Level 2 Protocol: Insulation Installation

1.0 Background

Level 1 Protocol: Insulation Installation discussed basic concepts and terms required by an insulation contractor in order to effectively understand and convey to the customer the scope of work required to increase energy efficiency of a home. *Level 2 Protocol: Insulation Installation* will explore methods of insulation installation for ceiling and roof systems. *Level 3 Protocol: Insulation Installation* describes more invasive installation applications such as wall and foundation systems.

Insulation of the building envelope reduces the conductive losses and gains by improving the envelope's resistance to heat flow. This greatly improves comfort while reducing the energy demand and the size of appliances required for space conditioning. The effectiveness of insulation is dependent on the quality of the installation and the insulation's rated ability to resist heat flow. The ability of insulation to resist heat flow is generally expressed by the material's R-value (see *Level 1 Protocol: Insulation Installation*).

Manufacturer's rated R-values refer to the insulation values under "best case" conditions when coverage is complete and without voids, the material has been installed to the proper density, and that the insulation is installed with proper and integral air and vapor barriers in place. Any deviation from these installation standards, will adversely affect the performance (R-value) of the material. Insulation can be added to an existing building envelope by filling the framing cavities (floor, ceiling and wall) or by installing an additional layer of insulation, usually a rigid board type, adjacent to the frame of the envelope. Insulation should be selected for its ability to completely cover or fill the area of placement and to provide the optimum U-value for the most reasonable cost. It must also be installed in accordance with all fire, electrical and safety regulations.

2.0 Tools and Materials

Infrared scanner, blower door test equipment, diagnostic smoke generator, HEPA vacuum cleaner, personal protection equipment including respirators, gloves, eye protection, protective coveralls, and boot covers, heavy mil trash bags (see *Level 1 Protocol: Insulation Installation* for description of these tools).

3.0 Procedures

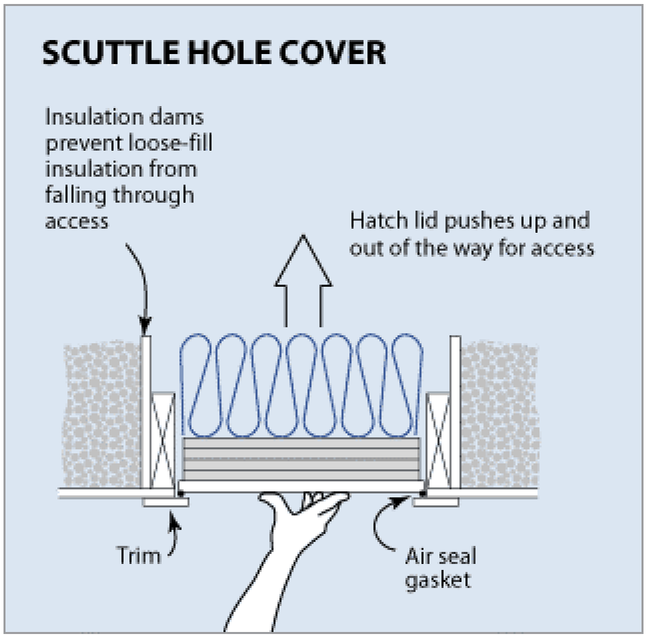
3.1 Insulating attics and roof systems

Several options exist when deciding what techniques and materials should be used to insulate an attic or roof system. The determining factors are accessibility and available space for insulation. Where attics are accessible and when space permits, a blanket of blown cellulose is an effective and inexpensive way of filling unusually sized spaces and providing even coverage. When a floored attic exists, high-density cellulose will provide some air sealing capabilities, while also providing a uniform thermal boundary. Normally in attics, ventilation is installed to relieve heat and moisture buildup in the attic. In cooling climates, radiant barriers installed over the insulation can be very effective at reducing heat transfer from the attic to the conditioned space. Radiant barriers are usually only effective in the warmest of climates.

