ⇒ The door shall be opened and closed to ensure its proper operation and to ensure that the vinyl insert achieves a good seal.

## Rehabilitation Work

Rehabilitation Improvements (or Rehab Work) refers to Improvements to a home's energy efficiency that would be described as minor repairs. Examples of rehab work include:

- Installation of new insulation, caulk, and/or weatherstripping

- Minor repair work such as broken glass, glazing or prime door replacement
- Removal of attic fan, resulting repair
- Reinstallation of knee wall or floor insulation
- Installation of ground vapor barrier
- Replacement of a damaged window

### **Pre-approvals.**

- All Rehab Work to be self-installed by the Participant must be pre-approved by the power distributor prior to installation. Rehab Incentives for Participant-installed work are limited to cash rebates and only the cost of materials (no labor charges) will apply toward Participant Incentives.
- Incentives shall be limited to the cash rebate amounts specified in the Retrofit Incentive Schedule.
- Rehab work to be installed by QCN members will normally be pre-approved in the local distributor's Program Implementation Plan (PIP). Additional Rehab work, not identified in the distributor's PIP, must be submitted as a case-by-case approval request to the distributor, and pre-approval obtained prior to beginning installation of the additional rehab work.

### **Replacement Entry Doors (Primary Doors) - Installation Requirements**

**Applicability.** New (primary) entry doors may be installed in qualifying homes to replace existing doors where specified in the In-Home Evaluation's Recommendations.

**Material Specifications.** All new replacement entry doors must be new and meet Energy Star requirements. Unless otherwise approved by TVA's Consumer and Small Business Design staff or local distributor, the new entry door shall be installed with a new jamb and new threshold that was shipped with the door from the manufacturer.

**Installation Requirements.** New replacement entry doors must be installed in accordance with the manufacturer's installation requirements. Unless otherwise stated in the manufacturer's installation instructions, the following installation practices are required:

- The existing doors shall be completely removed to accommodate a new door with its jamb and threshold.
- Door frames (jambs and threshold) must be properly set and aligned in their rough opening so as to allow for expansion and contraction of the door. Shims used at the bottom of the door should be rot-proof. Shims should be used only on the bottom and sides as needed to ensure the door is properly aligned in the rough opening.
- Gaps between the frame and door's rough opening shall be insulated and the finished frame shall be sealed with a flexible caulk to limit air leakage or moisture intrusion into the wall cavity.

Manufacturer warranties shall be left with the homeowner.

### **Replacement Windows**

**Applicability.** New windows may be installed in qualifying homes to replace existing windows that are damaged or as recommended to improve the energy efficiency of the home.

**Material Specifications.** All new replacement windows must be new and in compliance with Energy Star requirements.

**Installation Requirements.** New replacement windows must be installed in accordance with the manufacturer's installation requirements. Unless otherwise stated in the manufacturer's installation instructions, the following installation practices are required:

- New windows must be installed in conformance with applicable code requirements, including egress requirements, design pressure ratings and tempered/safety glass requirements as applicable.
- Windows must be properly set and aligned in their rough opening so as to allow for expansion and contraction of the window. Shims should be installed only on the bottom and sides as needed to ensure window is properly aligned in the rough opening.
- A self-adhesive flexible flashing with a minimum width of 4 inches, is required to effectively seal air leakage and moisture penetration from entry into the wall cavity. The flashing material must meet a minimum water resistance of 24 hours in accordance with ASTM-D779.
- Sill flashing should be installed before the window is installed and should extend beyond the sill at least 2 inches. Side flashing and header flashing shall be installed in such a manner as to ensure overlaps of the flashing promote drainage from the top down.
- Gaps between the windows frame and the rough opening should be sealed air tight. Batt insulation or other window manufacturer approved flexible insulation materials shall be used to fill the gaps between the window frame and it's rough opening. Care should be taken to ensure that gaps are not overfilled to the point where it would warp the frame. Do Not Use Expanding Foam to seal gaps between the window and rough opening.
- Interior jambs and trim shall be caulked or otherwise adequately sealed to reduce air leakage between the wall cavity and the conditioned room.

Manufacturer weep holes in the window frames must face the exterior and shall not be plugged or otherwise sealed during installation.

Manufacturer warranties shall be left with the homeowner.

