Findings & Recommendations

Executive Summary

The issues at hand are:

1 home will not cool properly in the evening

2 high power bills

3 humidity is high

We conducted an airflow analysis on the five ton heat pump. Additionally we spent time in the attic inspecting the duct work and the attic insulation. Finally we conducted a blower door test to measure the leakiness of the home.

During our inspection of the home the relative humidity with the system running, was in the range of 50% through out the house. The maximum was 51.5% and the minimum was 49.5% . We also found that both thermostats understated the temperature by a little over 2 degrees. So when the thermostat displayed 71 degrees the temperature was a little over 73 degrees.

The blower door test revealed that the home is relatively tight with an ACH50 of 6.60. Our airflow test revealed that some rooms are receiving more and some receiving less than the design. We know that some adjustments have been made to direct air to different rooms which may explain these variances.

The overall airflow was rather low with the supply airflow efficiency at 84.9%. The temperature analysis confirmed that the bypass damper was not closing fully. It is imperative that this be repaired.

Our Airflow analysis also revealed that at the end of the cooling cycle the hvac system is not going into dehumidification mode. Additionally, during our tests which lasted approximately four hours, the air handler fan ran the whole time even after the thermostats were satisfied. The only time the fan stopped was when the disconnect was pulled for the blower door test. It appears that the Honeywell 8150 control module terminal Gf is constantly energized which is keeping the air handler blower from shutting off. This must be addressed immediately.

In a nutshell, the bypass is reducing airflow to the home by at least 15%, causing short cycling and reducing dehumidification. The air handler is running constantly and as a result is raising the humidity in house considerably. Furthermore, with the air handler being on all the time the energy consumption is much higher.

Findings & Recommendations

Recommendations

Please Note

Any repair work suggested, should be completed by a competent, licensed contractor.

1 repair the bypass damper
2 repair the temperature sensor
3 disconnect the 8150 control module from the zone board
4 repair the armor flex gap above the family room
5 add more insulation above bedroom 5 and above the family room
6 repair the trunk outer wrap
7 confirm that the ventilation damper is closed when then 8150 control module is off.
8 try to separate the duct work in the second floor attic
9 repair the air handler dehumidification cycle settings
10 repair the insulation failures in the second floor duct connections
11 seal the perimeter of the interstitial space
12 consider installing a whole house filter assembly

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Blower door

The Blower door test is performed to determine how "leaky" a house is. That is how much outside air can be drawn into the home over time. Modern building practice calls for tight houses to reduce air leaking in (infiltration) so that the home can be more energy efficient. Unwanted outdoor air leaking into the home in a hot humid climate like Florida can cause the hvac system to run longer and can cause indoor humidity to rise. Additionally, outdoor air pollution like mold spores are an unwanted effect of infiltration.

1 Blower Door Test Closed: The Blower door test was conducted with the house depressurized. That is, an air tight screen was installed in an outside door with a calibrated fan installed in the screen. The fan removes air from the house (depressurize) and the amount of airflow through the fan is measured with accurate meters. The fan and meter are controlled by a computer to assure accuracy and eliminate the chance for error or gaming.

Outside Temp	80 °F	Conditioned floor space	2,840 sq. ft
Wind speed	5 mph	No. of bedrooms	4
Inside temp	72 °F	Conditioned volume	22,655 cu ft

Table 1 - Building data

2 BD Test Results: The Blower tests showed that the home had a leakage of 2,492 cfm at 50 Pascals of pressure which is equivalent to 6.60 air changes per hour at that pressure. This is a tight house.

3

Effective Leakage Area	128.0 square inches. This is the cumulative size of all the holes and cracks in the exterior of your house through which unconditioned outside air enters your home and conditioned air escapes.	
Air flow at 50 Pascal of pressure	2,492	cubic feet per minute at a house pressure of -50 Pa
Air Changes per hour at 50 Pascal of pressure	6.60	air changes per hour

Table 2 - Blower Door Test Results

Findings & Recommendations

Airflow Test Criteria

There are three criteria that are measured.

a) Airflow measured vs capacity or industry standards
b) Static pressure (resistance to airflow) measured vs manufacturers limits
c) Leakage, measured vs a 10% limit.
d) Standard test protocol calls for the air flow to be measured with the filter removed

Airflow Test Results

Main System	5.0 Ton Condenser, Var spd air handler set to 5 tons, nominal speed	airflow report number 7001-4940-5521

4 Air Flow Efficiency: This system consists of a 5.0 ton condenser and a variable speed air handler set to 5.0 tons and nominal speed. The air handler is set to deliver 350 cfm per ton for a total of 1,750 cfm. The supply is designed to deliver 1,750 cfm. It is actually delivering 1,485 cfm for an airflow efficiency of 84.9% Meanwhile the return is providing the air handler with 1,389 cfm of airflow vs a design of 1,750 cfm. The return airflow efficiency is 79.5%. The supply and return are both below the limits of acceptability of 90% to 105%. (see air flow primer for more information)

5 Bypass Damper: The bypass damper is not fully closing. That means that approximately 15% of the cold supply air is recycling back to the air handler without ever reaching the conditioned space. This is causing the return air temperature to get colder and colder and in turn make the supply air temp even colder. This should have set off the temperature sensor but we found that the sensor wire was not connected to the sensor dats contact on the zone board. If it was connected the condenser would shut even during cooling mode. This colder supply air satisfies the thermostat very quickly which reduces evaporator coil residence time and as a results reduces dehumidification.