3.1.1 Attics:

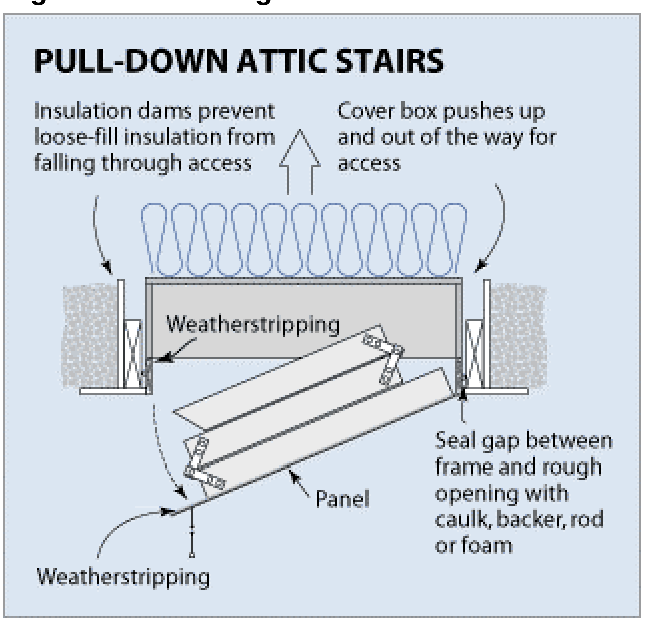
- Install attic vents in accordance with ventilation requirements established by local building code. If excessive summer heat buildup is expected, ventilation should equal one square foot of ventilation for each 300 square feet of attic space. One half of the ventilation should be installed low in the attic, with one half of the open area being higher in the attic. This will encourage airflow. Installing ventilation in opposite gable ends encourages cross ventilation. Use screens to keep birds, bats and insects from entering the attic through these vents.
- Air seal any bypasses from the conditioned space below, to the attic floor. Seal any electrical, plumbing and framing penetrations. Urethane foam works well for areas that are not associated with any heat sources.
- Air seal any ductwork found in the attic. Seal leakage of plenums, distribution boxes, register boots and duct connects with fasteners and latex-based mastic. If flex ducts are to be suspended above the installed insulation, install duct hangers every 6 feet, minimum.
- Poor wiring must be replaced before the attic is insulated. Do not insulate over knob and tube or aluminum wiring as this creates a fire hazard.
- Baffle around heat sources forming a metal barrier between the insulation and heat sources. Recessed light fixtures, combustion vent pipes and electrical appliances require a code-specified clearance be maintained. Electrical boxes must be properly covered and should be marked in some way for future identification. Using wide fiberglass insulation batts, baffle around the attic access hatch to form an insulated barrier that will keep loose fill insulation away from the access.
- Insulate the attic hatch or access with 4 to 6 inches of rigid foam board secured to the attic side of the hatch door. The attic access should be properly weatherstripped to prevent air leakage. Figure 1 and Figure 2 illustrate insulating scuttle hole cover and stairway hatches respectively.

Figure 1 Insulating a Scuttle Hole Cover



Source: U.S. Dept. of Energy Energy Efficiency and Renewable Energy

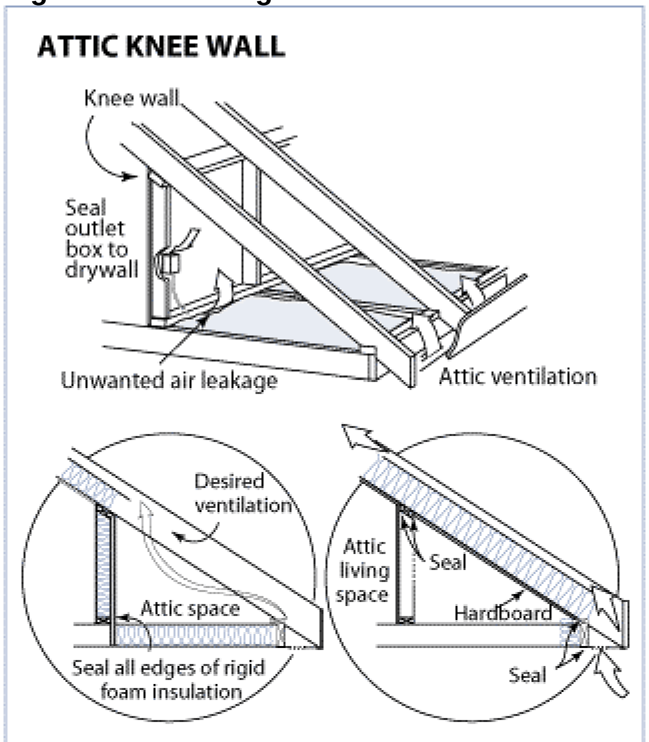
Figure 2 Insulating Pull-Down Stair Attic Access



Source: U.S. Dept. of Energy Energy Efficiency and Renewable Energy

- Secure depth markers to the attic floor joists every so often throughout the attic. The installer will gauge the depth of the delivered material by these markers.
- Install wind baffles around the eaves wherever ventilation will be provided. The baffle is designed to direct ventilation over the insulation nearest the sidewall. Wind blowing through the insulation will reduce its effective R-value.
- Use an insulation blowing machine to reach the distant attic areas. The primary hose is used for installing cellulose in an attic without a floor. During the installation, it is important to prevent creating unnecessary amounts of dust in the attic. Air pressure required to freely move the insulation through the hose should not be exceeded. The material feed should be in the full open position.
- Operate the blowing machine and install cellulose insulation to the desired depth, starting in the areas furthest from the access and working toward the escape area. Maintain a level uniform application using the markers as guides to depth. The finished insulation depth should equal 12 inches where room permits and should
- Cover all floor joists and framing materials.
- Attic knee-walls are usually constructed with no sheathing on the attic side of the frame. Simply hanging fiberglass batts in the knee-wall frame is an ineffective insulation technique because air moving through the attic will move through the insulation batts and dramatically reduce the R-value of the material. If fiberglass batts are used to insulate knee-walls, encase the insulation batts within the wall cavity by placing a rigid sheathing or insulation board over the insulation and the wall frame, on the attic side of the wall. Alternatives to using fiberglass batts include spraying the wall frame and cavities with 2-part urethane foam, installing rigid insulation board on the attic side of the wall, or installing blown fiberglass or cellulose (high density) into a wall cavity that has been closed with sheathing on the attic side of the wall. An example of insulating attic knee-walls is shown in Figure 3.