## Storm Windows (SW) and Fixed Glass (FG)

**Applicability.** Storm windows or fixed glass may be installed when an existing home contains single-glazing (one layer of glass) primary windows without existing storm windows.

**Material Specifications.** All storm windows shall be new.

Storm windows shall be used in conjunction with a single glazed prime window, to achieve double glazing, and shall be a storm window certified by the American Architectural Manufacturers Association (AAMA), the National Accreditation and Management Institute (NAMI), or an equivalent certification program. Evidence of certification by AAMA, NAMI or equivalent shall be a (1) certification label, (2) listing in the latest edition of their certified product directory, or (3) letter of certification from the certification authority.

The inserts of storm windows installed in the program must be removable from the main frame. For operating storm windows and internally-applied fixed storm windows, the inserts should be removable toward the inside. For externally-applied fixed storm windows, the inserts should be removable toward the outside.

On certain prime windows, the storm window insert may not be removable toward the inside due to the prime window design. For these windows the storm window insert may be removable toward the outside. Examples are Oriel windows and the fixed light of a 3-light horizontal slider. The meeting rails of the storm window should be checked for proper alignment with the meeting rails of the prime window.

Approved thermal break materials shall have a minimum life expectancy of 15 years.

### Installation Requirements

- **Application**—Storm windows may be installed on the interior or exterior side of the prime window opening to achieve an isolated air space between the two glazing materials of 3/4-inch minimum to 4 inches maximum. Storm windows designed for interior installation should be used in cases where (1) the prime window cannot be effectively sealed against excessive air leakage or where (2) mechanical operation of the prime window or access to the prime window would make external application impractical.
- **Preparation**—The prime window shall be made as weathertight as possible both inside and outside (excluding required weepage systems) before a storm window or fixed glass is installed. This includes weatherstripping, caulking, reglazing, replacing of broken glass, or other work required to make the prime window weathertight. If a prime window requires caulking, the caulk should be applied in such a manner as to avoid interfering with the mounting surface where the storm window, thermal break (spacer), or subframe, will be installed.

- **Building Codes**—It shall be the QCN member’s responsibility to comply with local building codes regarding the installation of operating or fixed storm windows or fixed glass. The QCN member shall refer to the manufacturer’s instructions concerning removal of retaining bands or shipping clips.
- **Weepage**—When the storm window is installed on the exterior side of the prime window, weep holes (approximately 1/8 inch round or equivalent) or an effective weepage system shall be provided for each insert track (glass and screen) and on the main frame, sill expander, and sill subframe near each corner of the window. Weep holes shall be located with a maximum of 4 feet on-center in between. A weepage system should be provided in prime windows for internally applied storm windows if not provided by the prime window manufacturer.
- **Piggyback**—The QCN member will be permitted to install piggyback or fixed glass over better grade wood prime windows that are designed especially to accept the manufacturer’s storm window inserts and over any wood casement or wood-awning-type single glazed prime windows.
- **Mounting Devices**—All mounting hardware, screws, or other miscellaneous items in direct contact with aluminum storm windows shall be of aluminum, stainless steel, or other non-corrosive material compatible with aluminum. All mounting hardware in direct contact with steel storm windows shall be of non-reactive material that is compatible with steel.

When subframing materials are used for mounting storm windows, the sub frames shall be anchored to the prime window frame or window opening mounting surface with adequate anchoring devices to provide a secure installation of the storm window.

Screws used for installing storm windows shall be equally spaced approximately 12 inches apart beginning approximately 2 inches from the main frame corners with not less than two screws per jamb. Where the design of the prime window opening does not provide a mounting surface for the storm window at the head or sill, or access to the head, screws will not be required if the storm window is adequately secured to the window opening and is weathertight except for the weep holes along the sill. If the storm window is not adequately secured, the installer will be required to add the necessary mounting brackets, subframing, and thermal break materials.

- **Metal Storm Windows Over Wood Prime Windows**—The storm window shall be effectively sealed to the prime window opening by one of the following methods:
  - Applying a continuous bead of approved caulk to the mounting surface (perimeter) of the prime window or to the perimeter of the storm window before setting the window in place and then pressing the storm window so as to embed the window frame into the caulk.
  - Installing a continuous, flexible, closed-cell vinyl material or an approved, closed-cell foam tape or extrusion weatherstrip material as a seal between the two surfaces.

