

VanAir Doors vs. Door Grilles

By: James Higgins, CTO VanAir Design

Summary

Completed in collaboration with RDH Building Science, this study establishes a basis of comparison for the performance of VanAir doors and common door grilles. In the laboratory, the VanAir Standard, VanAir Sound Option, and two door grille configurations (varying in size and fin profile) were tested for airflow performance.

The airflow data presented here can be used by ventilation system designers to determine the suitability of VanAir doors in applications such as offices, washrooms, bedrooms, and laundry closets. Additionally, the results show that door grilles are more restrictive to airflow than generally assumed.

Airflow and Door Grilles

In buildings, mechanical ventilation systems and natural effects (like thermal buoyancy and wind) create differential pressures and drive airflow through rooms. The rate of airflow depends on the pressure as well as the size and shape of ventilation openings and air transfers. Door grilles are inherently restrictive to airflow as they aim to uphold visual separation across a door. To accommodate application specific air transfer requirements, door grilles are commercially available in many sizes, and manufacturers offer various fin profiles.

Ventilation designers specify fresh airflow rates while maintaining the total pressure drop across all air transfers within the system's capacity. For a given ventilation opening, the pressure drop varies with the airflow rate. This relationship is characterized by the Equivalent Leakage Area (EQLA), which is the area of an unobstructed, sharp-edged hole required to produce the same airflow as the ventilation opening in question.

A door grille's % Free Area is the ratio of its Equivalent Leakage Area to Nominal Opening Area. Due to the size and shape of their fins, typical door grilles are assumed to have 50% Free Area.

Highlighted Results:

The results of this study indicate that the VanAir Standard is less resistive to airflow than two 6x10" door grilles, and the VanAir Sound Option is less resistive to airflow than a 10x10" door grille.¹

The two door grille configurations measured exhibited Free Areas of only 40% and 26%.

The nominal ventilation opening areas published for the VanAir Standard and VanAir Sound Option are 140 in² (900 cm²) and 80 in² (515 cm²) respectively, and these are based off a conservative 50% Free Area.

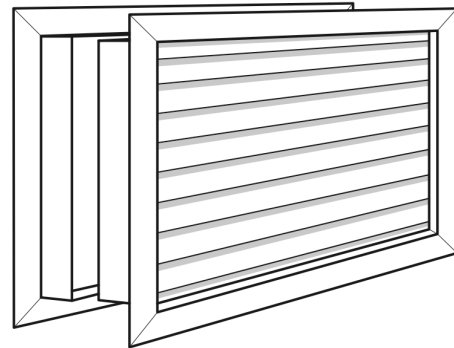


Figure 1 - Typical Door Grille Assembly

Testing Completed by:



¹ L. Ricketts, M. Lisi, J. Tatara, "Airflow Characterization of VanAir Doors and Common Door Grilles," RDH Building Science, Burnaby, British Columbia (2020)

* full report available upon request

Test Method

Two VanAir doors and two door grille configurations were tested: the VanAir Standard, tested without a perimeter seal; the VanAir Sound Option which has a sound absorptive interior lining, tested with a perimeter seal; a door with two 6x10" grilles of inverted V fin profile, tested with a perimeter seal; and a door with one 10x10" grille of inverted Y fin profile, tested with a perimeter seal. These two grille configurations were selected for testing as they are within the range typically specified for offices, washrooms, and laundry closets.

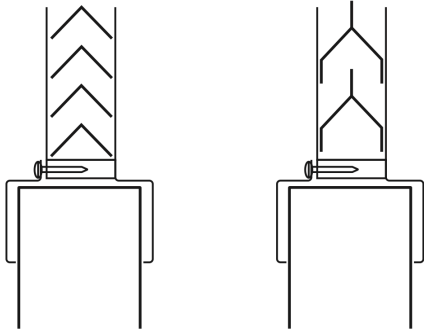


Figure 2 - Cross-Sections of Inverted V and Y Fin Door Grilles

The test apparatus, shown in Figure 3, comprised an air sealed chamber connected to a calibrated measurement fan through a balanced ventilation trunk. The airflow rate was measured at the fan, and differential pressure was measured between the test chamber and ambient air. For each test door, measurements were recorded across pressures of 2-30 Pa. Test methodology is in general conformance with standards ASTM E283² and E779³ and was adapted for applicability to interior air transfers.

