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13269 Middleton Farm Lane
Herndon, VA 20171

Home Energy Audit - Home performance rating on your home was below average. Home was also compared to an Energy Star Home. A copy of the results and how your home would compare to an Energy Star home is attached along with this report.

Subject: Existing Home Performance Test.
The following items are listed as a result of our Building Performance Inspection and Test performed at the above address on January 3rd, 2011. The results of our building analysis of the subject home are as follows:

Air Leakage Test Result:

1. **Measured Typical Natural Conditions: Blower door reading: 6210 CFM@50 pacals.**

2. **Measured House Leakage: 404 sq. in, or 2.80 sq. ft. @ 4 pacals.**

3. **Estimated Annual Hourly Air Change Rate: 0.51 ACH (73 CFM/person)***

4. **Estimated Cost of air Leakage: $730 per year*****

What are all these numbers?

The leakage area represents the cumulative size of all holes and cracks in the exterior of your house through which unconditioned outside air enters your home and conditioned air escapes. Your home has a hole equal in size to 404 sq. in. or approximately 2.80 sq. ft.

The estimated air change rate is 0.51 air changes per hour and 73.0 CFM per person (using # of bedrooms + 1). A healthy house should have at least 0.35 air changes per hour or 15 CFM's per person, whichever provides the greater ventilation.

Some of the house leakage may be located in the forced air duct system; the actual leakage tends to be higher than quoted above. This is because they are subject to much higher pressures than typical house leaks. Duct leaks also seriously degrade air quality.

*National ventilation guidelines recommend that houses have an effective air change rate of 0.35 ACH (or 15 CFM/person) to maintain acceptable indoor air quality. The annual air change rate is based on ASHRAE Standard 136-93 and assumes no mechanical ventilation. Ventilation guidelines are based on ASHRAE Standard 62.2-2003

Ventilation Guideline

ASHRAE Standard 62.2-2003 recommends minimum ventilation requirements for residential buildings to maintain acceptable indoor air quality. **Based on the results of the air tightness test performed on your house, Standard 62.2-2003 does not recommend adding mechanical ventilation. If air sealing is done ventilation may be necessary.**

Information may be conflicting. You may wonder why this report suggests fixing air leaks in your home, but may also recommend installing additional ventilation. The answer has to do with indoor air quality and comfort.

In winter, as hot air escapes through leaks in the upper level of your home, replacement air is drawn in through the lower level from areas with poor air quality, such as the garage (with fumes from car exhaust and stored chemicals) and basement window wells (with fumes from herbicides, pesticides and radon). The opposite is true in summer (to a lesser extent). As cool air sinks to the lower areas in your home, polluted air is drawn in from the attic. By installing proper mechanical ventilation you can be sure the air entering your home is fresh. Some mechanical ventilation systems use existing conditioned air allowing for further energy savings.

Another benefit of mechanical ventilation is comfort. Your home may disproportionately leak in one area, making that area uncomfortable. By sealing random air leaks and installing mechanical ventilation you will be able to distribute the fresh air evenly throughout your home.

Additional Information

Many factors contribute to indoor air quality including ventilation rates, sources and locations of pollutants, proper operation of combustion appliances and occupant behavior. Additional testing is needed to fully evaluate the air quality in your house.

** ASHRAE Standard 62.2-2003 also contains requirements for local kitchen and bathroom mechanical exhaust systems. These local exhaust systems may be incorporated into a whole building ventilation strategy. Consult Standard 62.2-2003 for more information on ventilation strategies and specific requirements and exceptions contained in the Standard.

*** Cost of air leakage is assuming Electric cost of $0.12 per kWh.
*** Cost of air leakage is assuming Natural Gas cost of $1.50 per CCF.

HVAC Duct System: A Duct Blaster Test was not performed on the HVAC systems in the attic or basement. Visual inspection of the HVAC system and flexible duct lines show connections have some leakage at most of the connections. In the attic, most of the flexible duct connections and collars that attach to the return supply trunk and plenum are leaking. Most of the junction boxes have at least one flexible supply duct line that is disconnected and lying on the attic floor. This is not allowing conditioned air to flow through the duct lines, but also not allowing the junction box with other supply lines to build up enough static pressure to delivery conditioned air throughout the second floor. This Flexible duct runs in many places are pinched or are bent beyond (45 degrees) recommended levels. Also the supply and return duct vents that penetrate the second floor ceiling are not sealed to the drywall and is allowing air to flow into the attic. All of these concerns is reducing air flow to the second floor and making the system less efficient. See pictures in figures 1, 2 and 3, 4, 5, 6, 7 and 8 on the next page.