*NOTE: The materials used must completely seal the window opening to provide a weathertight seal except for the sill weep hole openings. Rigid materials used as spacers will require caulking.*

- **Metal Storm Windows Over Metal Prime Windows**—If caulking is required to seal the perimeter of a metal prime window frame and wall opening, it should be applied in such a manner as to avoid interfering with the storm window installation. Caulk will not be accepted as a thermal break material in any application. The storm window shall be effectively sealed to the prime window opening by one of the following methods:
  - Secure an approved rigid thermal break (spacer) material to the window opening with screws on approximate 12-inch centers to form a secured mounting surface for the storm window, or secure the rigid thermal break material to the perimeter of the storm window framing. Apply a continuous bead of approved caulk to the mounting surface or to the perimeter of the storm window before setting the window in place and then press the storm window to embed the window frame into the caulk. Secure storm window in place with screws equally spaced approximately 12 inches apart beginning approximately . 2 inches from the main frame corners.
  - Install a continuous, flexible, closed-cell vinyl material or an approved, closed-cell foam tape or extrusion thermal break material to the prime window opening mounting surface or to the perimeter of the storm window. Then press the storm window in place and secure with

screws approximately 12-inch centers beginning approximately 2 inches from the main frame corners.

*NOTE: Caulk should be applied over the thermal break along the head of the storm window (exterior side) if the head is exposed to the weather as in an overlap installation where water could accumulate on the gasket material.*

- **Fixed Storm Windows**—Fixed storm windows or hinged inserts will be allowed to cover metal casement, awning, or jalousie prime window openings subject to the approval of the TVA Customer Service Center on an individual design basis. In any of these three prime window types, the fixed or hinged storm window may be applied internally or externally. However, the installation should not prevent the normal operation of the prime window with the storm insert removed.
- **Coverage (Thermal Isolation)**—Metal storm windows applied over metal prime windows shall to completely and effectively isolate (thermally) the entire external or internal prime window opening, including any mullions. Fixed or operating storm windows installed on the interior of metal casement, awning, or jalousie prime windows will be exempt from this requirement; however, the storm window should cover as much of the interior metal prime window as possible without interfering with the operating hardware of the prime window. On any grouping of windows joined by a metal mullion bar, the storm windows must be installed either all on the inside or all on the outside.

*NOTE: For metal prime windows, the storm window shall not be installed as an insert in the screen track.*

- **Wood Subframes For Metal Window Applications**—Wood may be used as a thermal break or as a subframe between metal-to-metal application provided the wood meets the 1/4 inch or greater minimum thickness for hardwoods and 3/16 inch or greater minimum thickness for softwoods. Wood trim installed as a subframe for blindstop applications or as a thermal break must be water-repellent preservative-treated or the wood must be protected against moisture penetration and painted with a finish coat. A priming coat of alkyd (oil-based) paint or latex (water-based) paint is acceptable in these applications as a preservative treatment (protectant).
- **Trim for Bug-Eye Windows**—When wood strips are used to thermally isolate the framing of a bug-eye prime window (a prime window that protrudes from the window opening), the wood must be water-repellent preservative-treated. Finish coats are required if the storm window is mounted to the wood trim.
- **Other Installation Techniques**—Other methods of installation will be subject to field review. They will be approved if determined by the TVA to be equal to any one of the methods described above.
- **Fixed Glass (FG) Over Wood Prime Windows**—A piece of glass without a sash mold (unframed sheet glass) defined as fixed glass may be installed over a fixed wooden prime window (picture window) in lieu of a framed insert (also defined as fixed glass) or a fixed storm window provided the glass is placed on neoprene shims at the base for support and is sealed around the perimeter with an approved caulk or other sealant. Wood molding or other suitable material shall be used to secure the glass to the opening. Framed fixed glass inserts over wood shall be installed as described in these standards.

**QCN member's Post-Installation Verification.** Each storm window installed shall be checked by the QCN member to ensure the following:

- The meeting rail or stile aligns with the meeting rail or stile of the prime window and that the window is installed with adequate clearance to permit operation of both the storm and prime windows and to permit removal of the storm window inserts.
- All movable parts of the storm window operate without binding and final adjustments are made where necessary to ensure proper fit and functioning.
- Weep holes (or an effective weepage system) are located in each glass and screen insert track and in the sill of externally applied storm windows to provide adequate ventilation and proper drainage.
- All main frame joints (lap, butt, miter, etc.) are either welded, brazed, or mechanically linked and sealed.