6 Static Pressure: The Return static pressure is 0.18 in. wc. The supply static is 0.29 in wc and the Total External Static Pressure (TESP) is 0.47 in wc. The TESP is high but still within Carrier's limits of safe operation of 0.75 in wc for this air handler . (see static pressure primer at the end of this report for more details).

Fan Curve: The Carrier fan performance data shows that at the measured static pressures the airflow should be approximately 1,750 cfm. This is higher than the measured results.

7 Air Handler Temperature Change - Cooling: Typically the temperature differential between the supply plenum and the return plenum is in the range of 16.5 to 21 degrees. This temperature differential is commonly known as the "Delta T".

In this case we measured a temperature differential or Delta T of 8.9 degrees.

Psychrometric Data System 1								
State point	Dry Bulb Temp DB (^oF)	Wet Bulb Temp WB (^oF)	Relative Humidity RH (%)	Humidity ratio W (gr/lb_{da})	Specific Volume v (ft^3/lb_{da})	Enthalpy h (Btu/lb_{da})	Dew Point Temp DP (^oF)	Vapor Pressure p_{wv} (lb/in^2)
Return	57.2	52.5	73.6	51.40	13.179	21.701	48.860	0.348
Supply	48.3	47.3	93.5	47.00	12.939	18.857	46.510	0.318
Δ	8.9			-4.40		-2.844		

Table 3 - Psychrometric Analysis of System 1

Airflow cu ft / min	Airflow Lb_{da}/hr	Heat Extraction Btu/hr	Tons of Cooling
1,485.0	6,760.8	-19,227.6	1.6

Table 4 - Actual Cooling Delivered

8 System Performance: Clearly the system is delivering more than 1.6 tons of cooling to the home. The psychrometric calculation is skewed by the fact that so much air is bypassing back to the return plenum and causing the return airflow temperature to be so cold. The low temperature and low air flow clearly shows that most if not all of the supply side airflow deficiency is caused by the bypass damper not closing. The bypass damper must be repaired.

9 Leakage: The difference between the measured supply and the measured return is a return leak of 96 cfm or 5.4%. A portion of this is leakage around the outside air damper and the balance is within the duct connections. We could not confirm the ventilation air damper was closed. The return leaks are better than the 10.0% limits of acceptability.

10 Air Handler exterior: The air handler is installed vertically inside of conditioned space. The exterior is clean.

11 Air Handler Interior: The air handler interior is clean.

12 Honeywell 8150 Ventilation Control: The control module is set to 2 bedrooms, 1,000 sq. ft and 100 cfm. The master switch was in the off position. There is a red, green and white wire connecting the control module to the equipment side of the zone board. The green wire which is connected to the Gf terminal on the module connects to the G terminal on the equipment side of the zone board. It appears that this terminal is constantly energized because the air handler blower runs non stop. This should be disconnected as soon as possible and left that way until the cause is rectified.

13 Condenser: The condenser is in good shape and runs when ever the thermostats call for cooling. However, at the end of the cooling cycle the condenser shuts down even when dehumidification is required.

14 Dehumidification: Typically, when a variable speed air handler is installed with humidity sensing thermostats, as this system has, the system will pass into dehumidification mode at the end of the cooling cycle. The unit will enter dehumidification if the relative humidity is above the set point. The unit will then slow down and provide the home with very cold dryer air. This will continue until the offset temperature is met. The off set is usually 2 or 3 degrees. That means that if the thermostat is set to 75 degrees and the off set is set to 3 degrees, the unit will continue in dehumidification mode until the humidity set point is reached or until the off set temperature of 72 degrees is reached. This unit is not entering into dehumidification mode.

15 Attic Inspection Bypass Damper: The bypass damper is hidden behind two trunks and gaining access to it is very difficult. The housing seems to be loose and it needs to be repaired so that it closes completely when required.

16 Attic Inspection Duct Work: The attic above the second floor is very cramped and as a result much of the duct work above the air handler is packed in very tightly. An effort should be made to try and separate the duct work as much as possible. There is no evidence of duct air leakage. However, there is evidence of duct insulation failure on the second floor attic. These should be repaired. Additionally, there is one trunk in the first floor attic within its insulation opened. This too should be repaired. (See repair procedure at the end of this report).

17 Attic Inspection Insulation: There are traffic areas in the first flor attic that should be resurfaced with blown fiberglass insulation. There is a gap in the batt insulation above bedroom 5. This should also be repaired. The second floor flor system or interstitial space is open to the first floor attic. This is permitting hot moist attic air to enter this space. The perimeter of the interstitial space should be sealed with an air barrier.

18 Whole House Filter Assembly: This system has a 1 inch filter installed. in air handler. The filter was vey dirty. In fact it was so dirty that is had been pulled up into the air handler cabinet. Consider having the ac contractor install a 4, 5 or 8 inch whole house pleated filter assembly. This provides the excellent air filtration with very little effect on system airflow. Furthermore, these filters can last up to six months.

19 Fan On: The air handler blower or fan was on non stop. This is the same as placing the thermostats fan switch in the on position. If the fan switch is in the "ON" position, and the cooling system is not running, air is blown across the wet evaporator coil and the drain pan inside the air handler. As a result of this air flowing across these wet surfaces, re evaporation occurs and the humidity in the home rises. In a well designed hvac system, this process will raise the relative humidity in a home an average of 10%. If the hvac system is oversized, this process can increase the indoor relative humidity by as much as 20%. In short, keeping the fan in the on position will increase the humidity inside the home. The fan switch should always be kept in the AUTO position.