Figure 1-Air leaking out around collars.

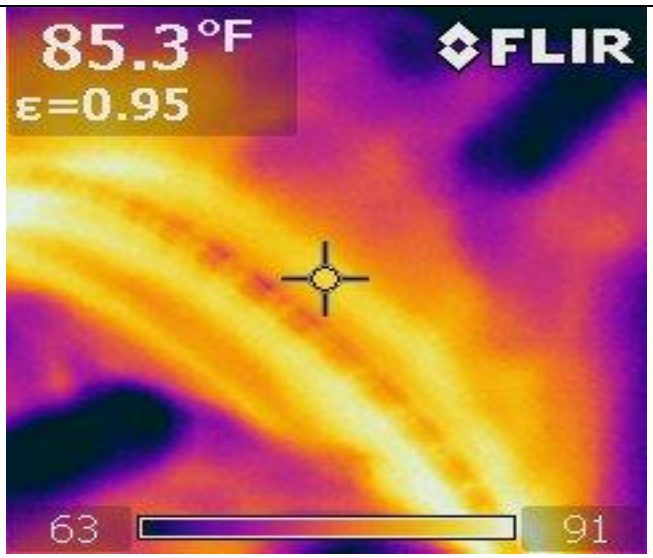

Figure 2-IR Image showing air leakage.

Figure 3-Trunk lines disconnected in attic.

Figure 4-Another line disconnected!

Figure 5-Trunk line bent at 90 degrees.

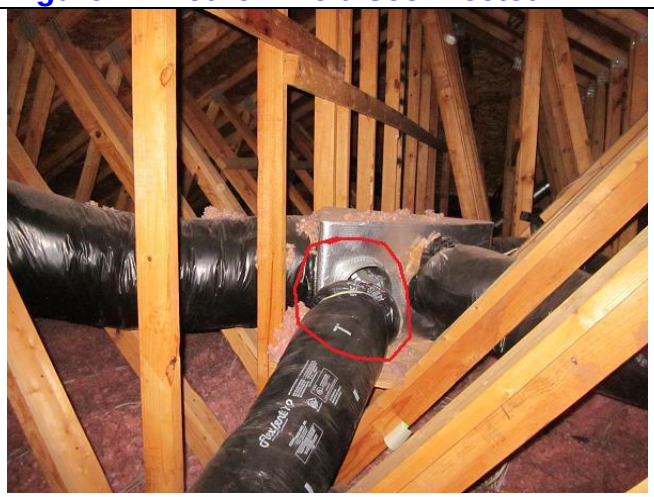

Figure 6-Junction box showing disconnected supply line.

Figure 7-Open flexible supply duct line.

Figure 8- Plenum not taped to air handler.

<u>Recommended Repairs</u>: Both systems have air leaks and should be sealed or taped where possible. In each system the solution is a little different. Since the basement unit is located in a conditioned area, it is not cost effective to try and seal each supply line connection that runs into the basement ceilings and first floor. However, the Supply trunk lines, plenum and duct lines that are accessible should be as air tight as possible. Filter should be replaced every 30 days. Add mastic and or foil tape to these areas. In the attic, before sealing duct leaks, consider removing junction boxes and duct lines from the roof rafters and place on attic floor. Once corrections are made and additional insulation is added to the attic floor, this will increase R-values to the duct lines and junction boxes and reduce energy costs. Seal supply duct line and plenum using mastic and foil tape. Duct collar and duct board junction boxes and duct vent boxes should be sealed around collars using mastic, duct tape or spray foam. Once system is sealed inspect duct vents at each location to make sure expandable foam does not block air flow. Also make sure to seal returns and duct vents to second floor drywall and correct flexible ducts that are bent and hung incorrectly.

Figure 5-Collar and duct connections with no mastic or tape.

Figure 6-All collars look the same.

Figure 7-Duct vent not sealed to ceiling

Figure 8-Same-different vent

Summary: **Duct leakage may be one of the largest sources of energy loss in some homes when the leakage is to unconditioned space. Leaky supply ductwork causes expensive conditioned air to be lost before it can be delivered to the house, forcing your system to run longer to keep you comfortable. Leaky ductwork can seriously degrade indoor air quality by pulling pollutants and irritants directly into your house. Leaky return ductwork can also pull moisture into your home, making it feel uncomfortable even when the air conditioning is running. See website:**
http://apps1.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12730

Recommendations: **The following suggestions are listed in the general order of most cost and/or comfort effectiveness.**

Attic air leaks and insulation problems will have the biggest effect on how efficient the heating system is in winter as warm conditioned air rises. Either the heat is conducted to the attic through un-insulated ducts and areas where there are gaps and voids in the insulation, or the warm air is able to escape through holes into to the attic.

