

# Proposal to Investigate Air Leakage and Conductive Impacts of Central Air Deep Media Filter Boxes and Electronic Air Cleaner Boxes.

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## Research Question:

What are the energy impacts related to air tightness and conduction of central heat and air deep media filter boxes and electronic air cleaner boxes based upon location within a home?

## Code and Background Relevant to Florida:

Florida code accounts for the leakage and conduction of air handlers based upon where they are located within a home. Deep filter boxes are becoming more common and the energy impact is not specifically accounted for filter boxes.

Consumer desire for air filtration media with higher filtration efficiency can result in air filters with more air restriction that may lower air flow rates and increase static pressure of the central system. The market has responded by offering optional filtration media with much more filtration surface area by pleating the media within 4 inch or deeper filter boxes. The manufactured filtration boxes are attached to the return duct system. Currently there is no known published data on the airtightness or R-value of optional central air deep media filtration boxes or electronic filtration boxes. The filter access covers are large and have been observed to have air leakage based on visual inspection.

The Florida Code accounts for energy impacts of ducts and air handler locations. While deep media filtration boxes will only represent a small fraction of the total central system surface area, the energy associated with leakage and conduction may be significant for garage and attic locations. Work by (Withers and Cummings 2006), (Cummings et al. 2002), and (Wastchak and Ueno 2002) found that new installed air handlers (1-2 years old at the time of testing) represented about 11% of the entire central duct system leakage. This amount of leakage existed even though the air handler only represented about 5% of the total system surface area. Therefore, the energy impact of a filter box located in an attic may be significant compared to one located in conditioned space with only modest leakage and very little if any panel insulation R-value. As an example, Cummings et al. 2002 found that air handlers located in south Florida attics would have about 17% increase in cooling conditioning energy and 10% increase in heating energy compared to air handlers located in conditioned space. Air handlers located in north Florida would use about 15% more cooling energy and 19% more heating energy than air handlers in conditioned space. This work was the basis for Florida code modification after the study.

## Scope of Work:

- 1) Determine airtightness and representative R-value (based on material characteristics) of 6 different deep filter boxes.
- 2) Run a total of 12 building energy simulations. Four filter cabinet placement configurations for three locations in Florida will be simulated.
- 3) Write a deliverable final report.

The airtightness of 6 different available deep filter box products will be determined in controlled bench lab environment. Tightness testing will perform a multipoint test to determine leakage flow coefficient and exponents so that a leak rate can be calculated at typical operating static pressure suitable to represent deep filter boxes used in residential applications. Leakage of each unit will be normalized by the exposed exterior cabinet surface area. In cases where there is insulating material on some portions of exposed exterior surface area and not others, the average R-value weighted by exterior area of coverage will be used. Representative R-value will be determined from material characteristics.

Annual space heating and cooling energy simulations will be performed using EnergyPlus to determine the energy impact for deep filter cabinet placement in indoor, garage and attic locations for a north, central and south Florida location. A total of twelve simulations will be performed. The simulation model will account for air leakage into the return duct and duct conduction heat gain.

The annual space heating and cooling energy use of unconditioned outdoor, garage, and attic locations will be compared to that of an indoor located box. This comparison will be used to determine if location of filter boxes should be considered in Florida code in the same way as air handlers are considered.

## Deliverable:

A final report will be prepared that explains the purpose, methods, and results of the research. The final report will provide a summary of test and simulation findings. Recommendations for Florida code changes will be provided if the authors feel it is warranted.

## Budget:

Budget total is \$29,000 and covers all costs for labor, materials, and overhead.

## References

Withers, C. and J. Cummings. 2006. "Air Handlers: An Appliance of Airtight Defiance?" Published in ACEEE Summer Study on Energy Efficiency in Buildings Proceedings. pp 348 -359. August 14, 2006 Pacific Grove, CA.

Cummings, J., C. Withers, Dr. L.Gu, J. McIlvaine, J. Sonne, P. Fairey, and M. Lombardi. 2002. "Field Testing and Computer Modeling to Characterize the Energy Impacts of Air Handler Leakage". FSEC-CR-1357-02. Cocoa, FL.: Florida Solar Energy Center. Submitted to Florida Department of Community Affairs September 23, 2002.

Wastchak, D., and Kohta Ueno. 2002. "Only Testing Will Tell". Home Energy, Jan / Feb 2002. 24-29.