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GreenHOME – Operation Caulk

Air Sealing Procedure for DC Habitat For Humanity Duplex Houses (February 2004)

A major component of heat transfer between the interior and exterior of a house result from infiltration of outside air. Therefore, minimizing air leaks in a house during its construction is just as important for creating an energy efficient home as is reducing radiating heat transfer with insulation and energy efficient windows. Minimizing air leakage in the outer envelope of a house during building is a process called air sealing. Care should be taken throughout the building process to create an effective air barrier separating the interior conditioned spaces from the exterior, as well as unconditioned interior spaces such as an attic or crawl space. In homes with forced air heating and cooling, sealing leaks in the ductwork is also very important because leaky ducts can be very wasteful of energy. Fortunately, air sealing and duct sealing can be done effectively with skilled labor and with minimum added costs. A little bit of attention to these details will pay off with savings for the homeowner for years to come. In addition, air sealing provide additional benefits to the homeowner, including eliminating drafts, preventing moisture penetration into walls, and reducing the chances of pest infestation.

GreenHOME, a nonprofit organization operating in Washington, DC, has been working on improving the air sealing of homes built by DC Habitat for Humanity since 1999. We have developed this procedure for air sealing and improving energy efficiency of duplex houses built by DC Habitat for Humanity. While the procedure applies specifically to this home plan, the principles and general techniques could apply to all houses.

General Tips

- Use caulk for gaps less than ¼ inch, and insulated foam for anything wider.
- Infiltration of light is a sure sign of an air leak. Check for outside light coming through the exterior walls before the insulation is installed. It helps to darken the room by covering windows. Also, after the drywall is installed, check the dark attic for light coming through from the top floor. Latex insulated foam is recommended because it works well around windows and doors, and being water-based, is much easier clean up than polyurethane foam. Polyurethane foam is useful for filling larger gaps.
- Do not use fiberglass insulation to fill in gaps around windows or other areas where air may infiltrate. Fiberglass insulation does not stop airflow and is not effective when it is compressed.
- Remember that each unit of the duplex house is staggered. This makes part of the party wall (i.e., the wall that separates the units) exposed to the outside. This part of the wall should be insulated and air-sealed like all other exterior walls.

A. Steps to Do Before the Insulation Is Installed

Insulating Headers

Headers are rectangular boards that fill the space in the framing of walls above windows and doors. Headers need to be insulated with rigid insulating foam board such as Dow Tuff® or Super Tuff® or Owens Corning Foamular®. At a minimum, sandwich a half-inch insulated foam board between the interior and exterior headers. Better still is to build a header with a single 1½-inch outer header board and a 2-inch inner foam board.

Sheathing

1. Fill gaps around cut-outs in sheathing where the electrical outlets and porch lamps are installed in front and in back of the house. Also seal all openings in metal electrical boxes where daylight is seen coming through from the inside. Use caulk and/or insulated foam.
2. Where there is a large hole cut out of the sheathing, such as the one for the outdoor faucet, install pieces of wood on the inside of the sheathing to make a tighter fit. Use a jig saw to cut a scrap piece of plywood or OSB board into two small rectangular pieces with a half-circle cut out of one side so that the pieces fit snugly around the pipe or wires. Glue the pieces on the sheathing, fitting them around the pipe or wires. Fill any remaining gaps around the pipe or wires with caulk, and caulk the joints between the pieces and where the pieces meet the sheathing.
3. From inside, caulk around electrical wires and cables wires where they come through the sheathing, filling any space where you can see daylight coming through.
4. In the back of the house a duct of the dryer vent penetrates the side wall between the first and second floor. Use foam or caulk to seal gaps around this duct.
5. Use caulk to fill gaps between sheets of sheathing where you see daylight coming through.
6. On the first floor, inspect around the exterior walls where the sheathing meets the bottom plate of the framing. Caulk any place where the seam does not appear tight or where daylight is seen coming through. Do the same thing on the second story where the sheathing meets the top plate.
7. Caulk the seam where the sheathing meets the vertical stud at all the corners of the exterior walls.

Framing

1. Around all windows and doors, fill the gaps between the framing and sashes using latex insulated foam. Do not use caulk or polyurethane foam for this. You may use sill seal or "caulk-saver" cords to fill in large spaces before finishing with insulated foam, but be careful not to cause the sash to bow out by stuffing too much material into the gap.

2. Caulk joints where the sheathing meets the studs of the window and doorframes. Make sure to caulk beneath the bottom of the windows as well as along the sides.

3. After the wiring and sprinkler system are installed, fill the holes made in the framing on the top floor where wires and pipes penetrate into the attic. Check the construction codes to determine which of these holes must be filled with red fire-rated caulk. Where permitted by code, you may use black fire resistant mortar or regular caulk to seal these holes.

4. In the wall of the upstairs bathroom, there is a large opening where a PVC pipe (sewer vent) goes through to the attic. Use a jig saw to cut a scrap piece of plywood or OSB board into two small rectangular pieces. Out of one side of each piece cut a half-circle with a diameter slightly larger than that of the pipe. Glue and screw these pieces to the wood on the bottom of the top plate, fitting them tightly around the pipe. Seal the gap between the pipe and pieces, as well as the joint between the two pieces, using red fire-rated caulk. Fill the open space above the pieces with insulated foam or a combination of foam and sill seal.