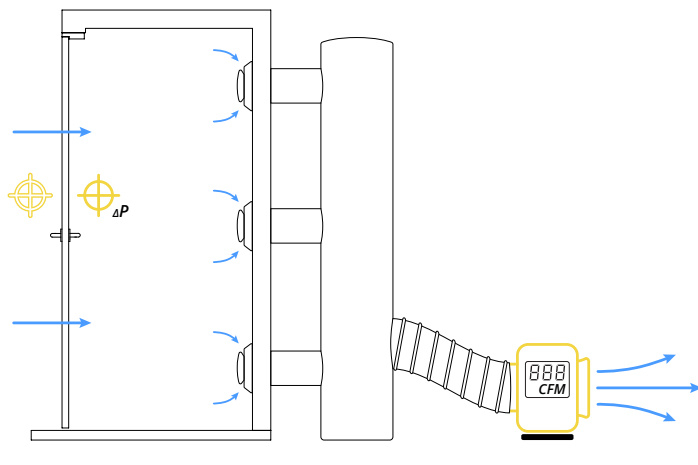


Figure 3 - Schematic of Airflow Test Apparatus

² ASTM International, "ASTM E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen," (2019)

Test Results

Performance metrics:

- Equivalent Leakage Area (EQLA)
- % Free Area (EQLA/nominal opening area)
- Airflow vs. differential pressures across 2-30 Pa

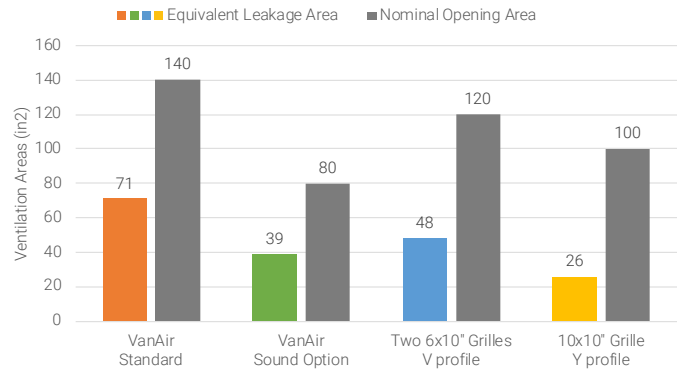


Figure 4 - Measured EQLAs and Nominal Opening Areas

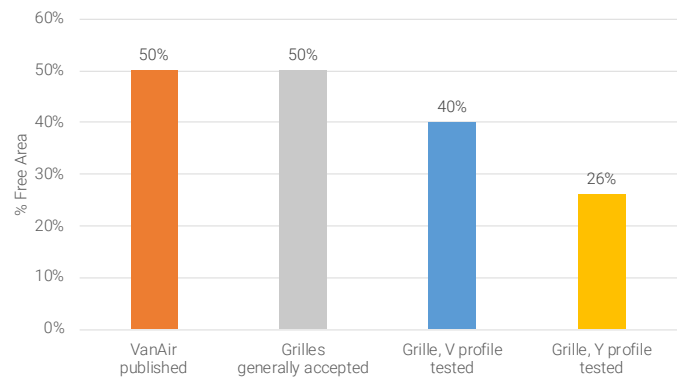


Figure 5 - Calculated % Free Areas

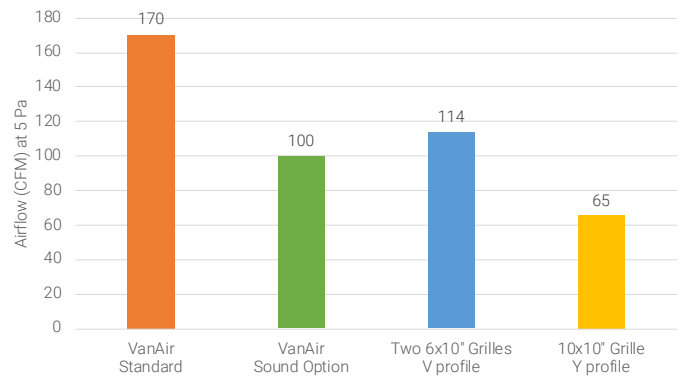


Figure 6 - Measured Airflow at 5 Pa Differential Pressure

³ ASTM International, "ASTM E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization," (2019)

