Dependable Comfort for All Seasons
CROSSWAY MECHANICAL
EXPERT AIR CONDITIONING AND HEATING

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May 9, 2023

Andrew Reeder
Subject: Site inspection conducted 5/2/2023
Location: 18 Hawkseye Place
Spring, TX 77381

Summary

On April 17, 2023, Crossway Mechanical representatives Axel Romero and Brian Wright performed an evaluation on a two-zone residential split AC system. The system was evaluated for performance as well as installation and application parameters. They took airflow measurements (static pressures) with the zones operating together and separately. Checked blower set up, thermostat and zone control operation and looked at the condition of the air filters, inner and outer surfaces of the system and the application.

They observed and made a record of performance deficiencies associated with application of the zone controls, the air distribution system, and the furnace airflow setup. The findings and photographic examples are below. The primary deficiencies noted are in the air distribution system.

A complete set of photos and videos taken that morning can be found (for 30 days from this date) at the link below. Thereafter, they will happily be made available upon request.

Photos and Videos - 18 Hawkseye Pl - Spring TX 5.2.2023

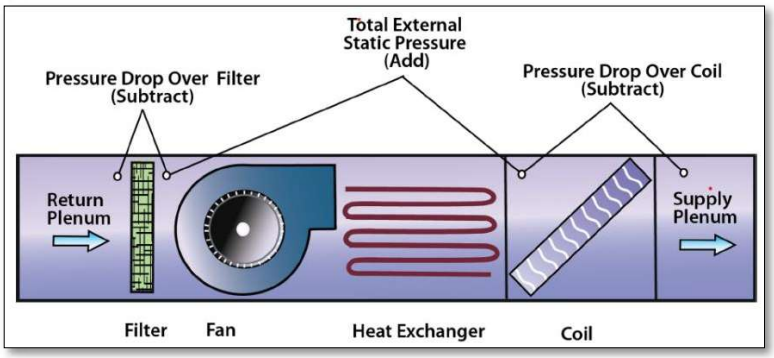
Comfort Delivery Equipment

System	Model	Serial	Component	Manufacturer
Zoned	EL18XCVS048-230A01	5820L03273	Condenser	Lennox
Zoned	SL280UH090V48B-05	5921C06788	Furnace	Lennox
Zoned	CH23-51	6021A14918	Evaporator	Lennox

Airflow

Airflow Determination Method: Our standard method for airflow evaluation is to use test ports (cleared orifices) made on the furnace at about 2" from the edge of the entering and leaving ends, as well as one at the supply plenum and one at the return plenum. We use calibrated manometers to measure the pull and push of air through testing hoses in inches of water column (abbreviation "WC, which is the pressure it takes to raise a column of water one inch, equating to 1/28 pound per square inch of pressure – put another way, 28 inches of water column would equate to 1 psi). This is how we measure static pressure. Static pressure is like blood pressure and provides an indication of resistance to flow.

To get a system's total external static pressure, we take the entering air pressure (before the blower) and the leaving air pressure (after the blower) and add them up. The resulting number is compared to the total external static pressure for which the system is rated by the manufacturer.



This method is in accordance with ACCA (Air Conditioning Contractors of America) and NCI (National Comfort Institute) standards and has experientially proved to be an accurate method to evaluate airflow.

ANSI/ACCA 5 QI – 2015 4.1.1

NCI DUCT SYSTEM OPTIMIZATION pg. 3

Below, are the final measurements taken at the equipment during cooling. The pressures may have a natural fluctuation of +/- 0.03" WC, but the readings captured and recorded at any test port are the ones sustained for the longest. Tests ran with cooling on, so the coil pressure drop is "wet coil" data.

The zoning application cannot have an effective excess air management strategy, as the total external static pressure with both zones calling (airflow on high and all dampers open) is above the allowable range by Lennox. (See Blower Performance table next page.)

Both Zones Calling (1600 CFM)
Static Pressure Before Filter: 0.05" WC
Return Air Static Pressure: 0.63" WC
Filter Pressure Drop (ΔP): 0.48" WC
Supply Air Static Pressure: 0.54" WC
Static Pressure After Coil: 0.33" WC
Coil Pressure Drop (ΔP): 0.11" WC
Total External Static Pressure: 1.17" WC

Upstairs Zone Only (1000 CFM)	**Downstairs Zone Only (1000 CFM)**
Static Pressure Before Filter: 0.01" WC	Static Pressure Before Filter: 0.01" WC
Return Air Static Pressure: 0.25" WC	Return Air Static Pressure: 0.25" WC
Supply Air Static Pressure: 0.50" WC	Supply Air Static Pressure: 0.42" WC
Static Pressure After Coil: 0.41" WC	Static Pressure After Coil: 0.31" WC
Total External Static Pressure: 0.75" WC	Total External Static Pressure: 0.61" WC

Furnace Cooling Airflow Setting

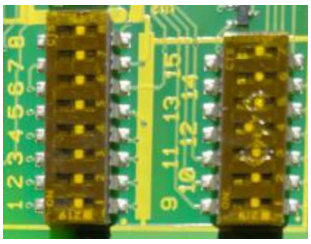
EL296UH090XV48C BLOWER PERFORMANCE (less filter)
BOTTOM RETURN AIR
0 through 0.8 in. w.g. (Heating) and 0 through 1.0 in. w.g. (Cooling) External Static Pressure Range