1. **Install compact fluorescent light bulbs in frequently used rooms. This upgrade should pay for itself about once a year assuming these lights are used approximately 2 hours each day (compact fluorescent bulbs are supposed to last seven years). Questions or concerns, please visit Energy Stars reference page on their website.**
   http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf

2. **Install an insulating blanket on the water heater. This will pay for itself several times a year. Visit DOA Website address below.**
   http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13070

3. **Install shower heads with a flow rate of under 1.9 gallons per minute. This will pay for itself several times a year because you will need to heat approximately 30% less hot water for each shower.**

4. **Replace both thermostats with programmable thermostats. This can reduce the energy it requires to heat and cool your home by up to 20 percent.**

5. **Seal all opening to the exterior of the house that is allowing cold air to migrate into the house using spray foam and silicone caulk. See pictures in 9, 10, 11 and 12 on the next page.**

Figure 9-Opening above foundation wall.

Figure 10-Air moving under siding.

Figure 11-Crack along house molding.

Figure 12-Same.

6. **The unfinished basement walls have leaks in the rim band joist above the foundation where it meets the first floor. Included in the rim band joist are additional penetrations that need to be sealed. Also make sure to seal opening around basement door. Remove insulation in the rim band joist and use spray foam to seal joist where accessible. Areas that is covered by drywall, cut back drywall and spray foam band joist once complete, install R19 un-faced batt insulation into rim joist and repair drywall. On the next page see pictures in figures 13, 14 and IR images in figures 15, 16, 17 and 18.**

Figure 13-Insulated rim band joist.

Figure 14-Utility opening in rim band joist.

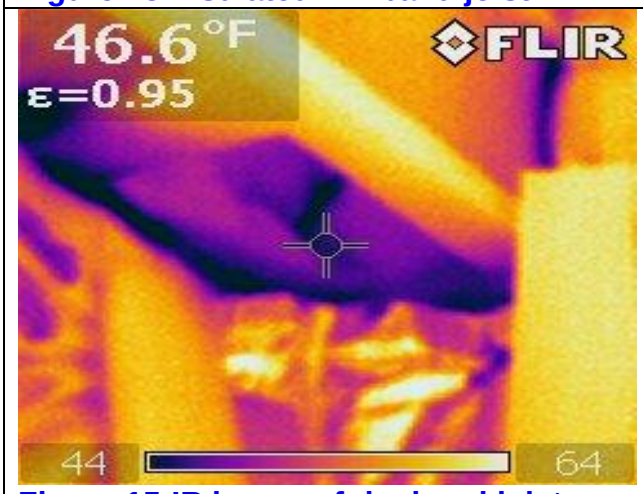

Figure 15-IR image of rim band joist.