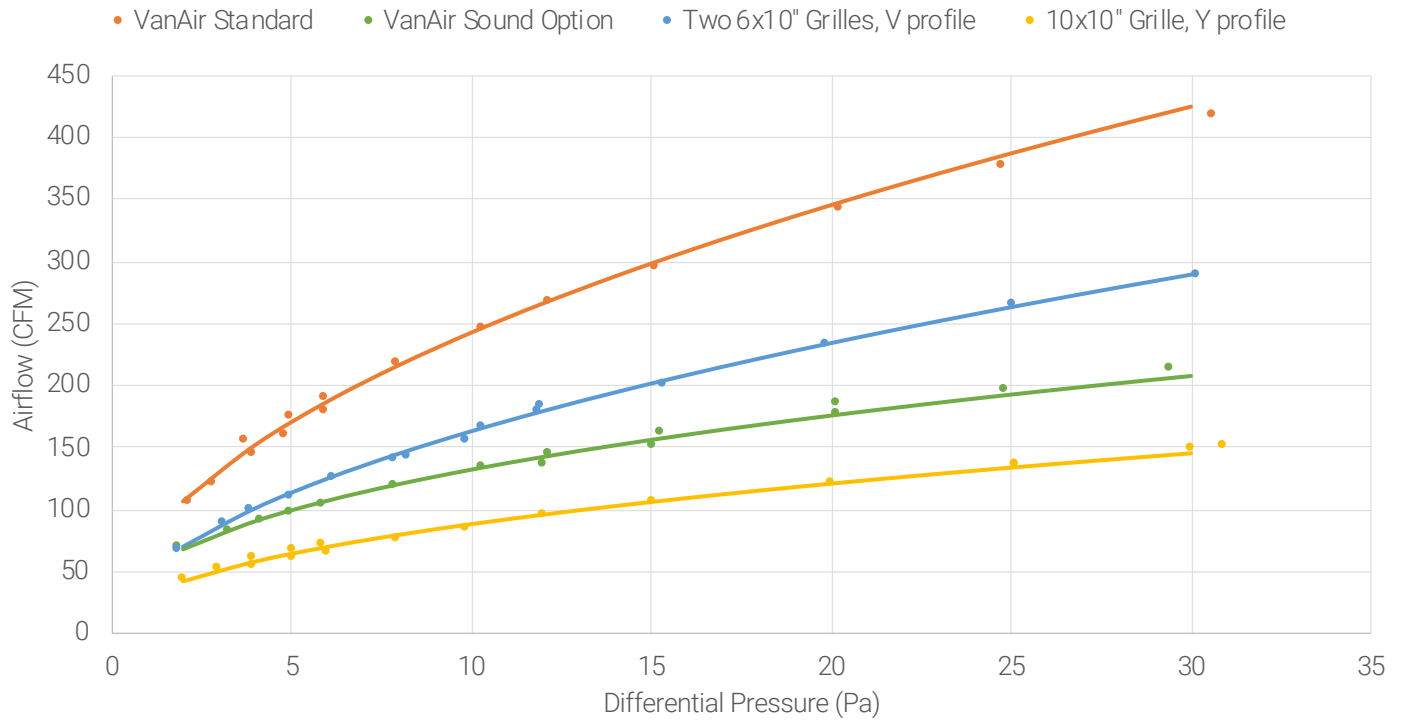


Figure 7 - Measured Airflow vs. Differential Pressure

Test Samples



Figure 8 - Test Samples: VanAir Door, Two 6x10" Door Grilles, 10x10" Door Grille

Test Apparatus



Figure 9 - Air Sealed Chamber and Exhaust Diffusers



Figure 10 - Measurement Fan and Ventilation Trunk

Door samples generously provided by:



Measurement equipment by:



Testing completed by:

