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To: Adam Winter

From: Kevin Goodnight

Subject: Performance review of AspenAir's filter vs. Aprilaire's 4400

Attached with this cover page is the report resulting in our conclusions of the data available from the Aprilaire factory as well as our own lab tests. The AspenAir filter out performs the Aprilaire 4400 in each category: Capture rates, Initial static, Dust loading vs. static, Operational energy costs and Microbial kill rate. AspenAir delivers more air resulting in increased comfort while driving down heating and cooling utility costs to the consumer.

Please feel free to contact me if you have any questions. Thank you.



AspenAir vs. Aprilaire's Filter Comparison

By Kevin Goodnight
September 1, 2009

The following report has been written to explain a few points from our presentation last Tuesday and to understand the performance characteristics between the two air filtration manufacturers.

Aprilaire's Air Cleaner Control Module:

The Air Cleaner Control mounted on the filter can be wired into the central hvac system to control the blower (requiring 24v power) otherwise (using battery power only) it only monitors the filter's run time.

To control the blower requires the running of new wiring from the furnace control board to the filter's LED base which consumes 2 amps or 48 watts of power as per the Installation Instructions found on www.aprilairecontractor.com. At PG&E electrical rates, the energy consumption equates to about \$101 annually for continuous operation.

Filter replacement:

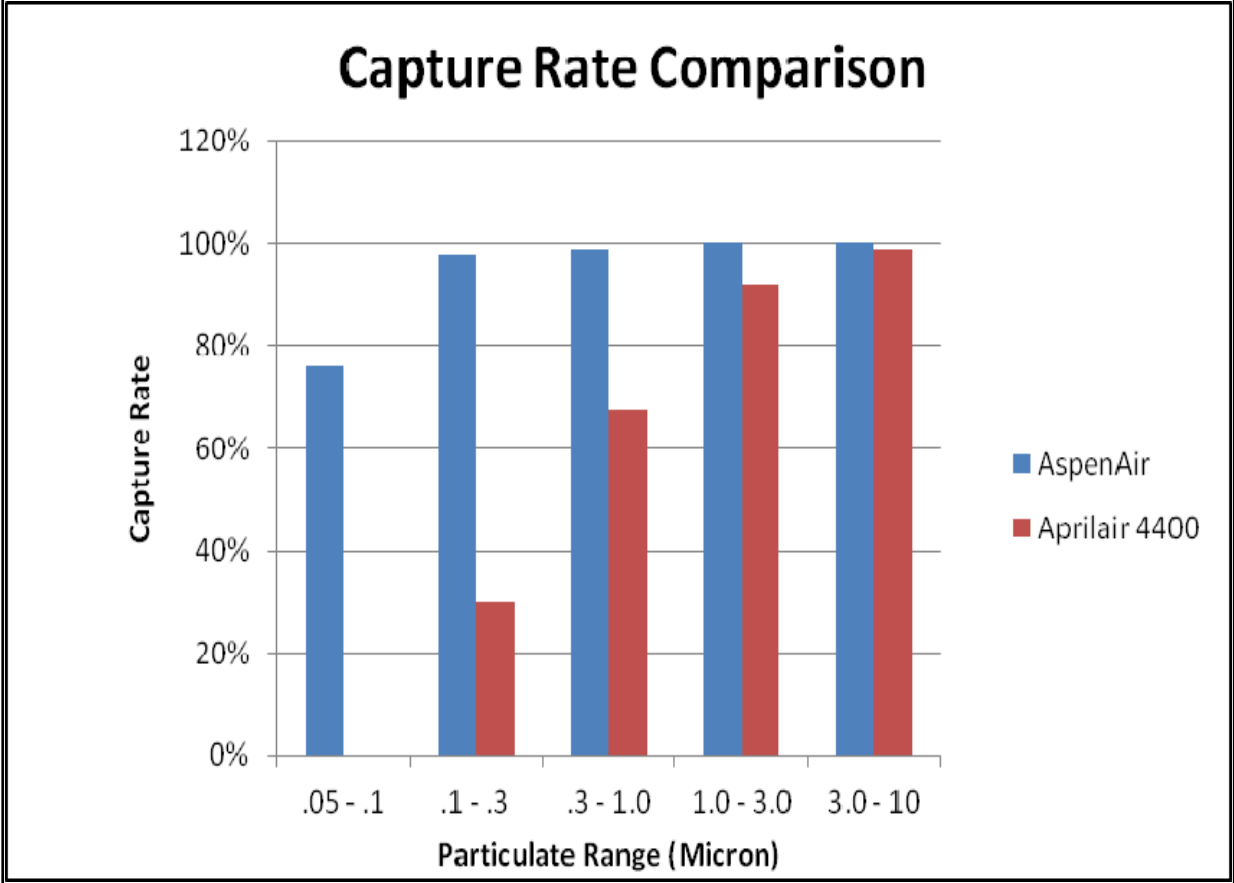
Aprilaire's Homeowner's Manual states the media filter can last 1 to 2 years yet the control can be programmed to alert the consumer to change the filter only in 3, 6, 9, or 12 month (not 24 month) intervals. Since the Air Cleaner Control monitors filter life based on fan run time as opposed to static pressure, the potential of the consumer changing the filter infrequently in a dirty environment is always present. Clearly, the hvac equipment's energy consumption from higher static is not a concern in the operation nor mentioned in any of the manuals.