5. Run a bead of caulk along all joints around the headers above the windows and doors on exterior walls.

6. Run a solid bead of caulk along the entire length of the joint between bottom plate and the concrete slab on the first floor from the inside of the house, all the way around exterior walls. Trim any sill seal that sticks out before caulking.

7. On the second story, check the joint on exterior walls where the sheathing meets the top plate. Run a bead of caulk along any place where this joint is not tight.

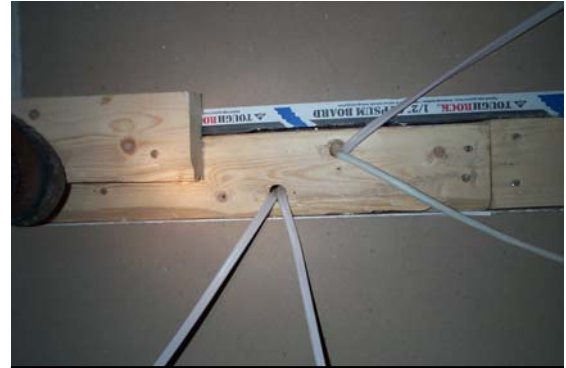


Figure 1 Penetrations in the framing where wires and pipes enter the attic should be sealed



Figure 2 Large gaps around pipes, such as around this sewer vent where it penetrates the attic, should be sealed first by cutting and fitting pieces of scrap wood snugly around the pipe, and then filling in the gap with insulating foam.

8. Look for spaces between studs on the framing on exterior walls that are less than 1 ½ inches wide. Since these gaps are difficult to fill with fiberglass insulation, it is best to fill them with latex or polyurethane insulated foam. If you use polyurethane foam, wait for it to dry and then cut away any excess foam polyurethane insulated foam to make it flush with the studs.

B. Inspection of Insulation

After wall insulation is finished, check that it is continuous and complete in its coverage. Fill gaps, even small ones, with fiberglass insulation. Check the bathroom on the second story to ensure that the exterior wall is insulated behind the tub. Keep in mind that the purpose of insulation is to deter heat transfer; don't expect it to stop airflow. Don't compress insulation since it is less effective when compressed.

C. Sealing the Air Ducts

1. Inspect tape applied to duct joints by the contractor. Make sure that they used metallic-backed tape, not duct tape. Remove any duct tape or tape that is not securely fixed to the ducts, replacing it with metallic-backed tape or sealing the joint with mastic sealer.
2. Apply a continuous coat of mastic duct sealer over all joints in the ducts not sealed by the contractor. The coat should be 1/16th to 1/8th inch thick. All joints should be sealed, including circular joints of branches and straight joints at elbow and between straight pieces.
3. Check the opening of the ducts in the floor of the second story. The sheet metal from the duct should be bend over the top of subfloor. Fill any openings in the corners with mastic or caulk.

D. Hanging Drywall

When hanging drywall on walls, run a continuous bead of glue along the horizontal upper plate on the top of the wall and bottom plate on the bottom of the wall. This acts as a seal that prevents movement of air and moisture in and out of the inside of the wall.

E. Steps to Do After the Drywall Is Hung

1. On exterior walls, fill gaps between all electrical boxes and drywall using caulk or insulated foam. Be careful not to get any caulk or foam on the interior surface of the drywall. Alternatively, you can install foam gasket beneath plates of the outlets and switches.
2. On the ceiling of the first story, fill the gap around the vents between duct endings (boots) and drywall using caulk, insulated foam, or duct sealer. (The duct vents on the floor of the second story are sealed when the ducts are sealed; see step 3 above.)
3. From the second floor, put masking tape over any large gaps in the drywall ceiling around the light fixtures. This will keep the insulated foam from falling through. Since the tape may damage the surface of the drywall and leave a visible rough area, only tape around light fixtures where the drywall will be covered by the ceiling light, and not around the water sprinklers.
4. Then go into the attic and fill all gaps around the light fixtures from the top using caulk and insulated foam. Also apply caulk or foam over all openings in the plastic covers over the light fixtures, blocking any penetrating light that you see. Seal the gaps in the drywall associated with the water sprinkler, around the pipe that penetrates from the second story and around the sprinkler outlets.
5. While in the attic, spray foam in the holes where wires penetrate through the framing. (The bottom of these holes should already be sealed with caulk.)
6. There is a large duct for return flow to the furnace in a walled-off space above the steps. If this space is not capped on the top, it will create a large air leak between the conditioned areas of the second story and the unconditioned attic. Check in the attic to see if the top of this space is covered with drywall. If it has been left open, cut a piece of drywall to fit and nail over top of the opening. Caulk around the edges of this drywall piece.
7. Check the ceiling on the second story and clean off any caulk or foam that came through the gaps. After the caulk and foam has dried, remove the tape from around the light fixtures.
8. When the attic hatch is installed, weatherstrip should be put around the edges of the hatch. Cut boards of rigid insulating foam that about 1/4 inch smaller than the attic hatch in both dimensions. Glue the boards to the top of the hatch cover to obtain a thickness of at least 4 inches.



Figure 3 This open chase for the return duct to the furnace creates a major air leak into the attic. It must be sealed with a piece of drywall or wood.

F. Things to Do Outside the House

1. Clear silicon caulk should be applied around the windows when they are installed. (This is normally done by the Habitat crew.)
2. Before the siding is installed, check to make sure that at least one layer of house wrap (Tyvek) is wrapped around the inside corner where the two houses are joined.
3. After the siding is installed, neatly fill with electrician's putty the gaps around pipes and wires where pass through the sheathing and siding.

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