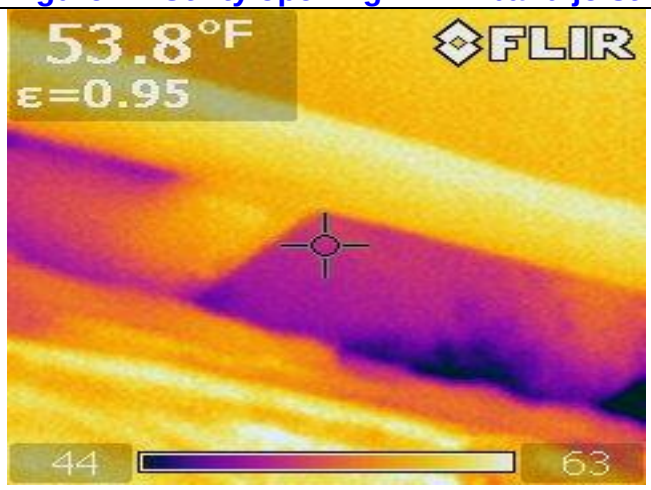

Figure 16-Same

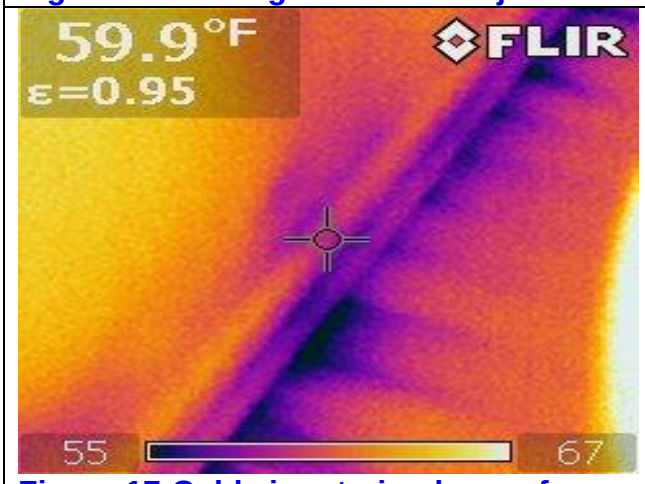

Figure 17-Cold air entering house from leaky rim band joist.

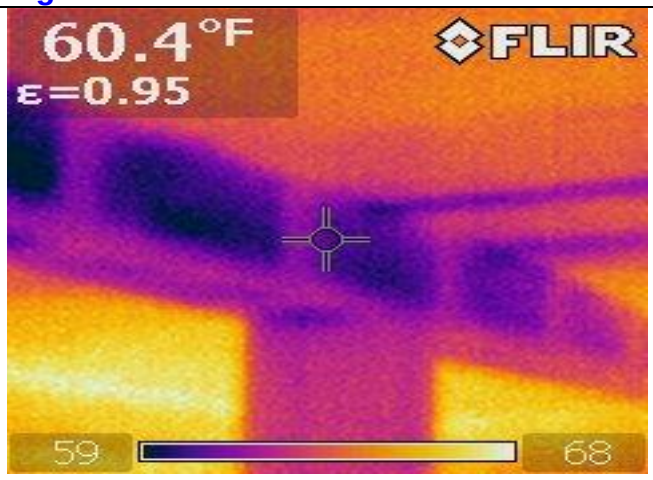

Figure 18-IR image shows large amounts of cold air inside utility chase.

7. **Wall along garage and dining room and leads up to the master bedroom bathroom has an open wall cavity that is allowing cold air to flow from the attic down the wall to the dining room. Remove vanity mirror in Master bathroom and seal open wall cavity using foam board and spray foam. See IR image and picture in figures 17, 18, 19 and 20.**

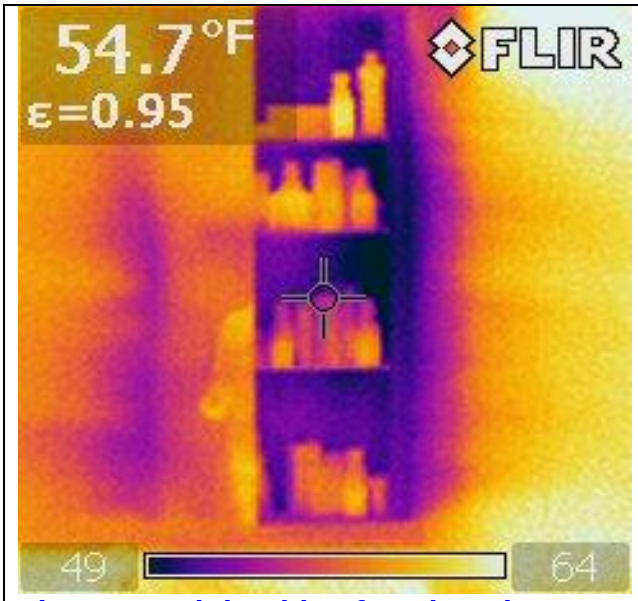

Figure 17-Right side of vanity mirror.

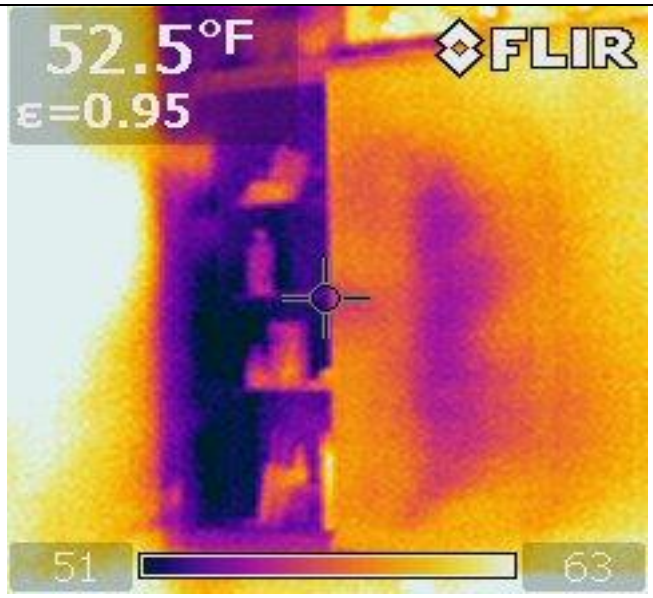

Figure 18-Left side of vanity mirror.