## Floor Insulation and Ventilation

**Applicability.** This improvement is applicable only if none of the following conditions exist:

- Presence of any effective floor insulation
- Underfloor area of insufficient height for installing floor insulation
- Floor is over an area that is being converted or will be converted to a conditioned space
- Underfloor area is subject to moisture problems (such as flooding or drainage problems)

**Material Specifications.** Materials installed as floor insulation must be an acceptable material suitable for floor insulation.

When physically possible, a continuous ground cover vapor barrier should be applied to cover approximately 80 percent of the crawl space ground surface to assist in keeping crawl space humidity at a low level. This will decrease the ventilation requirements as shown below. If a ground cover vapor barrier is not feasible, additional crawl space ventilation may be needed as described in these Standards.

Six mil polyethylene or 55 lb. roll roofing shall be used.

**Ventilation.** The frame and screening materials used for the foundation wall vents shall be constructed of durable materials (preferably metal) and be of sufficient size and number to provide the minimum required net free area of ventilation as shown below.

Minimum Crawl Space Ventilation		
Ratio of Total Net		
Under Floor Area	Ventilating Area to Floor Area	Minimum Number of Vents
Without ground cover vapor barrier	1/150	4
With ground cover vapor barrier	1/1500	4

**Support Materials for Floor Insulation.** In general, support materials shall be rot-proof, rust-proof, stretch-free and strong enough not to break when affixed to the underfloor structure.

- When netting and staples are used as support, netting shall be knotted, looped, woven, or heat fused at all junctions; staples shall be the type commonly used to support insulation batts.
- Wire staves shall be made of a single piece of 13-gage (0.087 inch diameter) or larger “hard drawn” steel wire, pointed at both ends. Staves shall be manufactured especially for the purpose of supporting underfloor batt or blanket insulation.
- Staves shall be of good quality steel with sufficient spring to return to their original shape with little or no deformation when released.
- Wire staves shall have a length between 1/2 inch to 2 inches longer than the inside joist spacing on which the staves are used.
- When the wire staves are cut to a shorter length to fit smaller joist spacings, the cut shall be on a diagonal in such a way to produce a barb that will more easily secure the wire stave into the joist.
- Wire, nylon string, or other equivalent permanent materials of sufficient strength shall be used to support the insulation material. Wire staves should be spaced 12 to 18 inches from each other, as needed to keep the insulation tight against the subfloor.
- Nails with small heads, such as brads or casing and finishing nails shall not be used.

**Installation Requirements.** The QCN member for each weatherization item covered under Floor Insulation shall be responsible for ensuring that all materials used and work done comply with the installation procedures and criteria outlined in these standards.

- *Preparation Work*—Work identified as preparation work shall be completed prior to, or in conjunction with, installing floor insulation.
- *Existing Conditions*—The QCN member shall be responsible for determining if the installation of additional floor insulation will cause structural damage to the residence. If applicable, QCN

members shall notify inspector and customers prior to installing insulation if they determine that an R-value different from that recommended should be installed.

The QCN member shall be responsible for completing all preparation work involving insulation materials already existing in the residence, such as blocking around heat-dissipating devices that were covered with existing insulation, etc.

The customer shall be responsible for seeing that preparation work such as repairing the floor, foundation wall leaks, pipe leaks, vent leaks, removing objects stored in the crawl space area, etc., is completed if failure to do so would adversely affect the installation of additional insulation.

- General Requirements

- Cross Bracing. Batts and blankets shall fit snugly against the floor joists, cross-braces, headers, and adjacent batts or blankets. Gaps between floor joists and insulation caused by carpenter error or warped joists shall be stuffed with insulation to reduce energy loss. Batts or blankets shall be cut and split in such a way as to fit between any cross-bracing if looping under the cross-bracing will require more than one-third of the batt or blanket to extend below the floor joists. Any method other than cutting and splitting at the cross-bracing must be approved by TVA.

- Heat Dissipating Devices. Insulation materials shall maintain a minimum 3-inch clearance from heat dissipating devices such as furnaces and electric motors; also the insulation material shall be prevented from blocking or restricting combustion air openings of gas or oil-fired furnaces.

