Energy Scan Report

Inspection Address:
1000 N. Anywhere, Washburn, AZ

Date Performed:
April 1, 2008

Prepared For:
Happy Homeowner

Prepared By:
Northland Inspections Inc
4275 N. Fanning Dr.
Flagstaff, AZ 86004

Office: 928-525-1881
Fax: 928-525-2010

Energy Scan Report #:
04.01.2008

Auditor:
Brion Grant

- **Level 1 Certified Thermographer**
- **Building Performance Institute - Certified Building Analyst**

Weather Conditions at the Time of this Scan:	**Sunny**
Outdoor temperature:	**55 Degrees F**
Indoor temperature:	**75 Degrees F**
Indoor/Outdoor Temperature difference (△T):	**20 Degrees F**

Introduction

Energy Conservation can Greatly Reduce the Cost of Operating Your Home!

What are your utility bills running now? Several years ago, the U. S. Department of Energy estimated that the average homeowner, nationwide, was spending in excess of $1,300 a year on their utility bills. Recent escalation in the cost of fuels both for heating and generating electricity have undoubtedly greatly increased this sum. What has been your experience? Have you recently totaled up all of your utility bills to see where your costs stack up?

What's more important for you personally, will be how a large a segment of your overall household budget you are forced to spend just to operate your home. Perhaps it has been just such a realization that has heightened your interest in having your home investigated in hopes of discovering economical ways to increase efficiency and comfort while reducing your energy consumption, and thus your utility costs.

How Energy Is Consumed In Your Home

In order to develop a conservation plan we need to know where and how energy is used. Home energy experts estimate that the largest proportion of energy is used to heat and cool our homes. This use ranges between 45% and 70% and is influenced by a variety of factors which we will discuss later. Another approximately 14% is used to heat water, and around 9% to run the refrigerator. Approximately one-third of our energy consumption goes to light our homes, cook and power other appliances.

By any measure then, the energy required to heat and cool our homes should be our first and highest priority in our quest to reduce our cost of operation. To heat our homes, we burn fuel (or consume electricity) to raise the inside temperature above the temperature on the outside. Just as gravity causes an object to fall to the floor when you drop it, so elementary physics dictates that heat flows (transfers) from a hotter body to a colder one. So when we turn up the thermostat on a cold day to warm the inside of our house, the heat generated by our heating system will have a natural tendency to seek ways to escape to the colder air surrounding the house.

Likewise, during warm weather, when we turn on our central air conditioner to reduce the temperature inside the house, warmer air from the outside will be trying to make its way into our cooler interior. It logically follows then, that if we are going to make a sizeable dent in our largest use of energy, we need to find ways to reduce heat transfer through the shell of our home by reducing heat *loss* during the heating season and heat *gain* during the cooling season.

How Does Heat Flow Through Your Home's "Building Envelope"?

Heat flows (or transfers) in three different ways; by conduction, convection and radiation. Everyone has experienced at one time or another, the unpleasant sensation of touching a hot stove or picking up a hot object. When you did that, you were burned by heat transferred through **Conduction**. In the case of your home, heat can be transferred by conduction through poorly insulated walls and attics and through poorly made doors and windows (windows with only one layer of glass, for instance). Conductive heat transfer can be detected utilizing *Infrared Thermography* conducted by a trained *Thermographer*, such as the Investigator you have engaged to do this Energy Scan.

The other primary cause of heat transfer into or out of your home is **Convection**. Convective heat loss or gain is caused by leaks and drafts through holes, cracks and openings in the building envelope. The vast majority of these heat "escape routes" are concealed and not visible to the naked eye. However, by combining the use of a *Blower Door* to reduce the air pressure inside your home, this convective flow can be accentuated and with the aid of an *Infrared Camera*, documented to help guide your energy conservation efforts. So the most useful and comprehensive energy studies are achieved by **combining** IR Thermography **with** a Blower Door.

Radiation is, by far, the smallest form of heat transfer from a home of typical wood frame construction. However, for homes with outside walls constructed of concrete block or other dense materials, the walls can "store up" heat radiated from the sun during the day and release it into the interior during the night. Under winter heating conditions, this can be an advantage, but obviously during the summer air conditioning season it can be detrimental.

Note: For an explanation of several of the terms used in this Report, please refer to the **Glossary** on the last page.