20 Test & Balance: Comparing the airflow measurements to the load calculation (design) requirements many rooms do not fall within the tolerance. Once the comfort issues are addressed, the air flow balance should be revisited if required.

21 Thermostats Set Points & The Florida Energy Code: The Florida Energy Code requires that the Cooling portion of the load calculating design be based on an indoor temperature of 75 degrees and an indoor relative humidity of 50%. Therefore, expecting a system to cool a house to 71 degrees is beyond the design parameters of the system and as a result the system may not be able to accomplish that expectation.

Conclusion

22 This system is under performing. The bypass damper does not close all the way allowing at least 15% of the airflow to recycle back to the air handler. This provides less airflow to the home, makes the supply air much colder, satisfies the thermostats too quickly and reduces dehumidification. Additionally, since the fan is constantly on, the humidity in the house is being raised and excessive energy consumption is taking place.

Findings & Recommendations


1 downstairs thermostat displaying 71 degrees actual temperature 73.5 degrees


2 second floor thermostat displaying 71 degrees actual is 73.1 degrees


3 bypass damper is virtually impossible to get to. The housing is loose. It needs to be repaired


4 The attic space is very limited and there is a lot of duct work in this space making access difficult.


5 second floor attic batt insulation


6 gaps in the second floor batt insulation

Findings & Recommendations

7 gaps in the second floor batt insulation

8 too little space for the duct work to pass

9 both zone dampers visible - signs of insulation failure and supply plenum

10 insulation failure along the edge of the supply plenum

11 first floor attic - mixing box

12 first floor attic - supply duct work

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Findings & Recommendations

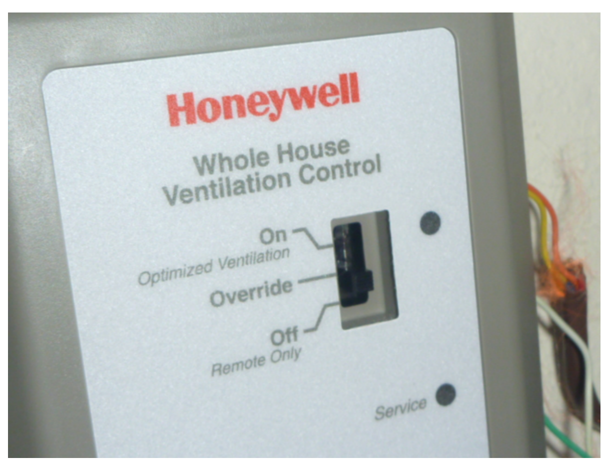
13 missing armor flex insulation - above the family room - this should be repaired

14 duct work properly supported

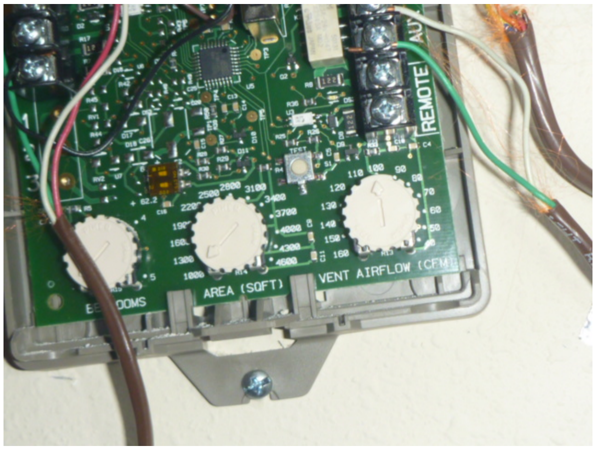
15 outer wrap has opened - this should be repaired

16 missing insulation

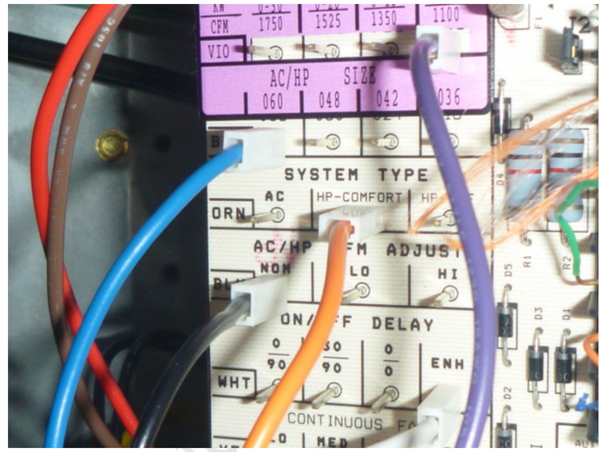
17 The floor system or "interstitial space" is open to the attic. Permitting hot moist attic air to enter.



