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COMMENTS BY NATIONAL SMACNA

Please see the attached comments submitted on behalf of National SMACNA

Additional submitted attachment is included below.

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.

Tuesday, March 9, 2021
Regarding:
Comments on Draft 2022 Energy Code
Multifamily Restructuring Proposals for 2022
Leak Testing

Proper air leakage specifications for HVAC forced air ducted systems:

For decades, at least as far back as the 1960's, SMACNA has had some form of leakage testing procedure. Originally using a percent to fan flow was used. It did not take long however for the industry to realize that using the percent approach had issues and later to prove it is an incorrect metric.

While searching for a better way SMACNA came across the concept of a leakage class. The documentation indicates this approach was being utilized in Europe so SMACNA began to evaluate the application of a leakage class in the United States. In the early 1970's SMACNA, commissioned a research project to evaluate air leakage from ducts[1].

The test data provided a number of conclusions:

Leakage was in fact a function of pressure (of course we should all know this as it is basic Fluid dynamics)

Leakage was a function of certain attributes in the duct. The type of seams and joints had an impact as well as the amount of any joint or seam. This research led to the removal of several joint types from SMACNA's HVAC Duct Construction Standards as they were shown to be excessively leaky

Leakage was not really a function of duct wall thickness (gage).

Leakage was not a function of flow. This was proven by measuring leakage at a specific static pressure while varying the flow rate.

Almost a full decade later a similar larger scale test was conducted through ASHRAE research, specifically ASHRAE RP 308[2]. SMACNA was recognized as a contributor.

All the above conclusions were also demonstrated to be true although I did not see a flow test.

At the same time (1985) SMACNA published the first stand-alone Duct Air Leakage Test Standard.

The process and methodology have both withstood the test of time. In fact, as we look at non-duct components, we find very similar behavior. Leakage from any component is a function of pressure. Leakage from a given component correlates with overall size or quantity. This correlates with our own research and with research available from manufacturers.

[1]*Measurement and Analysis of Leakage Rates from Seams and Joints of Air Handling Systems – AISI/SMACNA 1201-351/5-71 (1972). AISI and SMACNA*

[2]*Investigation of Duct Leakage - ASHRAE RP-308*. (1985). ASHRAE.

So why is the percent to flow approach still used? Here are some reasons based on my experience. The first is that it is easy to assume and specify a percent. Keep in mind it is not a correct method this would contradict fluid mechanics. I have also seen manufactures use the percent as a marketing tool by advertising a low percent but not fully explaining the conditions of the test. It is easy to skew the percent by assuming a high flow and a low pressure, and this is what is done. The problem is that this creates a false confidence because the test conditions do not reflect typical operating conditions. This is also why picking a test pressure of 25 Pa (~0.1 in. w.g.) and an acceptable leakage of 6% may not represent a "good" system. It depends greatly on the system both in size and operating pressure. Another reason is that the software (models) used in energy analysis treat leakage as a percent. Unfortunately, when these programs were written SMACNA or others with decades of knowledge and experience were not included. This is not a total loss as one can convert leakage class to a percent once enough information about the system is known.

A proper leakage requirement for HVAC forced air systems would include a leakage class and the test pressure would be specified by the designer.

If we use a leakage class of 4 cfm/100ft^2 of duct surface area @ 1 in. w.g. (ASHRAE/SMACNA etc. use this class) and test at the prescribed pressure of 25 Pa (0.1 in. w.g.). Assuming a ratio of cfm/ft^2 of duct surface area between 1 and 5 we get leakage expressed as a percent to be a high of 0.90 % and a low of 0.19%.

If we convert the 6% leakage (let's use 3% assuming half of the leakage is from the duct system) at the prescribed test pressure with the same ratio assumptions that converts to a leakage class of 13.4 up to 67 cfm/100ft^2 @ 1 in. w.g. Well above the allowable leakage of current industry standards (below the performance). Even allowing a more generous but still reasonable leakage class of 6 would be a vast improvement over the current requirements.

Please consider the above information as it applies to the California Energy Codes.

Sincerely,

Mark Terzigni
Executive Director
Market Sector Councils and Construction Technology

[1]*Measurement and Analysis of Leakage Rates from Seams and Joints of Air Handling Systems – AISI/SMACNA 1201-351/5-71 (1972). AISI and SMACNA*

[2]*Investigation of Duct Leakage - ASHRAE RP-308*. (1985). ASHRAE.