

TECH TALK

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Effective Area vs. Free Area

by Dave Fetters

What are *effective area* and *free area* as they apply to grilles, registers and diffusers? What are the differences between these two areas and how are they used in our industry?

Effective area, given the abbreviation A_k (pronounced “A sub k”), is the area of the register, grille, or diffuser in square feet that is utilized by the air flowing through it. This is a calculated figure that can only be determined in our laboratory. It is used in the equation:

$$CFM = \text{Face Velocity} \times A_k$$

It is calculated by carefully measuring the Airflow Rate in Cubic Feet per Minute or CFM, and the Face Velocity in Feet per Minute or FPM. We then divide the Flow Rate by the

Face Velocity (Ft^3/Min) divided by $\text{Ft}/\text{Min} = \text{Ft}^2$. The result is the effective area (A_k) in square feet. Notice that all the units match; that is, both sides of the equation use “feet” and “minutes.” You have seen this relationship before in *TECH TALK* TT-08, and you will be seeing it again in future discussions. The engineering data tables for all of our products are based on this relationship. In use, the actual CFM delivered by one of our products can be determined by measuring the average face velocity and multiplying it times the A_k for that size product found in our catalog Engineering Data.

Free area is the sum of the areas of all the spaces between the bars or fins of a grille measured in square inches. It is sometimes called the

“see-through” area. If you were to measure the area inside the margin of a register face and then subtract out the area of all the bars, free area would result. Free area is different for each style of product. Rarely can a simple reduction in percentage of the listed size be applied to a grille to find its free area. There is no single formula that applies, either. Every product has a different set of input dimensions for calculating free area.

When air flows through the bars or louvers of a product, it is compressed slightly between the bars, and there is some friction as the air makes contact with the bars as it flows past. This has the result of reducing the total area available for the air to pass through. Effective area is usually less than free area for the same product because of these reasons.

If the engineering data of both supplies and returns use A_k , what is the need for free area? The answer is that some velometer manufacturers ask the user to use free area multiplied by the measured instrument reading. (Hopefully, they ask that this area be converted to square feet.)

Some national codes, like the International Mechanical Code and the National Fuel Gas Code, also talk about the square inch “net free area” of grilles used to supply combustion air to gas-fired appliances in enclosed spaces. Again, free areas are commonly asked for and given in square inches, whereas A_k or effective area is always given in square feet. One can convert square feet to square inches by multiplying square feet by 144 (1 square foot = 144 square inches). The reverse is possible by dividing square inches by 144 to get square feet.



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