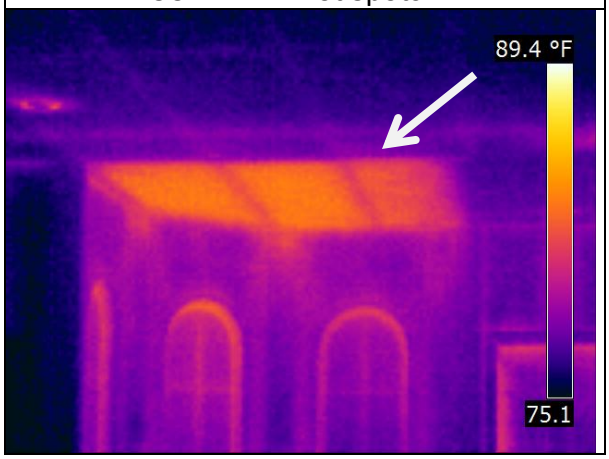
How to Interpret the Information Presented on the Following Pages

Aided by the use of thermal imaging, we look for areas of substandard performance. When we find such areas, we note them in individual thermo graphic reports like those that follow (typically, two per page). Simultaneous Infrared thermographs and visual photographs were taken of areas of interest during the inspection to help you "orient" yourself to the location where we took each thermal image. Naturally, if we did not find a reportable condition, we did not create a thermo graphic report.

As you view the images in this report, you may notice that we have highlighted or otherwise called out the areas that in our professional opinion were of significant concern. When looking for areas with little or no insulation, the areas of deficient insulation look darker in images taken during colder months (winter). In images taken during warmer months (summer), the areas of deficient insulation look lighter.

"WINTER" Cold Spots

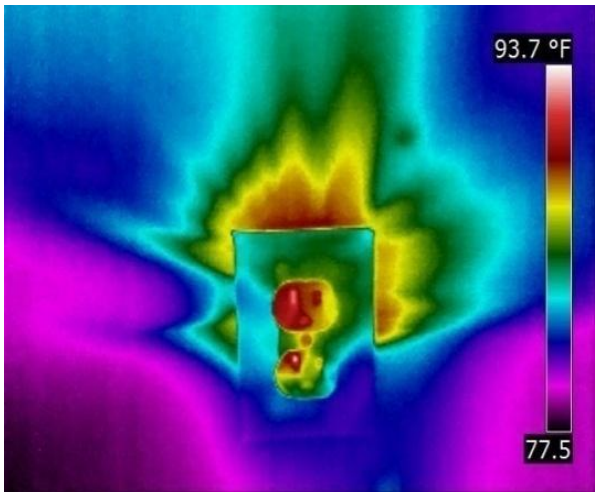
"SUMMER" Hot Spots



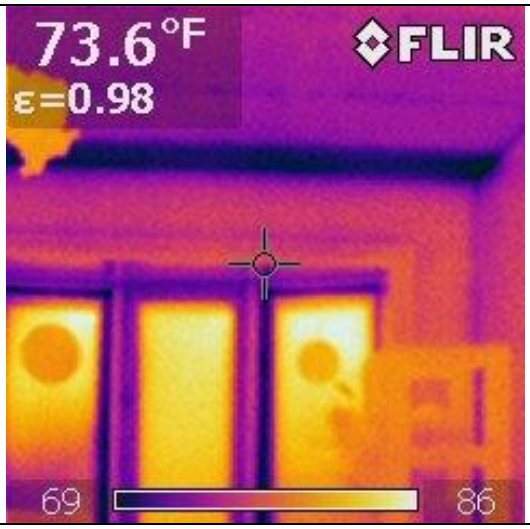
The blower door which we used during this scan helps to highlight areas of significant air leakage around doors, windows and exterior penetrations. Images taken from around these penetrations often show streaking (see white arrows) which is directly associated with air leakage or drafts.