HEATING		
[1] Heating Speed DIP Switch Settings	First Stage Heating Speed - cfm	Second Stage Heating Speed - cfm
+24%	1490	1645
+18%	1415	1565
+12%	1330	1480
+6%	1295	1405
Factory Default	1220	1325
–6%	1150	1260
–12%	1065	1190
–18%	1010	1105

COOLING								
[1] Cooling Speed DIP Switch Settings	First Stage Cooling Speed - cfm				Second Stage Cooling Speed - cfm			
	Low	Medium-Low	Medium-High	[2] High	Low	Medium-Low	Medium-High	[2] High
+	840	1005	1155	1315	1165	1375	1580	1770
Factory Default	780	915	1045	1190	1075	1265	1440	1645
–	690	835	955	1070	935	1145	1320	1465

[1] Cooling and heating speeds are based on a combination of DIP switch settings on the furnace control. Refer to installation instructions for specific DIP Switch Settings.

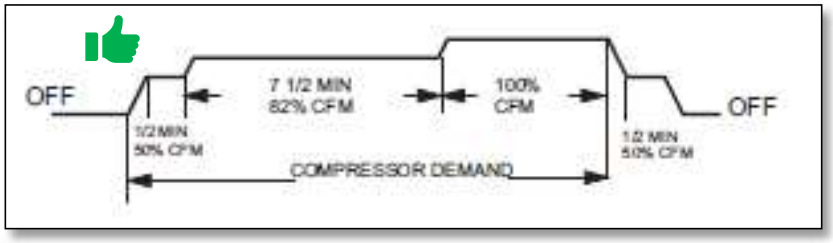
The furnace cooling airflow was set for high speed with no cooling airflow trim adjustment. All dip switches are in default (OFF) position. See picture below. NOTE: Cooling airflow demand is controlled by the variable capacity outdoor unit



Filtration

The filter pressure drop is excessive. It should be noted that an air filter's performance is rated at a face velocity of 300 Feet Per Minute (FPM). The face velocity for the 20x25x5 in this application is 461 FPM when the blower is on high speed. This reduces the filtration effectiveness and creates higher resistance to airflow. The picture below shows another reason filter pressure drop is high. The filter cabinet is larger than the furnace and has some of the filter area "cut off". There should be a duct transition between the filter cabinet and the furnace cabinet to allow full use of the filter area and ensure smooth airflow.

Furnace Set Up for Cooling Mode Blower Ramp Option "A" – Preferred mode for humid climate.

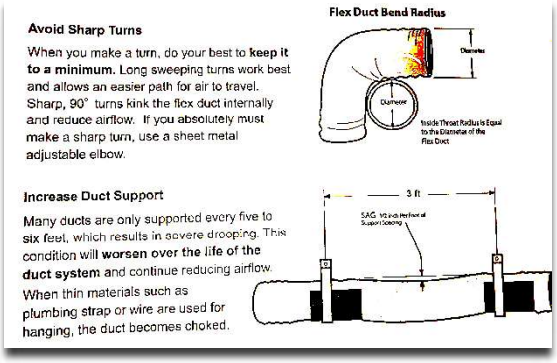


Ductwork

Deficiencies found during the ductwork evaluation included: compressions, hard bends, improper support, and kinks. These deficiencies effectively decrease the duct's internal diameter, causing air resistance and turbulence. Additionally, the more bends and turns, the less the air can maintain velocity. This causes more heat transfer through the duct walls, resulting in system capacity losses and duct "sweating". It must also be noted that ducts making direct contact with each other will allow the surfaces to condense moisture from the surrounding air.

The ducts throughout most of the air distribution system are the original ducting with an original insulation value of R-5.8 (current code requirement is R-8). The new plenums and first few feet of duct are newer, but then it transitions (via some poorly made couplings) into the original ducts. Due to age and degradation, this older ducting insulation value will have degraded some.

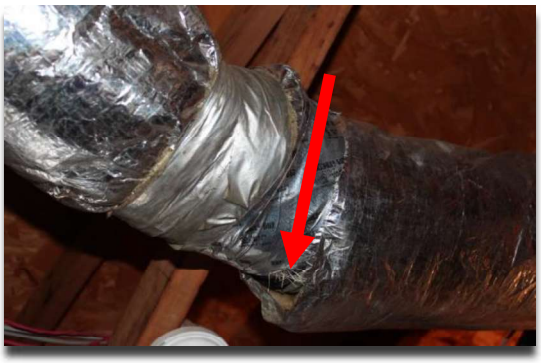
Hard bends, like the ones below cause turbulence which increases resistance to airflow, they also compress the insulation, which will cause condensation of moisture from the surrounding air.



Insulation compressed by hanging strap or tape causes condensation where compressed. Also, note the duct located very close to the underside of the roof decking. This duct will gain a lot of heat when the roof is hot, substantially reducing the capacity delivered to those spaces.

Insulation compressed at remote plenum starting collar by "panduit" strap and tape. Ducts in uninsulated direct contact with each other will condense water vapor from the ambient air.

Insulation compressed at poorly made duct coupling. Also, outer insulation sleeve open to attic will allow humid air to enter the space and condense on the inner liner, which has been seen to cause condensation to accumulate in the sleeve. This can leak out and cause ceiling damage.



Supply Plenum Contaminated with Organic Matter. We used a telescope camera to take photos inside the plenum.

Attic Ventilation:

Need to have contractor look at siding on home the verify there is vapor barrier. We can see lots of day light from attic. It could affect the home with infiltration being driven from attic.