- Underfloor Protection. Insulation materials in open underfloor areas shall be protected from the weather and other hazards by fastening (stapling) a minimum 6-mil thickness polyethylene to the bottom of the floor joists perimeter inwards 2 to 3 feet. In addition, the floor insulation shall be supported by poultry netting or nylon mesh beneath the entire floor to protect it from destruction by animals.

- Crawlspace Vents. Proper crawl space ventilation, as discussed in these standards, shall be installed if needed. The insulation shall not cover or block the ventilation system in any way.

- Exhaust Vents. Clothes dryer and other exhaust vents shall be vented to the outside.

- Vapor Barriers—An acceptable floor vapor barrier shall be installed toward the winter-warm side of the insulation.

- Approximately 80 percent ground coverage is recommended for existing homes (one year old or older). In placing the vapor barrier over the underfloor surface, the adjoining edges shall be overlapped at least 4 inches, with 6 inches preferred. To achieve this approximate 80 percent coverage, areas adjacent to foundation walls and support piers should remain uncovered.

- After the vapor barrier is in place and all openings lapped or taped (small tears may be repaired by taping over them with a quality duct tape), bricks, other small masonry pieces, or an equivalent material shall be used to prevent movement of the barrier. Other methods used to prevent movement of the barrier shall be submitted to TVA for approval on a case-by-case basis. Ground cover shall be used in conjunction with ventilation, not in place of it.

- In extremely damp underfloor areas where there is concern over the possibility of drying out the residence too rapidly, the vapor barrier should be installed initially to cover approximately 50 percent of the ground surface, with enough material folded back for eventual 80-percent coverage.

- Vents—After determining the correct number of vents required for the particular underfloor area, vents shall be evenly distributed around the foundation to provide the best air flow over the greatest area. When only four vents are required or possible, two vents should be located on the prevailing wind side of the house and the other two on the opposite side. As with attic vents, foundation vents should remain open in winter as well as in summer to provide the necessary ventilation. However, during freezing conditions, it is advisable to temporarily close vents located next to water pipes in order to lessen the chances of water in the pipes freezing.

- Vent openings shall be located as close to building corners as is practical and should provide cross-ventilation through at least two opposing foundation walls. Adequate cross-

ventilation shall be provided whenever possible for all separate areas within a partitioned crawl space. Vent locations for proper cross-ventilation of crawl space areas shall be defined according to the “polygon method.”

- First, the crawl space is sketched with the location of all existing and/or proposed vent openings shown. The vent opening locations are then connected with straight lines (which do not cross each other) to form a polygon (i.e., a multi-sided figure, such as a triangle, rectangle, pentagon, hexagon, etc.). If the crawl space is partitioned, a polygon is drawn for each separate crawl space area.
- If the area of the resulting polygon covers 70 percent, or more, of the crawl space area to be ventilated, then the distribution of the ventilators is adequate.
- If the area of the resulting polygon does not cover 70 percent of the crawl space area, then additional vent openings or relocation of proposed vent openings shall be required to allow a similarly drawn polygon to indicate an adequate distribution of ventilators.
- All other possible steps (such as making access doors into screened vents, enlarging existing foundation vents by removing wooden screen frames, etc.) should be taken to increase total existing net free area instead of adding more openings in foundation walls.

## Crawlspace Wall Insulation

**Applicability.** Crawlspace wall insulation may be accepted as an alternate to floor insulation where approved by the local power distributor. In some instances, local building codes may have restrictions and or code requirements that must be addressed when using crawlspace wall insulation; in such instances, it is the responsibility of the QCN-W to assure the final installation complies with local codes.

Where crawlspace wall insulation is a **Recommended Improvement**, QCN is responsible for installation meeting the following conditions:

- Crawlspace wall insulation shall have a uniform thickness.
- Insulation used for crawlspace walls must be a product that has been approved for crawlspace wall applications by the manufacturer and has been installed in accordance with the manufacturer’s installation requirements.
- Crawlspace walls must be installed in a manner that prohibits moisture problems that would degrade the wall’s insulation value.
- Prior to installation, Participant shall be advised of potential risk associated with termites or other pest and that the installation may void their contract with a pest/ termite protection service.
- Crawlspace vents shall not be covered or otherwise blocked.
- Ground vapor barriers and adequate ventilation requirements are the same as those specified under Floor Insulation.

**Material Specifications.** Materials used to insulate crawlspace walls must be an acceptable material suitable for crawlspace wall applications.