An Exterior Door

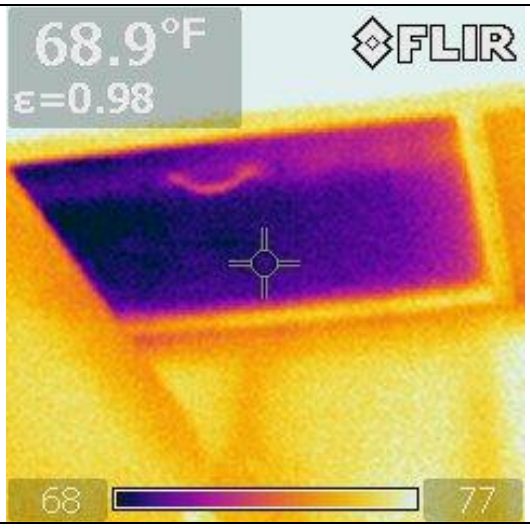
An Electrical Outlet in an Exterior Wall



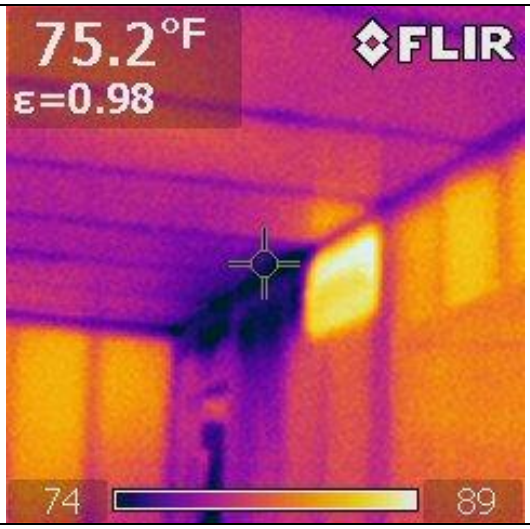
Thermal and Visual Images



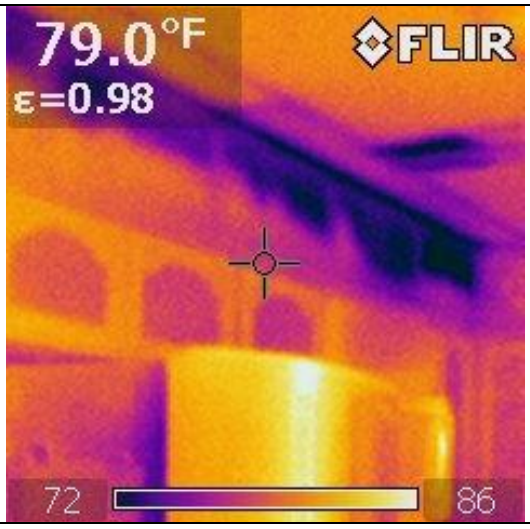
LOCATION: **Office / Library** WHERE: **Ceiling**
CONDITION: (Loose/Missing) The thermal pattern is indicative of loose or missing insulation.
RECOMMENDATION: We recommend repair as an Optional Repair.



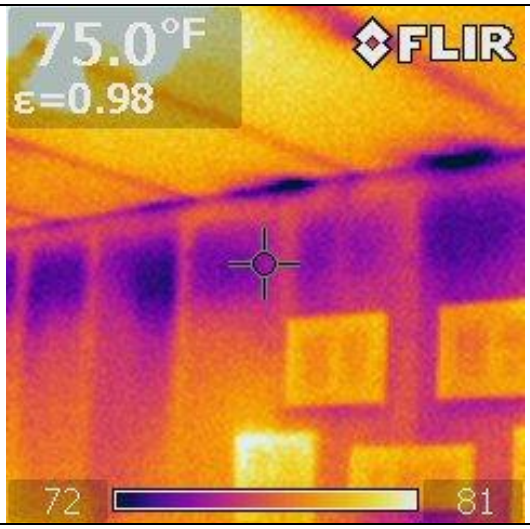
LOCATION: **pantry** WHERE: **Ceiling**
CONDITION: (Attic Access) The attic access cover appears to be lacking proper insulation.
RECOMMENDATION: We recommend further review and repair as an Optional Repair.