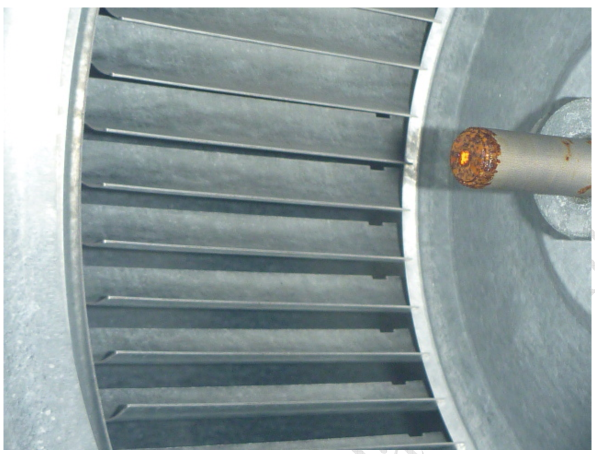
18 Honeywell 8150 ventilation control module



19 Honeywell 8150 ventilation control module - settings 2 bedrooms, 1,000 sq. ft., 100 cfm



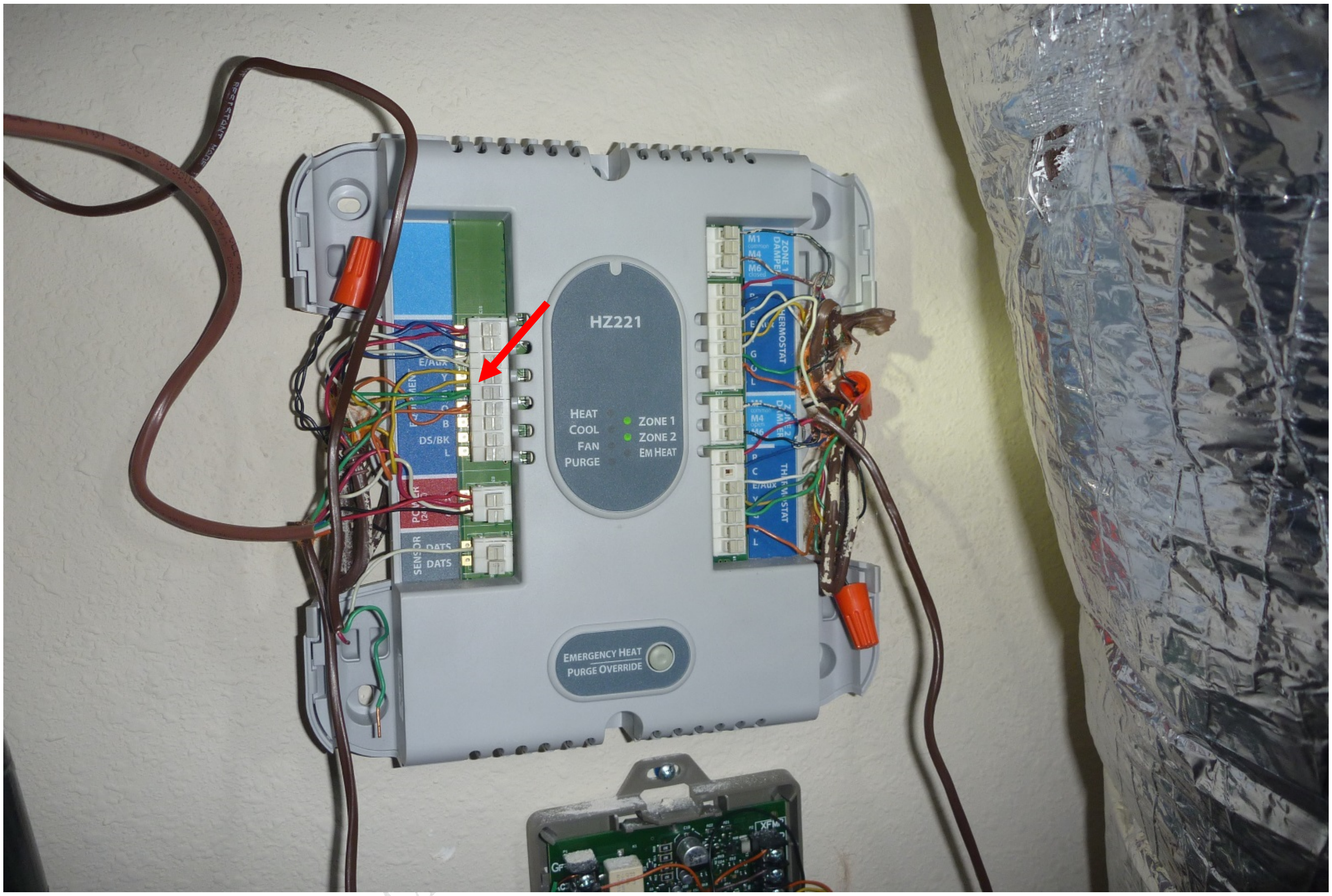
20 AHU set to 5 tons, nominal speed, hp comfort


21 air handler interior clean

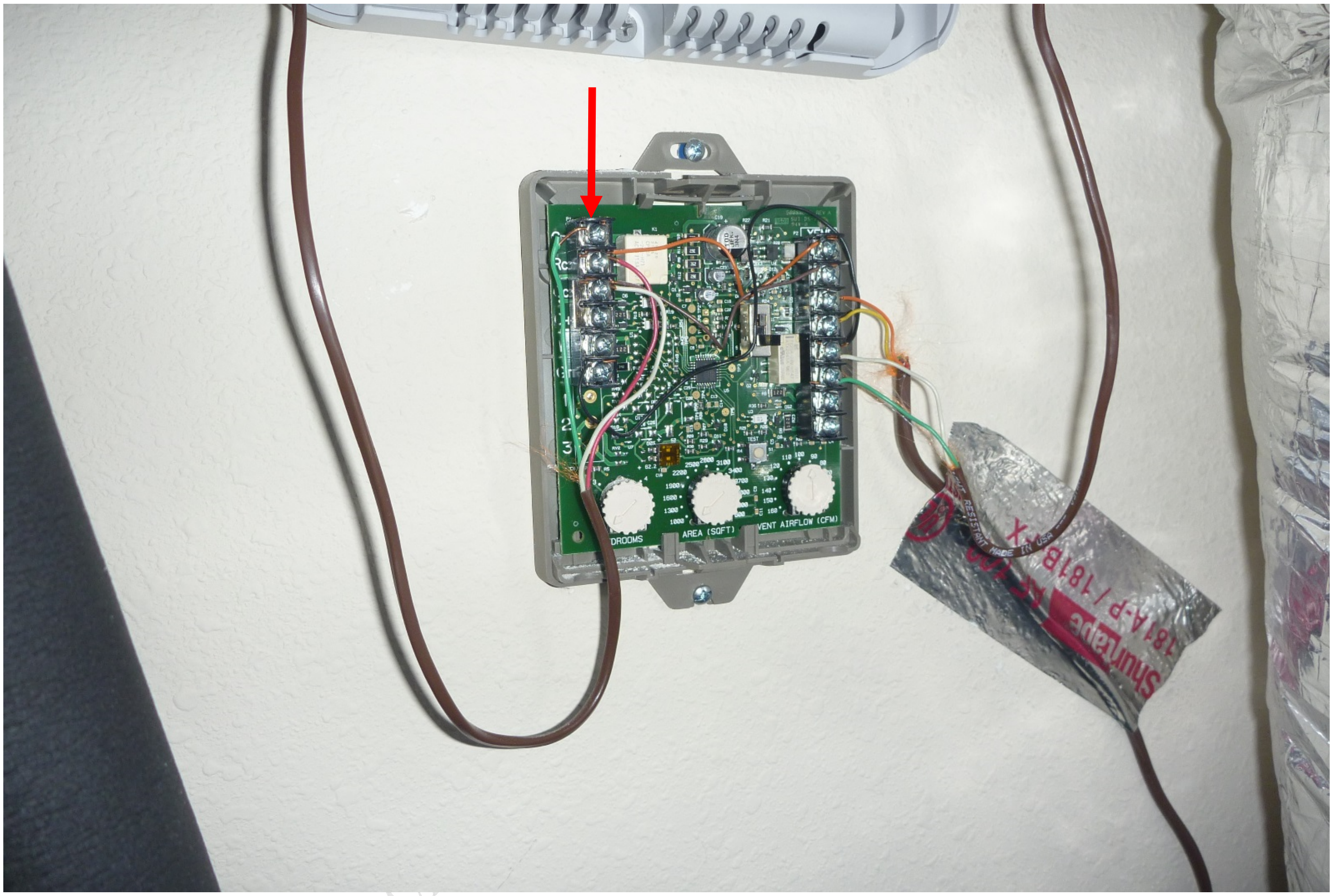

22 ventilation damper - could not confirm it was closed


23 dirty filter - it was sucked up into the air handler cabinet

24 Honeywell zone damper and ventilation control module



25 Honeywell HZ221 two zone board - arrow indicates the 8150 control wire that is constantly energized - this should be disconnected until the cause of the issue is rectified.



26 Honeywell 8150 ventilation control module - arrow indicated the source connection of the constantly energized contact - This module should be disconnected until the cause of the issue is rectified

BUILDING LEAKAGE TEST

Jacksonville Building Science, LLC
450-106 State Rd 13 N
Suite 132
Jacksonville, Fl 32259

Date of Test: 10/10/2016		Technician:	Michael O'Donoughue
Test File: Debra Alessi BD		Project Number:	
Customer:	Debra Alessi 107 Summer Mesa Ave Ponte Vedra, Fl Phone: Fax:	Building Address:	Debra Alessi 107 Summer Mesa Ave Ponte Vedra, FL

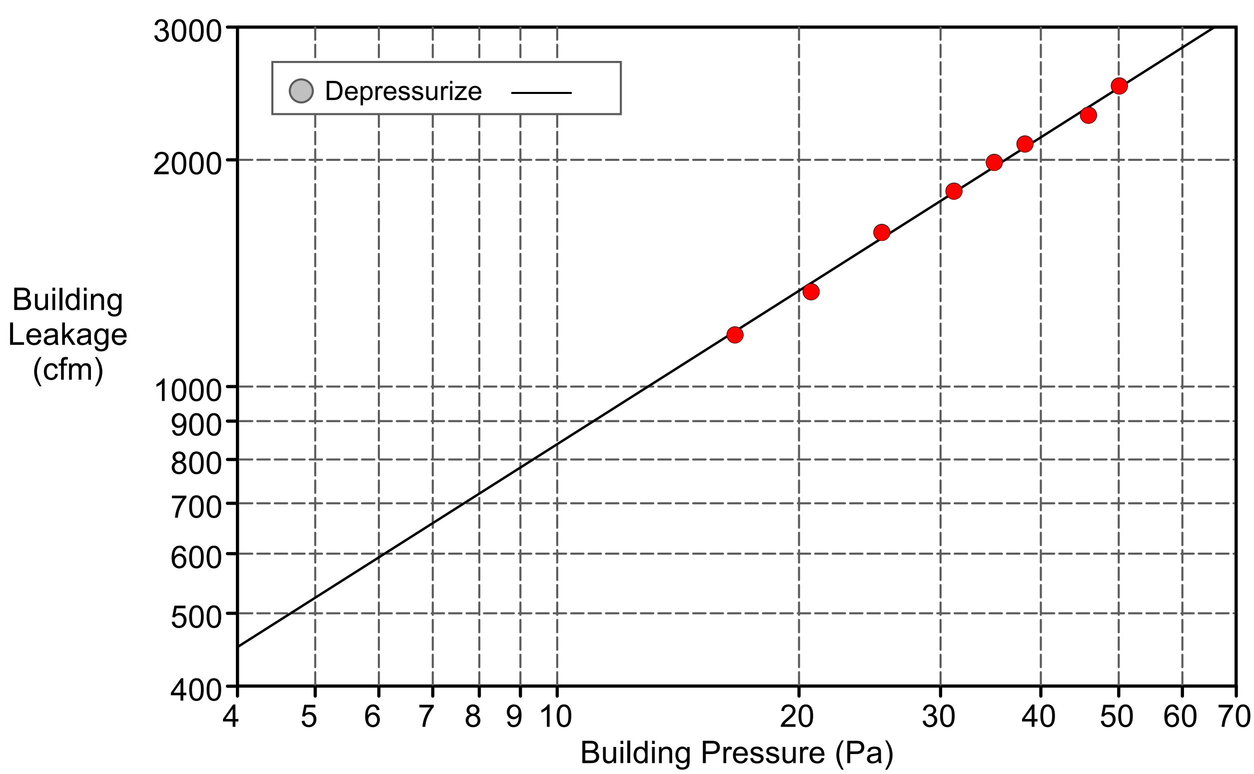
Test Results at 50 Pascals:

cfm50 Airflow	2492 (+/- 0.9 %)
ACH50	6.60
cfm/ft² (Floor Area)	0.8774
cfm/ft² (Surface Area)	0.8774

Leakage Areas: 246.3 in² (+/- 2.7 %) Canadian EqLA @ 10 Pa or 0.0867 in²/ft² Surface Area
128.0 in² (+/- 4.5 %) LBL ELA @ 4 Pa or 0.0451 in²/ft² Surface Area

Building Leakage Curve: Flow Coefficient (C) = 176.5 (+/- 7.3 %)
Exponent (n) = 0.677 (+/- 0.020)
Correlation Coefficient = 0.99731

Test Standard: CGSB
Test Mode: Depressurization



Date of Test: 10/10/2016 Test File: Debra Alessi BD

Building Information

Volume (ft^3)	22655
Surface Area: (ft^2)	2840
Floor Area: (ft^2)	2840
Year of Construction	2015

Equipment Information

Type	Manufacturer	Model	Serial Number	Custom Calibration Date
Fan	Energy Conservatory	Model 3 (110V)	29272	-
Micromanometer	Energy Conservatory	DG700	36025-7	9/8/2016

Date of Test: 10/10/2016 Test File: Debra Alessi BD

Depressurization Test:

Environmental Data

Indoor Temperature (°F)	Outdoor Temperature (°F)
72.0	80.0

Data Points

Nominal Building Pressure (Pa)	Baseline Adjusted Building Pressure (Pa)	Fan Pressure (Pa)	Nominal Flow (cfm)	Adjusted Flow (cfm)	% Error	Fan Configuration
0.2	n/a	n/a				
-49.3	-50.1	26.1	2488	2507	0.5	Open
-45.0	-45.8	162.6	2276	2293	-2.4	Ring A
-37.4	-38.2	135.7	2083	2099	1.0	Ring A
-34.2	-35.0	121.0	1970	1985	1.4	Ring A
-30.4	-31.2	101.0	1804	1817	0.4	Ring A
-24.5	-25.4	78.0	1590	1602	1.8	Ring A
-19.9	-20.7	53.7	1326	1336	-2.6	Ring A
-15.8	-16.6	41.0	1162	1171	-1.1	Ring A
1.4	n/a	n/a				

Deviations from Standard CGSB - Test Parameters

None

Date of Test: 10/10/2016 Test File: Debra Alessi BD

Comments

None

Jacksonville Building Science, LLC
450-106 State Rd 13 N, #132
Jacksonville, FL 32259
904-807-3540

A/C Airflow Report

Home Enalasys
A SERVICE OF THE HONEYWELL-ENALASYS ALLIANCE

Customer	Debra Alessi 107 Summer Mesa Ave. Ponte Vedra, FL 32082 (904) 466-5292		
Test Taken	1:54 PM 10/10/16	**Technician**	Daniel Decker
Condenser Make	CARRIER	**Air Handler Make**	CARRIER
Condenser Model	CH14NB060 - A	**Air Handler Model**	FV4CNB006
Capacity	5 Tons	**Evap. Coil Capacity**	5 Tons
Condenser Serial #	0915X67626	**Design Airflow**	1,750 Cfm
Capillary Tube		**Capillary Tube**	
AC Unit Comments:	Blower set to nominal speed		

Airflow Summary Information

Airflow	Design	Actual	Difference	S/R Eff.	Airflow Efficiency
Supply Air Flow	1,750 Cfm	1,485 Cfm	265 Cfm	84.9 %	79.4%
Return Air Flow	1,750 Cfm	1,389 Cfm	361 Cfm	79.4 %	
Supply/Return Imbalance		96 Cfm	Positive Pressure		

Airflow Detail Information

Supply Airflow		Return Airflow	
Location	**Cfm**	**Location**	**Cfm**
Bathroom2	20	Bed 2 hall	930
Bedroom3	126	Bedroom2	94
Bedroom2	79	Bedroom3	52
Laundry room	17	Loft	261
Office	66	Bedroom5	52
Kitchen	111	Outdoor air	0
Family room2	77		
Family room1	77		
Dining room	117		
Master bedroom1	116		
Master bedroom2	96		
Master bath	27		
Master wc	24		
Master wic	25		
Stairway	72		
Bonus room	208		
Bathroom3	62		
Bedroom5	165		
Supply Total	**1485**	**Return Total**	**1389**

Jacksonville Building Science, LLC
450-106 State Rd 13 N, #132
Jacksonville, FL 32259
904-807-3540

A/C Airflow Report

Static Pressure Measurements (inches w.c.)				
Before Filter				
Return	-.18	**Filter Drop**		(Filter at Plenum)
Internal		**Coil Drop**		(Blower after Coil)
Supply	.29	**External Drop**	.47	(Supply / Return)

JACKSONVILLE BUILDING SCIENCE LLC

Proportional Test &Balance for Energy Star 3.0

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Alessi-Sromovski Residence

	Room	Design Airflow	Proportional Balance	Min	Max	Actual	Pass/Fail
1	Bathroom 2	27	21	0	46	20	Pass
2	Bedroom 3	106	82	57	107	126	FAIL
3	Bedroom 2	118	91	66	116	79	Pass
4	Laundry	38	29	4	54	17	Pass
5	Office	143	111	86	136	66	FAIL
6	Kitchen	183	142	113	170	111	FAIL
7	Dining room	181	140	112	168	117	Pass
8	Family room	286	222	177	266	154	FAIL
9	Master bedroom	198	153	123	184	212	FAIL
10	Master bath	35	27	2	52	27	Pass
11	Master WC	1	1	0	26	24	Pass
12	Master WIC	21	16	0	41	25	Pass
13	Stairway	142	110	85	135	72	FAIL
14	Bonus Room	242	187	150	225	208	Pass
15	Bath3	41	32	7	57	62	FAIL
16	Bedroom 5	155	120	95	145	165	FAIL
	Total Airflow	1,917	1,485	1,078	1,929	1,485	

Area	2,840	Cond	CH14NA060****A
Volume	22,655	AHU	FV4CNB006

Glossary of Terms

Air Flow Efficiency

The normal range of acceptability for airflow efficiency is 90% to 105% as measured against the industry standard of 400 cfm per ton of conditioning. If the efficiency is below this range, then we have inadequate airflow which leads to moisture buildup in the air handler, excessive energy consumption, excessive equipment wear and moisture related issues in time. Additionally, this lower airflow can cause larger than designed for temperature differences between the air handler interior and the external ambient temperatures. This will lead to thermal failure and the possibility of condensation on the outside of the air handler which also leads to moisture related issues in time.

Efficiency above this range is indicative of excessive airflow. This prevents sufficient airflow "resident time" on the evaporator coil inside the air handler. Consequently the air does not become dry enough for adequate conditioning. This will cause the conditioned area to feel cool but damp. This is often referred to as a "clammy" feeling. This too, in turn leads to moisture related issues over time since the water vapor is not properly removed from the airflow.

Variable speed air handlers have motors that can range from zero to full speed and they typically have three maximum speed settings. Low speed would be 315 cfm per ton, nominal speed would be 350 cfm per ton and high speed would be 400 cfm per. These settings can vary from manufacturer to manufacturer. These settings of course will affect the 90 % to 105% range of acceptability.

Static Pressure

The static pressure measurements are taken immediately before (return side) and after (supply side) of the air handler. The two values are added together to provide the Total External Static Pressure (TESP). The pressure is measured in inches of water column (in wc). Think of an open ended U shaped tube partially filled with water. The water level in both sides are equal. Applying pressure on one side will cause the water level on that side to drop and to rise on the other side. This difference is measured in inches. Hence, inches of water column.

The maximum magnitude of static pressure that an air handler can work with is determined by the manufacturer. This pressure is a "resistance" to airflow and is caused by sharp bends or constrictions in the air passageways as well as undersized passageways. These passageways are commonly called ducts. If a duct is too small, has a series of sharp bends or is constricted as it passes through a truss, then the static pressure will rise. Think of this in terms of trying to breath when your neck is being squeezed or high blood pressure caused by clogged arteries.

The higher the static pressure the more work is required of the air handler fan. High static pressure will cause excessive energy consumption, shorten the life of the fan motor, reduce latent heat (moisture) removal and in some instances actually "pull" water out of the condensate drain pan and add it to the air stream. This will lead to serious moisture related issues in time. Low static pressure is good. However, if low static is accompanied by low airflow then there are probably leaks in the duct work.

The air handler fan is a pump. All pumps are far better at pushing than they are at pulling. Consequently, high static pressure on the pulling side (return) of an air handler has dramatic affects on its performance. Return static should always be kept at an absolute minimum. This is the rationale behind Florida Building Code* requirements on the return duct work. Any reduction in return static pressure has far greater affects than similar supply static reductions.

* **§918.3 Heat Pumps**. The minimum unobstructed total area of the outside and return air ducts or openings to a heat pump shall not be less than 6 square inches per 1,000 Btu/h (13 208 mm^2/Kw) output rating or as indicated by the conditions of the listing of the heat pump. Electric heat pumps shall be tested in accordance with UL 1995.

Leakage

When there is a difference between the supply and the return air flow that delta is leakage. If the supply airflow for example is at 100% and the return is only 85% then we have a 15% return leak. Currently, the regional limit for leakage is 10%. Therefore any leakage in excess of 10% would be worse than the limits of acceptability.

Additionally, supply and return leaks can exist simultaneously. The magnitude of these leaks can be determined by comparing the airflow and staitc pressure with the manufacturer's published data or "Fan Curves". The fan curves tell us what the air flow should be at cetain level of static pressure. Therefore, the data can be compared with the measured results to determine the magnitude of leakage for both the supply and the return. It is always prudent to refer to the published fan curves when analyzing system results.

A return leak is caused by openings in the return duct work, connections or openings at the air handler. If the ductwork or air handler are outside of conditioned space, then these leaks are introducing dusty, moist air and (if the air handler is in the garage) exhaust fumes etc. into the air stream.

Supply leaks likewise are caused by openings in the supply ductwork. They push conditioned air into unwanted locations like the attic or garage. If the duct work is outside of conditioned space, then the home is placed under a negative pressure which drives unconditioned, contaminated air into the home. Hot moist air is drawn in at every opportunity when doors are opened and through ceilings and weaknesses in seals around doors and windows. Unlike the situation with return duct leaks, this air is not passing through the air conditioner before entering the home and thus sets up adverse conditions with respect to comfort and moisture levels within the home itself.

Building pressure - Mechanically Induced

Returns remove air from a room or zone. Supplies provide air to room or zone. The supply and return in rooms or zones should be equal. If they are not, then that room or zone is under a pressure differential. If the supply exceeds the return the room or zone is under a positive pressure and air is forced out of the room or zone.

Positive Pressure: If the supply exceeds the return, the room or zone is under a positive pressure because there is more air entering the room than there is being removed. Therefore, air is forced out of the room or zone. For example, a master bedroom suite with two supplies, a supply in the master bath, master water closet and master closet and no return is placed under a sizeable positive pressure. When the air handler comes on, the bedroom door is slammed shut as the air is being forced out of the room by the positive pressure.

Another common cause for positive pressure is leaks in the return duct work. In this scenario, attic air is drawn into the return ducts in lieu of air being drawn from the conditioned space. This means that hot, moist attic air is entering the system and placing additional burden on the system. In this case it is absolutely critical that these leaks be repaired. In fact studies have shown that return leaks of 15% "can reduce the effective capacity and efficiency of a cooling system by about 50%".

Negative Pressure: If the return exceeds the supply, the room or zone is under a negative pressure because there is more air leaving the room than there is being delivered. Therefore, air is forced into the room or zone. This means that unconditioned air can be forced into the conditioned space which can lead to moisture related issues in time.

Currently, the building code mandates that the pressure drop across a closed bedroom door shall not exceed 2.5 Pascals when all the bedroom doors are closed and the HVAC system is operating.

Fan Cycling

If the fan switch on the thermostat is in "**ON**" position, and the cooling system is not running, air is blown across the wet evaporator coil and the drain pan inside the air handler. As a result of this air flowing across these wet surfaces, re evaporation in the air stream occurs. This high humidity air is then distributed through out the home and as a result the relative humidity in the home rises. In a well designed hvac system, this process will raise the relative humidity in a home an average of 10%. If the hvac system is oversized, this process can increase the indoor relative himidity by as much as 20%. In short, keeping the fan in the on position increases the humidity inside the home. The fan switch should always be kept in the "**AUTO**" position.

Building pressure - Naturally Induced

When wind strikes one side of a house, that side experiences positive pressure. The leeward side however experiences negative pressure. These pressures can cause outdoor air that is moisture laden or contaminated with duct or mold spores to enter the conditioned space. This is known as "Infiltration".

Tall rooms and stairways can have a temperature differential between the top and bottom. This temperature differential will induce air flow and can cause the lower section to experience negative pressure if the air flow is permitted to exit at the top. This phenomenon is known as "Chimney Effect" and is a common occurrance

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Flex Duct Connection Repair Procedure

The inner wrap should be completely removed and any wet duct board or insulation should be replaced. Also, the mating surfaces must be thoroughly dry before the repair can be performed. The mixing box collars and boot throats on the connections should be sealed and completely coated with a 1/8th inch layer of UL 181 approved mastic. The inner wrap should then be slid over the mastic covered mating surface, mechanically fastened and the outer surface of the inner wrap and the interface should be sealed and coated with another layer of UL 181 approved mastic. The outer wrap should then be pulled over the connection, snugged to the mating surface, mechanically fastened, taped to the mating surface and sealed with another layer of UL 181 approved mastic to the interface. The boots must be completely covered with a blanket of insulation and the mastic must be allowed to dry thoroughly before the system is restarted.

Metal Duct Repair Procedure

The insulation should be completely removed from the metal joint. The mating surfaces must be thoroughly dry before the repair can be performed. The trunk or distribution box collars and boot throats on the connections should be sealed and completely coated with and 1/8th inch layer of UL 181 approved mastic. The metal duct should then be slid over the mastic covered mating surface, mechanically fastened with a rivet or screw and the outer surface of the duct and the interface should then be sealed with another layer of UL 181 approved mastic. The mastic requires 24 hours to dry. Once it is dry the duct should be pressurized and checked for leaks using a smoke pencil. If no leaks exist then the joint can be insulated. The insulation should completely cover the connection and should snugged to the mating surface, mechanically fastened and sealed with another layer of mastic. The boots must be completely covered with a blanket of insulation and the mastic must be allowed to dry thoroughly before the system is restarted.