**Installation Requirements.** The QCN member shall be responsible for ensuring that all materials used and work done comply with the installation procedures and criteria outlined in the insulation manufacturer’s standards.

## Insulating Water Heaters and Insulation Hot Water Pipes

### MATERIAL AND INSTALLATION STANDARDS

#### Water Heater Insulation

##### Applicability Criteria

The addition of insulation to the exterior of a water heater is applicable for electric water heaters located in conditioned or nonconditioned areas of a residence except when **an effective** exterior insulation already exists around the water heater.

### **Material Specification**

- Water heater insulation shall consist of a mineral fiber blanket with a foil or vinyl facing. The minimum acceptable thermal resistance value shall be R-6.
- High quality polyethylene coated duct tape or pressure sensitive aluminum duct tape shall be used.
- Commercially available water heater insulation kits shall be acceptable if specifications in item number 1 above prevail and provided the kit covers the top of the tank and extends down the tank to cover at least 75% of the tank's height.

### **Safety Precautions**

- Before starting any work on an electric water heater it is recommended that the source of electric power to the unit be turned off at the fuse or breaker box. Unless this is done, possible hazards could exist around any wiring connected to the water heater.
- Safety hazards also exist if an electric water heater is not equipped with a pressure and relief valve. This condition shall be corrected by installing a pressure and temperature relief valve before installing insulation.
- Mineral fiber batt and blanket insulation may irritate the skin. Therefore, it is recommended that long sleeve apparel and gloves be worn while installing water heater insulation.

### **Installation Standards**

#### **Preparation Work**

- Electric water heaters that do not have an existing pressure and temperature relief valve shall be retrofitted as described under Safety Precautions.
- All leaks in the water heater and plumbing that could affect the insulation material shall be corrected prior to insulating the water heater.

#### **Electric Water Heaters**

- These installation standards apply to electric water heaters only.
- If a commercially available water heater insulation kit is to be installed, it shall cover the top and at least the top  $\frac{3}{4}$  of the height of the water heater, and the manufacturers' instructions shall be followed.
- The following standards shall apply when mineral fiber insulation with foil or vinyl facing is to be installed (including insulation kits).
  - The insulation shall be installed with the foil or vinyl facing toward the outside thus becoming the outer surface.
  - The insulation shall be positioned approximately 2 inches above the floor. No more than  $\frac{1}{4}$  of the bottom of the tank shall be exposed.
  - The insulation shall be butted together at the seams, leaving no gaps.
  - To retain maximum R-value, compressing the insulation shall be minimized during and after installation. It shall be snug but not overly compressed.
  - High quality duct tape as described under Material Specification, shall be used to seal all seams. All surfaces should be clean to ensure proper adhesion.
  - If a commercially available water heater insulation kit is used which has only one vertical seam and no horizontal seams, two bands of duct tape shall be wrapped around the insulation at locations approximately equal distance along the height of the insulation kit.
  - All duct tape wrapped horizontally around the insulation (to seal seams and/or secure the insulation) shall be overlapped a minimum of 12 inches. As an alternative method, the tape may be overlapped a minimum of 2 inches with outward clinching staples added at the overlapped portion.
  - Access plates to heating elements and thermostat controls shall not be covered with insulation.

- Warning labels and operating instruction labels shall not be covered with insulation.
- Insulation shall not cover the junction box or the cover plate where the lead wire (house wiring) enters the water heater.
- The pressure relief valve and the drain valve shall not be covered with insulation. Insulation shall be installed between the tank and the drain tube whenever possible. The drain tube shall be extended beyond the side of the tank to prevent the insulation from getting wet.
- Inlet and outlet water pipes may be wrapped with insulation up to 5 feet of the water heater; however, this shall not be a requirement.

### **Non-electric Water Heaters**

The insulation of non-electric water heaters such as natural gas or oil is not covered by the program. However, installing insulation on these water heaters may also be helpful. It is recommended that the local fuel supplier be contacted for standards regarding the installation of insulation on non-electric water heaters.

### **Insulating Hot Water Pipes**

A closed-cell foam pipe insulation shall be used to insulate hot and cold water pipes connected to the top half of the water heater for a minimum distance of 24 inches from the tank. In addition, the pipe insulation should be extended beyond the first 24 inches for all hot water lines where evidence of heat loss is detected. Heat loss can be detected by carefully touching the hot water lines. Wait at least 10 minutes after the last hot water draw before touching the hot water lines. This will allow the lines to cool some. If they are still hot, this is an indication of standby losses that can be reduced by insulating the water lines. (Caution: Before touching hot pipes, carefully check that pipes are not hot enough to burn you.) Pipes that remain hot during periods of time when there are no hot water draws, represent sections of pipe that will benefit from pipe insulation.

For hot water pipes that have a built-in heat trap plumbed into the hot water pipe outlet, insulation should extend all the way up to and including the heat trap. If no heat trap exists on the hot water outlet piping, then carefully touch the pipes during delayed water draws, to detect evidence of heat loss, as explained above and insulate accordingly.

Pipe insulation should be secured by tie-straps or other means of keeping the pipe insulation fully surrounding the pipes being insulated.

### **Duct Repair and Sealing**

Requirements for duct repair and sealing are currently limited to visual checks of the heating and air-conditioning ducts and their connections to the operating system. Pressure testing of ducts is recommended but not required. The following procedures are requirements that must be met by the QCN member:

- Inspect the entire duct system, from its connection to the heating and cooling system to each supply register and return. Areas that are hard to access, such as floor or wall cavities or ducts installed between floors should be examined with lights, smoke pencils, or other means of identifying leakage to the exterior if these duct areas are outside the conditioned thermal envelope of the home. Watch for dirt accumulation near seams in the ductwork that may be evidence of air leakage. Also, moisture stains and/or damp spots may point to poor installation of insulation that results in moisture condensation. Fix defective insulation and seal the insulation exterior moisture barrier as needed.
- Check the system's supply and return for any evidence of unbalanced air flow. Assess if an imbalance may be due to inadequate duct sizing as opposed to air leakage.
- Visibly inspect all ducts and repair any damaged or disconnected ducts and straighten out flexible ducts that are tangled or crushed.
- Insulate any non-insulated ducts in non-conditioned areas (such as crawl spaces, attics and garages); where duct insulation has deteriorated or been damaged, remove and replace with new duct insulation.

- Replacement duct insulation should be **at least R-6**. In attic areas where ducts are exposed to high summer attic temperatures, replacement insulation should be **at least R-8**.
- Visibly inspect all duct connections for air leakage or potential air leakage. Where leaks are detected, seal such connections with a mastic, metal tape or aerosol-based sealant or other approved duct tape that will retain adhesion over the life of the duct.
- Only duct sealing materials and methods certified by UL 181 are acceptable for use. Tapes with adhesives, such as duct tape, that lose their adhesion over time or in hot attic conditions, are not acceptable materials as a means of sealing air leaks.
- For cracks and/or gaps larger than ¼-inch, cover with a 2-inch wide section of fiberglass tape, embedded in a bed of mastic sealant, and then cover the tape with additional mastic sealant to provide an air-tight seal.
- Sections of metal ducts shall be secured together with metal screws, or other approved connectors, as needed, to ensure the duct sections remain connected.
- Seal all supply registers and return grilles tightly to the ducts.
- Air sealing around air handlers regardless of duct type should meet the UL 181A standard of either AF-100 tape or mastic plus fiberglass mesh.

**Note:** Caution: Combustion appliance venting - QCN shall report to the Participant and to the local power distributor any issues or concerns related to venting of combustion appliances. Repairs and sealing of ducts shall be suspended until such issues have been resolved.

### **Procedures for prioritizing duct sealing and repairs**

- Seal the largest leaks first. These include: disconnected ducts, missing end-caps, and other catastrophic holes.
- Seal the areas of highest pressure. These include all the connections near the air-handler cabinet and supply and return plenums, flexible canvas plenum connectors, and filter slot covers.
- Seal return leaks that may contribute to negative pressures in the combustion appliance zone.
- Seal all accessible connections between duct sections, at branches, and where take-offs connect to the main trunk lines.
- Seal take-off connections to register boots and boot connections to floors, walls, and ceilings.
- Sheet metal and flexible ductwork shall be sealed at all duct connections using duct mastic or similar product designed for sealing ducts. Duct tape is not an allowable duct sealing material. Aluminum FSK tape may be used on ductboard systems and at the connections to the air handler cabinet and ceilings.

## **Basic Air Conditioning Tune-Up QCN Technical Specifications**

### **1.0 Field Personnel**

All personnel that perform Tune-Up field tests shall meet the requirements outlined in this section.

### **1.1 Data Collection**

All data should be recorded directly on the Tune-Up form while at the customer site.

### 1.1.1 Unit Information

1. Record Brand of HVAC unit along with model number.
2. If the system is split, collect the model number on both pieces of equipment.
3. Record the age of the HVAC unit, if possible. The manufacturer date may be printed on the equipment nameplate. Alternatively, the serial number may be decoded to determine unit age.
4. Check for presence of TXV (Thermal Expansion Valve). Record Yes/No.

### 1.1.2 System Checks

1. The thermostat should be located and checked for proper operation. For single-stage units, set the thermostat in cooling mode and lower the set point to a temperature low enough to engage the cooling circuit. Check the thermostat space temperature reading against a calibrated thermometer, and if a two degree or greater difference is present, calibrate the thermostat, if possible. Once the system turns on make sure the condenser fan, the evaporator fan, and the compressor are all running.
2. For two-stage systems, make sure the stages come on in the proper sequence and at the programmed set points. If a humidity control is in place, make sure the proper staging is engaged for humidity control at the preset humidity levels.
3. Clean or Replace Air Filter(s)
4. Check refrigerant capacity of system using sub-cooling or pressure gauges
5. Condensate Drain Inspection
  - a) Clean, insulate, or repair any plumbing components and traps, as necessary
  - b) Ensure p-trap is installed in the condensate line (some package units are internally trapped)
  - c) Check to ensure a secondary drain is in place
  - d) Make sure all drains are free from obstruction and drain properly
  - e) Inspect drain pan and accessible drain line for biological growth. Clean as needed to remove biological growth and ensure proper operation. Add algae tabs or strips as necessary. Ensure algae tabs or strips and cleaning agent are compatible with the fin and tube material
6. Evaporator Coil Inspection, if possible

Access to the evaporator coil for most packaged units will not be a problem and can be achieved by removing the access panel for the evaporator coil / blower compartment. Access to the evaporator coil on split systems is, in many cases, extremely difficult or impossible in a service situation. If access is possible on split systems and for packaged systems follow the procedure below.

- a) Make sure unit is not running and will not come on during inspection.
  - b) Check for evidence of the system being run without a filter in place.
    - 1) Shine a flashlight on all surfaces of the evaporator coil and look for debris such as pet hair, dust, smoke contamination or organic material growth that could be restricting air flow or interfering with low-side heat transfer (the ability of the evaporator coil to absorb heat).
  - c) If any of these conditions is present, use a brush or vacuum to remove heavy debris. For stuck-on materials such as organic growth (mold or mildew) or smoke, it is recommended that a chemical cleaning agent be applied according to the manufacturer's and cleaning product's recommendations. In most cases a spray-on, leave-on type cleaner will have to be used to prevent flooding of the return air compartment.
7. Evaporator Fan and Motor Inspection
    - a) Confirm that the fan or blower wheel has a tight connection to the blower motor shaft.
    - b) Inspect the fan for free rotation.
    - c) Vacuum blower wheel and blower compartment to remove dust and debris.
    - d) Lubricate as needed as recommended by manufacturer.
  8. Inspect all accessible refrigerant lines for leaks, kinks, crushed sections, and restrictions.
  9. Condenser Coil Inspection
    - a) Brush the condenser coil fins to remove any heavy debris.

- b) Use a fin comb or similar device to straighten any damaged or bent fins.

**10. Condenser Coil Cleaning, if necessary**

- a) Apply the appropriate cleaning agent to the all condenser coil surfaces and let stand for a minimum of ten minutes or the cleaning product or manufacturer's recommended time.
- b) Rinse the coil thoroughly with water. Stubborn or impacted debris may require the top panel be removed and the rinse applied from the inside out, opposite the direction of the condenser coil air flow.

**11. Condenser Fan Motor Inspection**

- a) Confirm the fan blade has a tight connection to the blower motor shaft.
- b) Inspect the fan for free rotation.
- c) Lubricate bearings as needed, only if recommended by the manufacturer.

**1.2 Quality Control**

CSG and/or the utility also has the option of performing additional quality assurance activities, such as field visits, phone calls, or other activities as deemed necessary by the program manager. CSG and/or the utility or a third party representative may perform these activities.