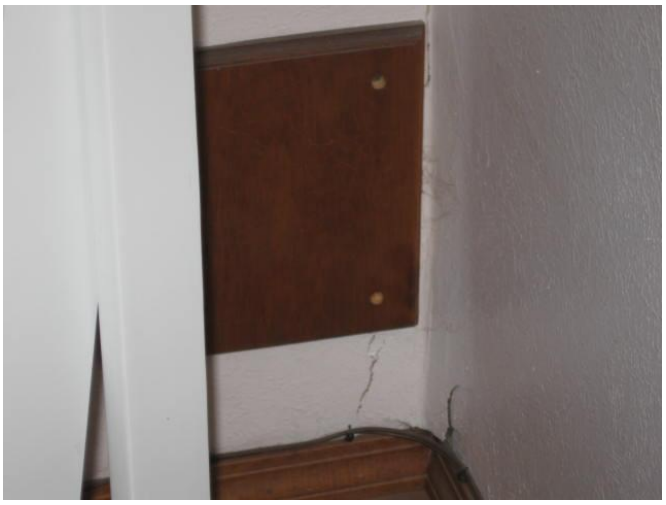
LOCATION: **Living Room** WHERE: **Rear Wall**
CONDITION: (Loose/Missing) The thermal pattern is indicative of loose or missing insulation.
RECOMMENDATION: We recommend further review and repair as an Optional Repair.

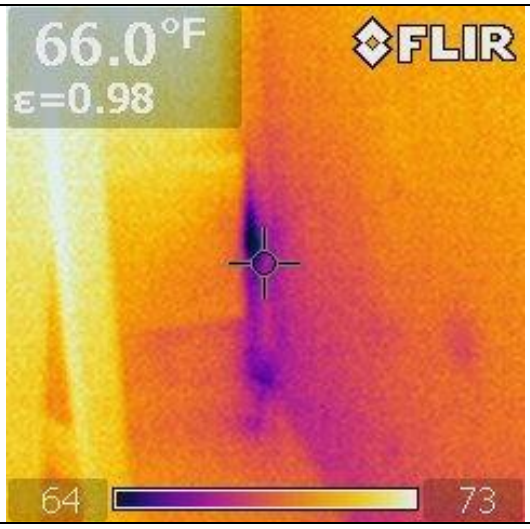


LOCATION: **Kitchen** WHERE: **Left Wall**
CONDITION: (Loose/Missing) The thermal pattern is indicative of loose or missing insulation.
RECOMMENDATION: We recommend further review and repair as needed. Choose an item.

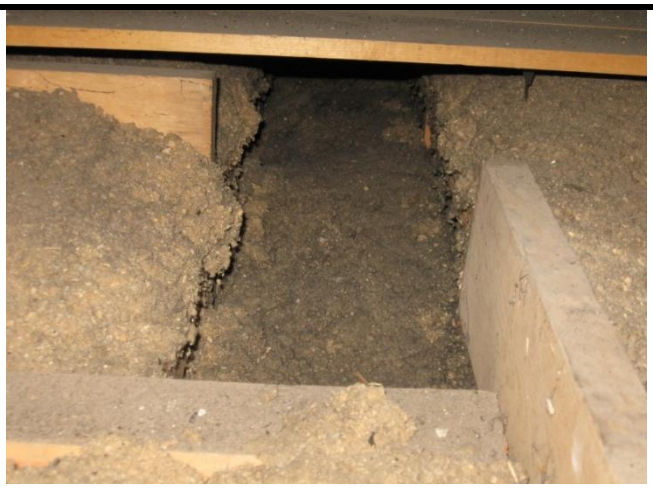


LOCATION: **Bedroom** WHERE: **Right Wall**
CONDITION: (Loose/Missing) The thermal pattern is indicative of loose or missing insulation.
RECOMMENDATION: We recommend further review and repair as an Optional Repair.





LOCATION: **Bedroom** WHERE: **Front Wall**
CONDITION: (Loose/Missing) The thermal pattern is indicative of loose or missing insulation.
RECOMMENDATION: We recommend further review and repair as an Optional Repair.



Wall/attic cavity needs filling with insulation

Area between walls needs sealing in attic

Kitchen drop ceiling soffit needs insulation

Enhanced Scan - Quantitative Analysis

Air Infiltration

Air leakage, or infiltration, occurs when outside air enters a house uncontrollably through cracks and openings. Properly air sealing these cracks and openings in your home can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. It is unwise to rely on air leakage for ventilation because it can't be controlled. During cold or windy weather, too much air may enter the house. When it is warmer and less windy, not enough air may enter. Air infiltration also can contribute to problems with moisture control. Moldy and dusty air can enter a leaky house through areas like attics and foundations. This "dirty" air in the house can cause health problems. The recommended strategy in both new and old homes is to reduce air leakage as much as possible and to provide controlled ventilation as needed. Note however, that air sealing alone cannot replace the need for proper insulation throughout your home, which is needed to reduce heat flow.

(Source: DOE's Office of Energy Efficiency and Renewable Energy)

A Thermal Scan of your home augmented by a Blower Door test will help identify the two largest sources of heat loss and thereby help save on your utility costs.

The Blower Door Test (sometimes called a Door Fan Test)

A *Blower Door* is a powerful fan that mounts into the frame of an exterior door. The fan pulls air *out* of the house, lowering the air pressure inside. The higher outside pressure forces air in through all of the unsealed cracks and openings. The *Thermographer* then uses a thermal imaging camera to identify air leakage locations. These tests were used to determine the air infiltration rate of your home and are represented below and on the following page.

Blower Doors consist of a frame and flexible or hard panel that fit in a doorway, a variable-speed fan, a pressure gauge to measure the pressure differences inside and outside the home, and a manometer and hoses for measuring airflow. We have included a photo of our Blower Door operating in your home during the test for air infiltration.

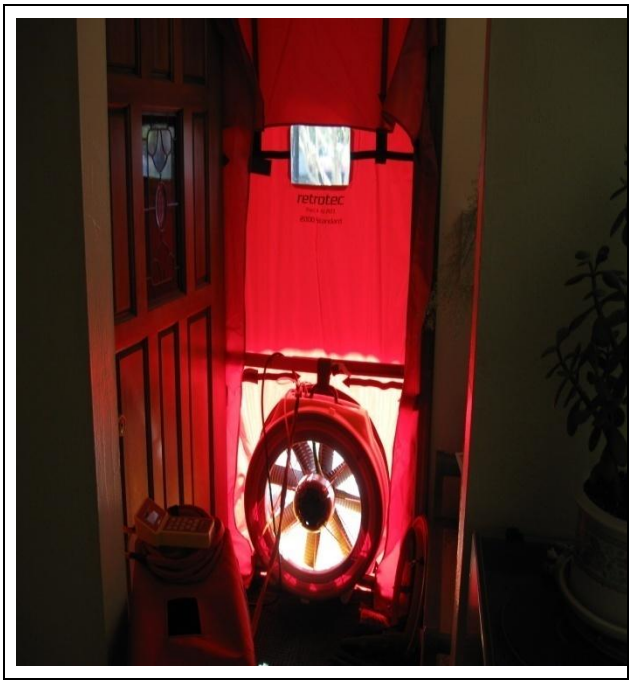
Basic Dimensions from Your Home:

Net Floor Area:	**1400**	Square feet (ft^2)
Average Interior Height:	**8**	Feet (ft)
Internal Building Volume:	**11200**	Cubic Feet (ft^3)

Environmental Conditions:

(20° ΔT requires a +/- 2% temperature correction to ACH50 below)

	Before	After
Inside Temperature: °F	**76**	**72**
Outside Temperature: °F	**56**	**74**



Test Results for *Your* Home

Note: For an explanation of the Terms used in these Charts, please refer to the **Glossary** at the end of this Report.

	Measured Values	Units of Measure
Air Changes Per Hour at 50 Pascal Pressure (ACH_{50})	**7.5**	Air Changes per Hour (ACH)
Air Flow (Infiltration) at 50 Pascal Pressure (CFM_{50})	**1360**	Cubic Feet per Minute (CFM)
EfLA (Effective Leakage Area at 50 Pascal)	**.75**	Square Inches (in^2)
"n" Factor for Building Tightness Limit calculation	**25.8**	From Lawrence Berkeley Laboratory

Your Air Change Test Results in Perspective

Air Changes Per Hour at 50 Pa Pressure (ACH_{50}) = $\frac{CFM_{50}\ (1360)\ X\ 60\ \text{(minutes per hour)}}{\text{House Volume (1120011200)}}$ **= 7.29**

Your ACH_{50} Value ▶			◎			
ACH_{50}	20	10	7	5	3.5	1.5
Subjective Rating	Bad	Fair	Good	Better	Excellent	Super!
Percent of Energy Bill	40%	20%	14%	10%	6%	2%
% $avings Potential	5 to 20%	3 to 10%	2 to 5%	2 to 4%	1 to 3%	None

Your *Natural* Air Change Test Results in Perspective

Natural Air Changes Per Hour (ACH_n) = $\frac{CFM_{50}\ (1360)\ X\ 60\ \text{(minutes per hour)}}{\text{House Volume (1120011200) * n (21.525.8)}}$ **= 0.28**

Your Natural Air Changes Per Hour ▶			◎			
Natural Air Changes per Hour	1	.5	.35	.25	.18	.075

Recommended Ventilation Requirements Related to Your Natural Air Change Test Results

The ACH_n reading of 0.34, which we measured with our Blower Door instrumentation, would characterize the "envelope" of this home as being average.

How Infrared Imagery from Thermography Helps Us Track Heat Flow

General

The information presented in this Report on heat and air flow through the outer walls of your home came from color images captured with an Infrared Camera. The science of tracing heat flow through the use of an Infrared Camera is called "Thermography."

Objects displayed in the Infrared images in this Report were *not* detected as visible light rather; the images were obtained from infrared measurements in wavelengths well outside of the visible spectrum. In our Infrared images, electric lights and other relatively hot objects will be very evident, but as a result of their heat, not light, emissions. Color images are important because it is the variation in colors that tell us differences in temperature. The colors in our thermal images can range from almost white (very high temperature and emissivity, the relative quantity of heat given off, or emitted) to almost black which would be obtained from very cold objects. So in the thermal images in this Report, objects that appear darker were cooler while lighter objects were warmer.

When we take an image with our Infrared Camera, it is recorded in the camera's internal memory and later converted to a digital image file with the help of a computer. The image may then be modified in a number of ways to enhance its value to our Clients. In the case of this Report, the images were digitized and then adjusted for contrast and brightness before being scaled and placed into our program.

A Word about the Scope of this Service

Where we have described the locations of the various features of this property as left or right, it is as though we were standing in the street looking at the front of building.

We were contracted to find areas in and around the building that waste energy. Our examination of this building was focused on heat loss by looking for missing, misplaced or damaged insulation in the exterior walls and ceilings and by evaluating air leakage by reducing the pressure inside the building by using a Blower Door.

Every attempt was made to image the property according to the ASTM C1060 Standard; however, due to circum-stances beyond our control this might not have been entirely possible. For example our efforts may have been compromised by weather conditions, inaccessible areas, and furniture or appliances that blocked our access/view.

This inspection Report reflects the conditions on the property at the time of the inspection only. Obviously, hidden or concealed defects could not be included in this report; therefore no warranty is either expressed or implied. We have made every effort to conduct a thorough evaluation of this building and report accurately on our findings.

Recommendations

We recommend that all areas documented in this report be further investigated. Repairs should then be under-taken wherever reasonable and practical. Our recommendations are not intended as criticisms of the building, but rather as professional opinions regarding the conditions that we found.
We are often asked how to prioritize the repairs that we have identified in this report. Here are three levels of concern we suggest you consider as you prioritize our recommendations:

- Conditions which affect performance and life safety issues (if any) are of course, of the highest priority. These conditions have been described as "**Urgent**".
- Next are conditions that do not appear to pose any threat to the safety of the building occupants, but that need repair because they create a condition that affects the performance of the building or could deteriorate the building itself. These areas should be tested by a qualified repairman to determine the appropriate corrective action, followed by repair or modification. They have been characterized as being of "**Significant Concern**".
- Finally, there may be conditions that have a low impact on the performance of the thermal, air and/or moisture barriers, but have reached a reportable level. These should be evaluated to determine if it is cost-effective to conduct repairs. These conditions have been designated "**Optional Repairs**".

Observations and Recommendations

Ms. Homeowner,

Following the air diagnostic and thermal scan of your home, the following observations and recommendations are respectfully submitted.

As we discussed your intention to add insulation in the attic, Northland Inspections Inc. will address items that should be addressed prior to and during the insulation process.

The following is a list of items we suggest for improvements to your thermal and air barrier.

1. The furnace closet is in need of some upgrades to the combustion air and the enclosure itself. You should consider sealing off the area between the water heater and furnace platform and the doors where they meet together. This will prevent the unconditioned room enclosure air from being sucked into the return air of the furnace under the platform.
2. As you stated that you were getting a new sealed combustion furnace. Combustion air for the furnace will no longer be needed inside the mechanical closet. Combustion air in the amount to satisfy the requirements of the water heater will still be required in the closet, ½ at the lower area of the compartment and ½ at the upper ceiling. The combustion air openings should be sized according to the BTU's of the water heater.