Comparative Performance: Capture Rates, Dust Loading, and Static Pressure Characteristics

Capture Rates:

In determining filter comparison data it is critical to know the differentiating airflow rates between the various tests. AspenAir's filter was lab certified at an airflow rate of 500 fpm or 2000 cfm while Aprilaire's 4400 filter has been certified at 347 fpm or 1388 cfm.

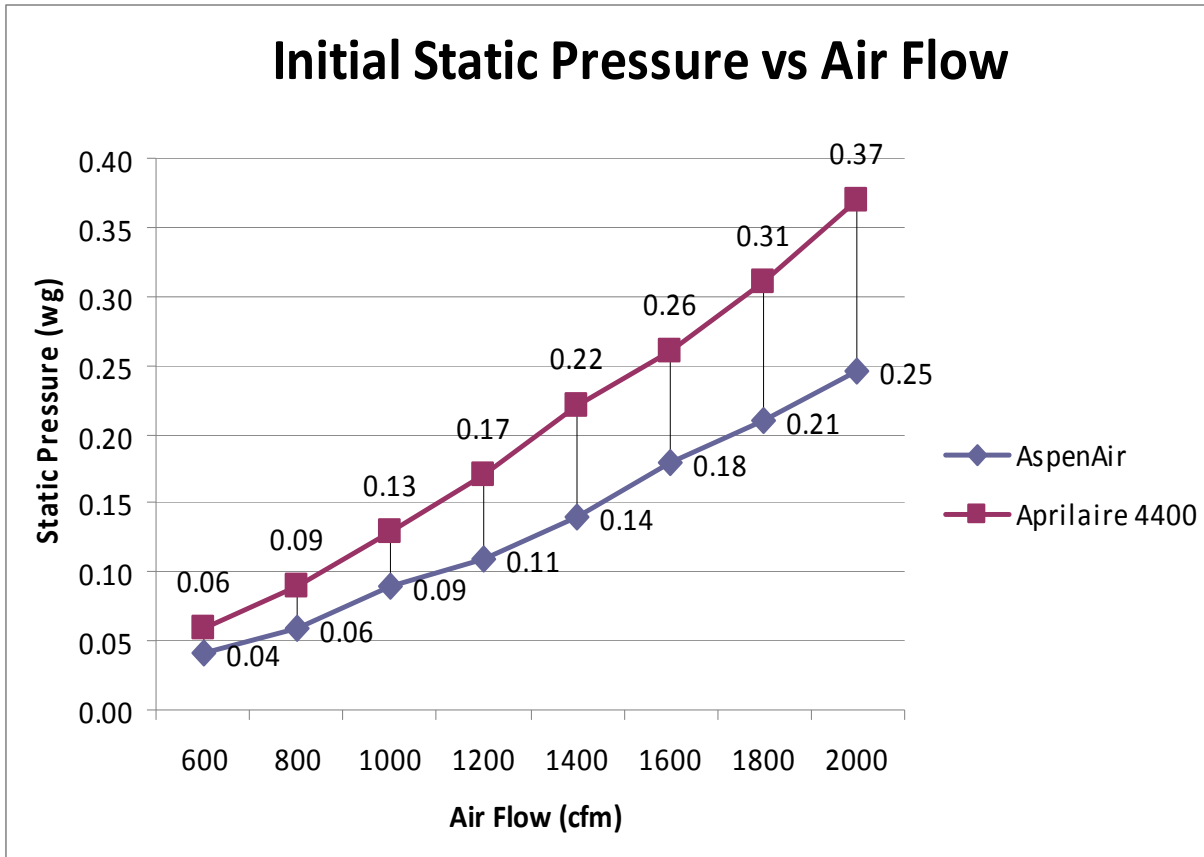
Please note Aprilaire’s Installation Instructions specify their filter’s airflow capacity to reach 2000 cfm; however, the technical paper supplied by the factory’s representative (found at the end of this study) clearly notes that two filters are “recommended” for 5 ton systems.



As seen from the above graph, AspenAir’s high-efficient filter drawing on 24,000 volts of power clearly captures a greater amount of dirt, pollens and microbial material then Aprilaire’s 4400 media filter. Note that virus and bacteria are generally < 1micron in size. Though AspenAir uses 24 volts to convert to 24,000 volts, it only does so at a rate of 2 watts which equates to roughly \$4 of annual energy costs to the consumer in continues operation. That equates to a 96% savings when compared to Aprilaire or an investment of \$40 over ten years versus a \$1000 investment over the same period by the consumer (if using the fan control module)!

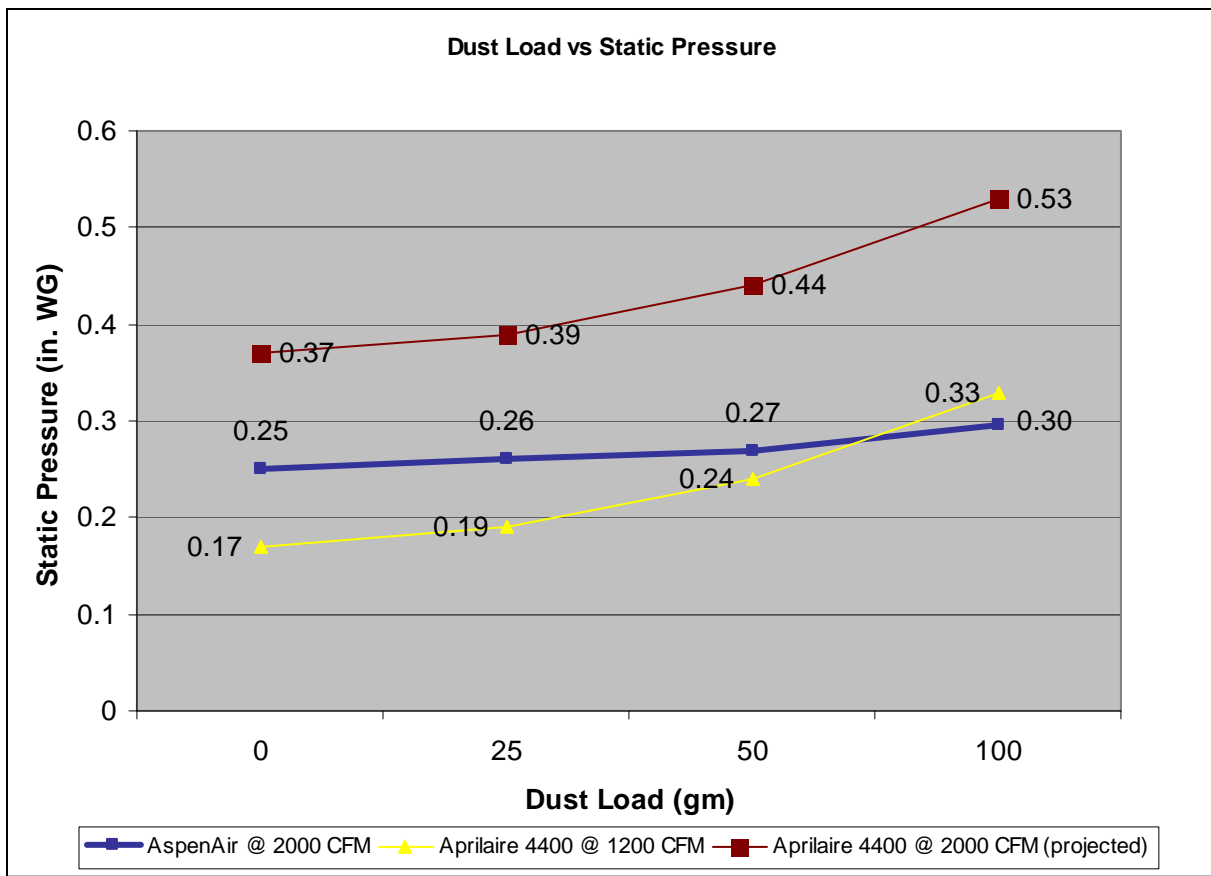
Initial Static Pressure:

A major factor which increases the utility energy cost to the consumer is the resistance to airflow by the filter. The greater the resistance the more money is consumed by additional operation costs. The first factor in this regard would be the initial static pressure across a clean filter (see graph below). As shown in the chart the Aprilaire 4400 shows an average increase of 49% in static pressure as compared to AspenAir at the same airflow. This results in AspenAir delivering approx. 33% more airflow than the 4400 at any given static pressure.



Dust Loading vs. Static Pressure:

The next factor to consider would be the rise in static pressure as the filters load with dust. The graph below shows the AA 4400 published loading curve at 1200 CFM, along with the AspenAir loading curve at 2000 CFM. Had both been tested at the greater velocity it is not hard to see the Aprilaire's static numbers would have increased. To that end we also show what those static levels would have been at 2000 CFM by adding 0.2" to each point (the difference between the AA 4400 at 2000 CFM and at 1200 CFM). This is probably a conservative number, and would be significant, even by adding only 0.1" to each value.



Clearly the static pressure rises on Aprilaire’s filter faster due to increased velocity and as their media begins the process of “face loading” which in effect is the clogging of the media. Their media is roughly 1/8” thick and quickly becomes clogged with material. You’ll notice all three of the dust loading lines end at 100 grams as that is the point Aprilaire recommends the replacement of their media. On the other hand AspenAir’s media is over 2” thick and has tremendous dirt holding properties of over 1200 grams.

Energy Costs:

In addition to energy saved by low operating power as outlined earlier, the difference in static pressure as both filters load drives significant energy costs. Initially through additional fan watts required to keep the airflow constant (if using an ECM motor), and then through reduced BTUs of heating and cooling energy as the ECM motor becomes limited in its ability to overcome the higher static. In the case of a PSC motor the total fan energy increases over time due to decreased delivered BTUs. The reduction of delivered BTUs, as with the AA 4400, results in

longer operational run times resulting in very significant additional energy costs. In other studies comparing AspenAir against filters with much less static pressure levels, AspenAir allowed significant energy savings on both operation energy consumption as well as the energy efficient delivery of heating and cooling. (See Beaman Assoc. Report 8 2009)

Bacterial Kill Rate:

Aprilaire makes no claim toward microbial effect while AspenAir has recently been lab certified showing results of a 98.7% bacterial kill rate within 1 hr. One of our competitors claims multiple bacterial and viral kill rates as well. Though their product charges the particles at 11,000 volts they capture the particles in a media immersed only in a 6,000 volt field. AspenAir's electrical field is 4 times the power, resulting in greater particulate capture rates and a common sense understanding of an equal to or higher total microbial kill rate.

Conclusion:

If one considers the consumer's best interest in mind then the following four criteria must be weighed:

1. Capture Rates for health and comfort
2. Dust Loading vs. Static Pressure (Airflow delivery)
3. Operational Energy Costs
4. Microbial Protection

AspenAir's Nex-Gen technology clearly surpasses Aprilaire's 4400 media by delivering better capture rates, possessing a substantially higher dirt holding capacity, creating significant sterilization effects all the while at a lesser airflow resistance which ultimately saves consumers up to 30% on their heating and cooling utility bills.

Appendix:

- Aprilaire Specification Sheet Models 4200/4400 Form No. 2343 10.21
- Aprilaire Installation Instructions Model 4200 & 4400 Form No. 10007820 3.06
- Aprilaire Owner's Manual Models 4200 & 4400 Form No. 10007821 3.06
- Aprilaire supplemental data sheet from the factory