Figure 3 Insulating Attic Knee-Walls



Source: U.S. Dept. of Energy Energy Efficiency and Renewable Energy

3.1.2 Roof systems:

- Insulating vaulted ceilings requires designing an air barrier, vapor barrier, ventilation and R-value, all in a very limited space. Due to the limited space available and the narrow tolerances for an effective system, vaulted ceilings are difficult to address.
- Roof systems or vaulted ceilings can be insulated using a ventilation channel (2 inches) between the insulation and the roof deck or by filling the rafter/truss full of insulation and not incorporating a ventilation system. The ventilated roof deck requires a clear opening from the eaves or rafter end to a ventilated ridge. Most shingle manufacturers require a ventilated roof deck, to honor the manufacturer's warranty on roofing materials. Situations where a high probability of condensation forming exists, (either by air leakage into the roof system or due to marginal amounts of insulation, causing dewpoint temperatures to occur within the roof system) warrant a ventilated system. An airtight ceiling is critical for proper performance of this roof system design.
- Seal the spaces between rafter ends *at the eaves*. Using a rigid material like insulation board, plywood, heavy cardboard, etc. Block off all of the openings except for a 2-inch space directly below the roof deck. This space will remain open for ventilation. The blockers should be in alignment with the exterior vertical wall of the house to allow rafter insulation to extend over the exterior wall plate. Fit the blockers, secure them with fasteners, and seal them in place with a durable caulking compound. This configuration is important as it prevents "wind washing" (reduced R-value) of the insulation.

- Provide ventilation at the top of the 2-inch air space between the insulation and the roof deck. This is typically done with a ridge vent or with rafters leading to an attic zone that can provide the necessary air moving from outdoors back to outdoors through the attic.
- Install as much insulation between rafters while still maintaining a 2-inch open channel between the insulation and the roof deck. Installed R-values should be part of a design to prevent dew point formation within the system and to resist the solar gains typical to sloped and dark roof surfaces. If the rafter is 8 inches, the cavity should be insulated with 6 inches of insulation. If the rafter is 12 inches, the insulation should be 10 inches. A vaulted truss system should have a minimum of 10 inches of insulation. Fiberglass insulation should be foil or kraft faced, with the face stapled to the room side of the rafters.
- Where possible, supplement existing insulation by installing rigid board insulation (polystyrene, polyisocyanurate, and urethane) on the living space side of the rafters. This provides insulation of the building frame as well as the cavity and can be used as an effective vapor barrier. Foil faced insulation may also act as a radiant barrier. Rigid insulation board needs to be covered with a fire rated material such as drywall. If the roof system is not ventilated, rigid insulation can be placed directly beneath the roof deck, on the upper side of the rafter.
- Skylight shafts and dormers have framed vertical walls that should be insulated in the same manner as the exterior house walls (See *Level 3 Protocol: Insulation Installation*). High density cellulose can be blown into each frame cavity by drilling a hole through the interior finish and injecting insulation through the hole. Because dormers and skylight shafts have short walls, a 1 inch hole will allow for a high density installation provided the material flow and air pressure of the blowing machine are properly regulated (low material volume, high air pressure). Holes drilled through interior surfaces should be plugged with tapered wood plugs, recessed ¼ inch and then finished with drywall compound and interior paint.
- The finished ceiling of the roof system should be air sealed, primed and painted. In most cases, the paint and primer serves as an effective vapor barrier. If the ceiling is to be finished with a material such as tongue and groove boards or other material that is not an effective air barrier, then an air barrier should be installed to the under side of the rafter *prior to the installation of the finished material*. Plywood, OSB, or the recommended rigid insulation board will provide an effective air barrier.

4.0 References and Suggested Reading

http://www.toolbase.org/secondaryT.asp?CategoryID=1025 — Insulation Materials standards, installation techniques and tools

http://www.pathnet.org/si.asp?id=482 - Roof Systems — Partnership for Advancing Technology in Housing

http://www.buildinggreen.com/features/ins/insulation.html — Environmental Building News: Insulation Guide

Builder's Guide; Chapter 12 "Insulation" Building Science corp., Westford, MA

http://www.epa.gov/lead/rrpamph.pdf — "Reducing Lead Hazards When Remodeling Your Home" EPA

http://www.housingzone.com/probuilder/article/CA467409.html - HousingZone.com; Insulating Attics for Performance

http://www.greenbuilder.com/general/articles/AAS.atticcool.html - GreenBuilder.com; Don't Let Your Roof Take the Heat