In the attic:

3. Seal or better insulate the area between the plumbing walls between the bathrooms.
4. Seal and insulate the attic access hatch.
5. Seal and insulate the drop down ceiling soffit areas in the kitchen.
6. Have a competent electrical person raise up any electrical boxes to above the level of the new insulation.
7. Consider installing insulation shields at the eaves so the blown in insulation will allow any exterior air from the soffits to ventilate the attic. If ventilation is added at a later date, this will be especially helpful.
8. Consider adding additional ventilation if the attic area is too hot after the insulation is added.

Attention to these items should provide energy savings and a better thermal and air barrier for increased comfort in your home.

Please call with any questions you may have.

Brion Grant
Northland Inspections Inc
928-525-1881

Glossary

Air Changes at 50 pascals (ACH_{50}) – The number of times the complete volume of the air in a home is exchanged for outside air when a blower door depressorizes the home to 50 pascals.
Air Exchange – The total building air exchanged with the outdoors through air leakage and ventilation.
Air Handler – A metal cabinet containing a blower with heating and/or cooling coils connected to ducts.
Annual Fuel Utilization Efficiency (AFUE) – An efficiency rating for heating appliances which accounts for chimney losses, jacket losses, and cycling losses.
Blower Door – A device that consists of a fan, a removable panel, and gauges used to measure and locate air leaks.
Building Tightness Limit (BTL) – See Minimum Ventilation Guideline (MVG).
CFM_{50} – The number of cubic feet per minute of air flowing through the fan housing of a blower door when the house pressure is 50 pascals (0.2 inches of water). This figure is the most common and accurate way of comparing the air tightness of buildings that are tested using a blower door.
Conditioned – Heated or cooled areas of a building are said to be conditioned, either intentionally or unintentionally.
Conduction – Heat flow from molecule to molecule in a solid substance, through direct contact.
Convection – The transfer of heat caused by the movement of a fluid like water or air. When a fluid becomes warmer it becomes lighter and rises.
Cubic Feet per Minute (CFM) – A measurement of the movement of liquids or gasses past a certain point or through a certain structure.
ELA (Effective Leakage Area) or EfLA - In layman's terms, the EfLA is the size of hole we would have if all the cracks and holes in the building's exterior could somehow be brought together into one opening.
Envelope – The building shell. The exterior walls, floor, and roof assembly of a building.
Exfiltration – Air flowing out of a building from its conditioned space through the shell.
Heat gain – Heat that accumulates in buildings; desirable during the heating season but undesirable during the cooling season.
Heat loss – The amount of heat escaping through the building shell during a period of time.
Heat transmission – Heat flow through the walls, floor, and ceilings of a building. Does not include air leakage.
Infiltration – The inflow of outdoor air into the indoors, offset by an equal outflow from indoors to outdoors.
Infrared (IR) Thermography – Using an Infrared Camera to take images showing areas of excessive heat loss or heat gain. See also Thermal Imaging.
Minimum Ventilation Guideline (MVG) – The measured blower door air leakage value below which mechanical ventilation is necessary. The same as the Minimum Ventilation Level (MVL) or Building Tightness Limit (BTL).
Natural Air Change - The number of times per hour that all the air in the house will be changed, without the use of mechanical ventilation. It is generally considered that 0.35 is sufficient, but the amount is dependent upon occupancy, building dimensions, indoor pollution sources and weather. Most homes will be under, and over, ventilated at different times.
Natural ventilation – Ventilation using only natural air movement, without fans.
Pascal – Often shown as "Pa;" a very small metric unit of pressure. 249 Pascals equal 1" Water Column (the pressure required to push water up 1" in a tube). One Pascal = 0.000145 psi.
Percent of Energy Bill - The amount of the total energy bill that can be attributed to air leakage.
% Savings Potential – The savings potential attributable to the fact that leakage can be reduced by 12 to 50 % with the average being 25%. However, duct leakage can double these losses.
Pressure Diagnostics – The practice of measuring air pressures and flows in buildings.
Radiation – Heat energy originating on a hot body like the sun, traveling from place to place through the air.
Thermal Imaging – The process of taking images with an Infrared Camera that display temperature differential of surfaces through variation in color.
Thermal Boundary – A line or plane where insulation and air barrier(s) exist in order to resist thermal transmission and air leakage through a building shell.
Weatherization – The process of reducing energy consumption and increasing comfort in buildings by improving the energy efficiency of the building.