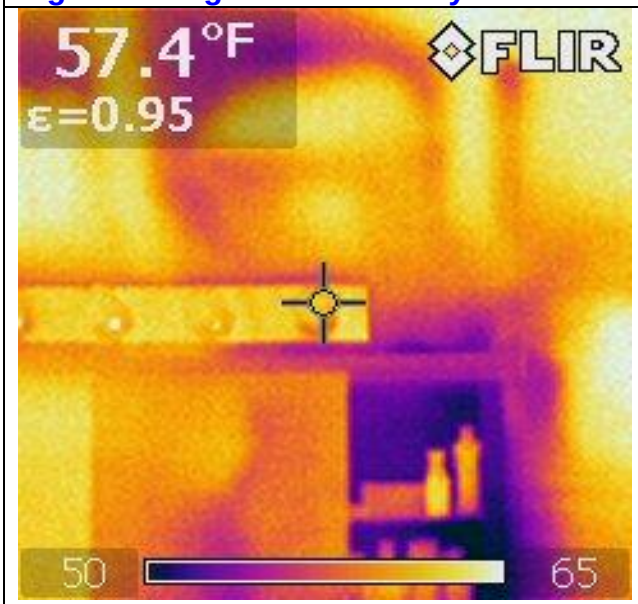

Figure 19-Above vanity mirror.

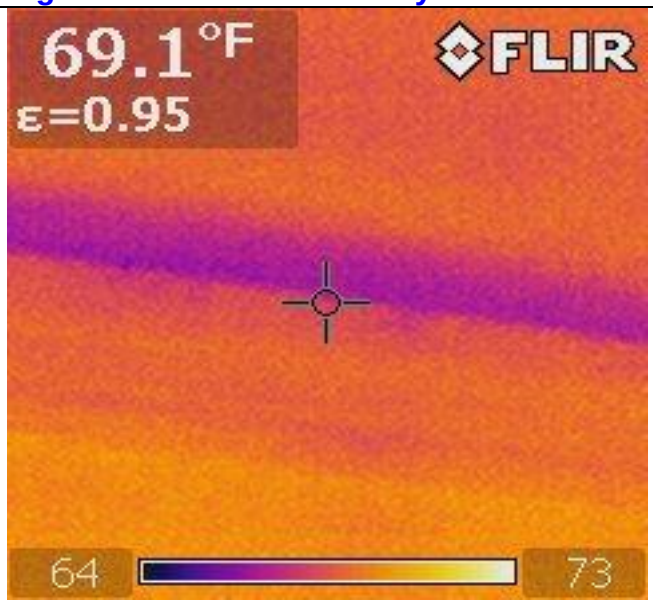

Figure 20-Top of dining room wall.

8. **Wall on the right side of the house that runs from the attic and down along the back bedroom and into the office and then to the basement is allowing cold air to drop inside the house. Seal opening created by electrical and plumbing holes using spray foam and foam board. See pictures in figures 21 and 22 and IR images in 23 and 24.**

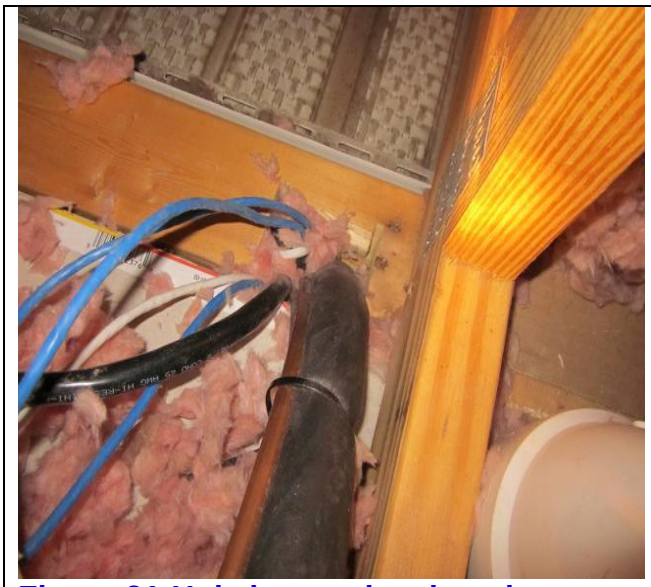

Figure 21-Hole in top plate in attic.

Figure 22-Fresh air exhaust vent hole.

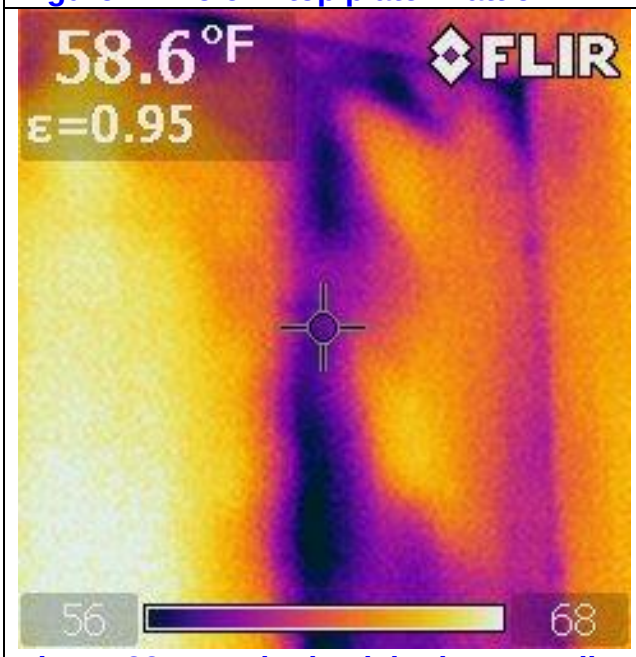

Figure 23-Upstairs back bedroom wall.

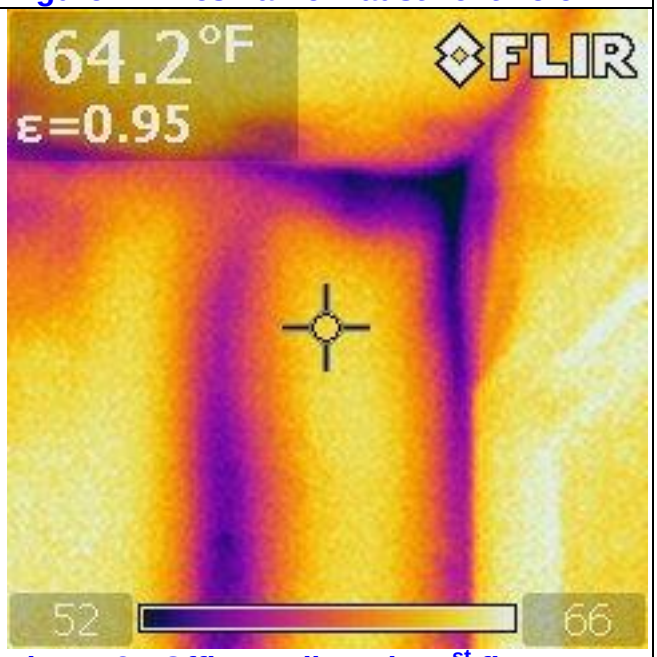

Figure 24-Office wall on the 1st floor.

9. **Access to the attic on the second floor is leaking conditioned air into the attic and allowing cold air to fall into the closet in the winter. Seal opening by building or installing a prefabricated attic hatch cover. If customizing hatch, look to Department of energy website to use as an example (includes building diagram). See IR image in figure 25 and diagram picture in 26.**

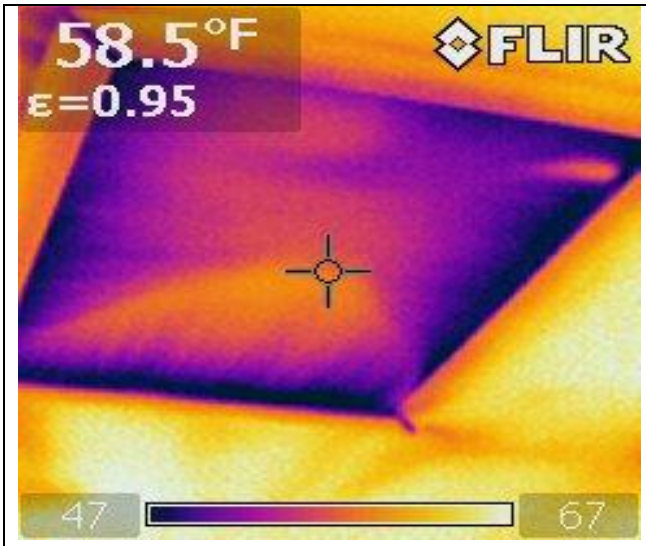

Figure 25-IR image of attic hatch

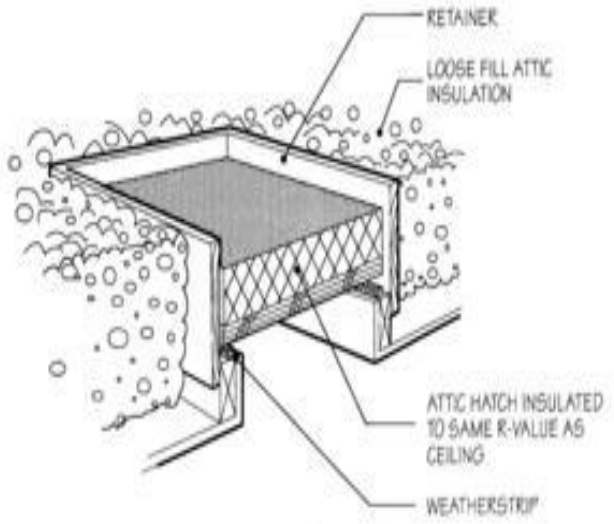

Figure 26-Proper hatch cover.

10. **Seal all openings in second floor ceiling from the attic using spray foam. Areas of concern: IC lights, open top plates, HVAC returns, electrical, plumbing and bathroom vents. See pictures in figures 27, 28. On the next page see pictures in 29, 30 and IR images in figures 31, 32, 33 and 34.**

Figure 27-Top plate with electrical holes.

Figure 28-Insulation covering IC light?

Figure 29-Holes with no wires.

Figure 30-Open wall cavity in attic.

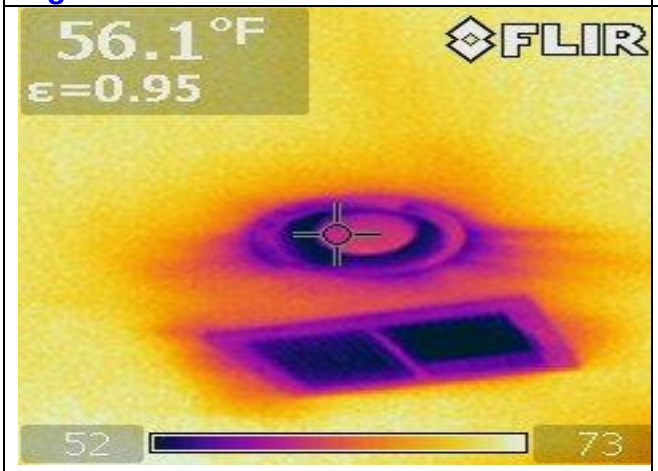

Figure 31-IR image of vent and IC light.

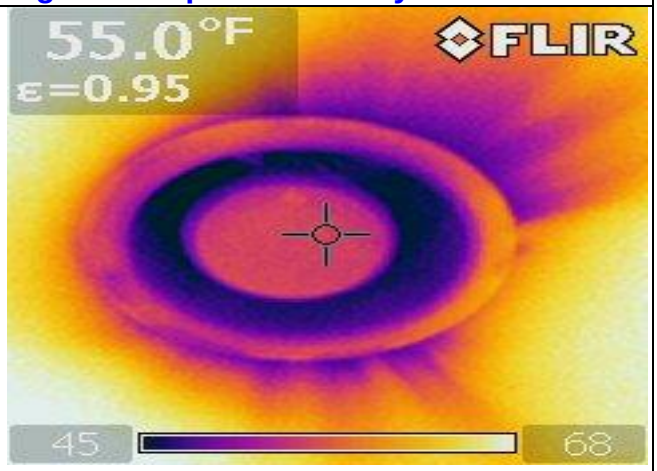

Figure 32-IC light.

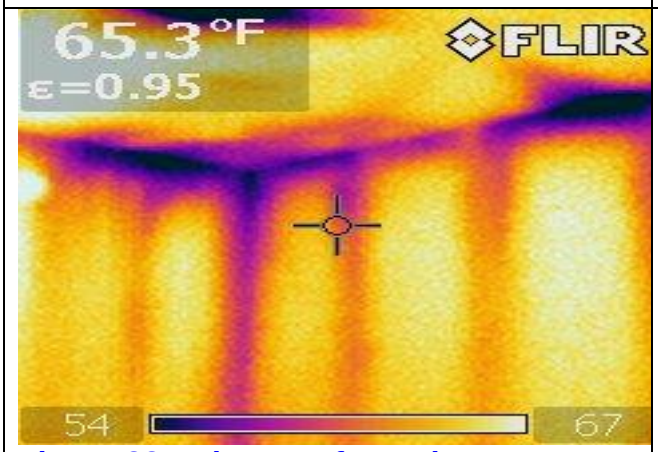

Figure 33-IR image of top plates.

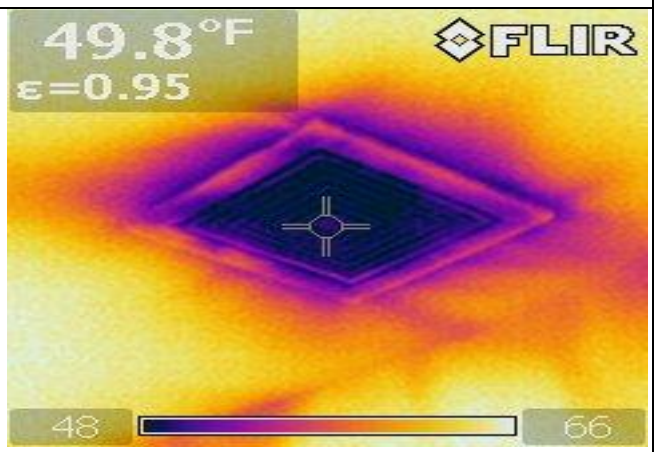

Figure 34-Bathroom vent not sealed.

11. **The existing attic insulation runs from R20 to R-38. Department of Energy recommends R49. The infrared scan and inspection of the attic shows insulation is thin in some places. The goal in installing insulation is to make sure the insulation is making full contact with the surface (example a wall or ceiling) and is free of voids, compressions and gaps. Once attic has been sealed as outlined in recommendation number 7, 8 and 10, spread insulation evenly thought attic floor. Add addition blown insulation to coat ducts here possible and attic floor.**

All concerns and recommended corrections listed above are the opinion of the Building Performance Specialist and may not be inclusive of all concerns, which may be in the subject's property.

A representative inspection was conducted and items were evaluated. Every effort has been made to provide accurate information. This does not constitute a warranty, expressed or implied.

Residential Energy Auditors, LLC.

Earl Haynes

Earl Haynes
Resnet Building Specialist

Definitions

@4 PA – 4 Pascals is the assumed natural pressure on the house during normal conditions.

CFM – cubic feet per minute

CFM @ 50 Pascals – actual measurement of the amount of air drawn through the fan during the blower door test on the house.

ACH – a measure of air changes per hour of how often the entire volume of air within the house is lost and replaced by outside air. The higher the air change rate the leakier the house. Example – if the house is 20 x 50 feet with 8 foot ceilings, the square footage is 1000 sq ft and the volume is 8000 cubic feet. If the air changes per hour are 0.5 then the house loses 4000 cubic feet of air each hour.

Band Joist – the area at the top of the basement or crawl space wall that encloses the ends of the floor joists.

CFM / person – a measure of the house leakage based on the potential maximum number of people in the house (assuming 2 people in the master bedroom and one in each of the others).

Duct Leakage as percent of system air flow – each system has a maximum air flow based on the size of the equipment. The % leakage is that measured by the test equipment divided by the system's maximum.

HVAC – **H**eating, **V**entilation and **A**ir **C**onditioning – the systems in the house that maintain comfort and air quality.

Leakage Area – An estimate of the total area of leakage if all the holes were combined into one. This is a gross estimate and is often used for comparing houses.

Pascals (Pa) – A measure of pressure (1 Pa = 0.2 inches of water column). 50 Pascals (the pressure used during the blower door test) are approximately equal to a 20 mile an hour wind blowing on all sides of the house.

Top Plate - the 2x4 at the top of the wall that supports the drywall on either side. As the house ages the 2x4 dries and shrink. This forms a gap that allows air in the walls to escape to the attic.

R-value – a measure of the resistance to heat flow of insulation. The higher the R-value the more resistance there is to heat flow. The Department of Energy recommendation for attics in this area is R-49.

Ventilation guidelines – There are guidelines on the minimum amount of leakage that is acceptable to maintain indoor air quality. The standards are 0.35 ACH or 15 CFM per person, whichever is higher.