September 21st, 2009

Home Energy Audit - Home performance rating on your home was above average. Home was 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 July 30th, 2009. 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: 4782 CFM@50 pacals.

2. Measured House Leakage: 277.4 sq. in, or 1.93sq. ft. @ 4 pacals.

3. Estimated Annual Hourly Air Change Rate: 0.30 ACH (46.4 CFM/person)*

4. Estimated Cost of air Leakage: $534 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 277.4 sq. in. or approximately 1.93 sq. ft.

The estimated air change rate is 0.30 air changes per hour and 46.2 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 estimated 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 recommends adding a mechanical ventilation system capable of providing at least 27.3 CFM of fresh, outside air into the house. If air sealing is done, even more ventilation will 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: Duct blaster test was performed on the HVAC system in the attic. Duct test showed system is leaking at 487 CFM’s at 25 pascals. HVAC system is leaking 28% of its air to the outside.

See IR pictures below, figures 1 and 2.

![Figure 1](image1.png)  ![Figure 2](image2.png)

**Recommended Repairs:** Repair air handler where it meets plenum using foil tape. See IR pictures in figures 3 and 4 on the next page. All ducts that run from the air handler, duct boots (collars) and duct connections at the vents are leaking. Remove each connection and use mastic around porous openings and slide flexible duct over collar and seal using a duct strap and then slide insulated wrap around flexible duct and once again use duct strap seal insulation wrap to collar.
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](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 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](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. All or most windows leak at the bottom and top of the window sill. Replace top and bottom window sill weather-stripping. This will create a tighter bond at the sill and help seal window when locked. See IR picture 5 and 6.

5. Caulk all windows around window molding from the inside of the house. See IR pictures 7 and 8.

6. The unfinished basement wall, underneath front porch and above the foundation where it meets the first floor is leaking from the band joist, electrical penetration
and vent pipes. Remove insulation from band joist and seal openings using spray foam. See pictures 9 and 10 in figures below. Also see IR pictures in 11, 12, 13 and 14.

7. Adjust door striker on mudroom, garage, front door and basement French doors.
8. Replace door sweeps to mudroom, garage, and front doors. Sweeps should be replaced every 3 to 4 years depending on use. See IR picture 17 and 18.

9. Seal all openings in second floor ceiling from the attic using 2-part spray foam. Areas of concern: IC lights—Need to build a drywall box around lights. All duct vents from HVAC lines, open top plates, HVAC returns, electrical, plumbing and bathroom vents. See IR pictures 17, 18 and 19, 20 on the next page.
10. Top plates are leaking in MB walls that where they meet the ceiling. Leaks are also in Becky’s, Rachel’s and Ted’s closet. On the next page look at IR figures showing openings in second floor ceiling. See IR figures 21, 22 and 23, 24 on the next page. Also see pictures 25 and 26 from the attic.
11. Master bedroom bathroom tub’s wall facing the outside is not insulated and is allowing unconditioned air easy access through wall and making the tub cold in the winter. From the bathtub access panel, spray 2-part foam all along the back of the outside wall. See pictures in figures 27 and 28 on the next page.
12. Master bathroom wall that faces Rachel’s bathroom has little to no insulation. There is also an opening in the wall facing the front of the tub. This wall cavity is open from the base of the tub to the attic. There is no insulation all along the vanity wall. From the main attic remove ¾ inch plywood at the top of the wall and fill wall cavity by spraying cellulose insulations. See figures IR pictures 29 and 30.
13. Air seal and insulate the pull down attic stairs by installing a cover on the attic side in Ted’s closet. Also weather-strip and insulate cover. There are several prefabricated products available. These products are similar to Energy Shield™. See IR picture in figure 31 and 32.

![Figure 31](image1.jpg) ![Figure 32](image2.jpg)

14. The existing attic insulation ranges from R-22 to R-24. Department of Energy recommends R49. Since the ducts are sitting on the floor of the attic this is great time to seal any duct connections and cover attic with additional 6 to 7” of blown cellulose. Install baffles in the attic to prevent wind-washing.

15. Entertainment system in the master bedroom was installed without concern of insulation values. All areas that have some form of equipment were left with zero R-values and must be repaired properly. Need to contact company to find out if system components in the attic can be covered by building a drywall box to cover components. Once components are boxed up, attic insulation can be return and additional insulation can be added to achieve maximum depth required by DOE. By boxing up system will prevent unconditioned attic air to move into master bedroom. See pictures in figures 33, 34, and IR photos in figures 35 and 36.
See additional photo's on the next page.
<table>
<thead>
<tr>
<th>Hole in the second floor (attic)</th>
<th>Gap in Bathroom vanity wall.</th>
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<tbody>
<tr>
<td>Classic top plate leakage</td>
<td>Bathroom fan not sealed to drywall</td>
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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.

CGE Solutions, Inc.

Earl Haynes

Earl Haynes
Building Performance 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 – Heating, Ventilation and Air Conditioning – 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.