RB-008

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RB-008: CFM Requirements for Outdoor Cooking Ventilation

P2 — Applied

EXECUTIVE SUMMARY

This paper synthesizes the plume physics of RB-001, the velocity decay and capture analysis of RB-003, the hood geometry effects of RB-005, and the wind interaction analysis of RB-006 into a unified, physics-based CFM sizing methodology for outdoor barbecue ventilation hoods. It delivers comprehensive CFM lookup tables for all source types at all standard mounting heights across four wind exposure classes, defines the outdoor correction factor relative to indoor baselines, establishes scaling relationships between cooking surface area, heat release rate, and required CFM, and provides wind exposure safety margins. The primary engineering deliverable is a set of consolidated design tables that integrate exhaust rate, hood geometry, and wind exposure into a single reference for outdoor hood specification.

THE CHALLENGE

The central engineering question for outdoor hood specification is: given a cooking appliance of known heat release rate, a proposed mounting height, a hood of known geometry, and a site with characterized wind exposure, what exhaust flow rate (CFM) must the blower provide to achieve reliable plume capture?

Outdoor Ventilation Standard

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Key Quantitative Findings

RB-005 also quantified the island versus wall-mount CFM differential (1.15-1.25x increase for island installations).

The Exposed value (2.5) is derived from RB-006 Section 3.9.3, which found that increasing CFM by a factor of 2.5 at 8 mph achieves approximately 60% capture without physical wind shielding

For a 5-foot hood over a medium-duty source: CFM_indoor = 5 * 300 = 1500 CFM for a full commercial installation, or scaled to residential duty at approximately 200 CFM/ft, giving 1000 CFM

For a more typical residential indoor range hood of 4 feet at 250 CFM/ft: CFM_indoor = 1000 CFM

However, actual residential practice typically uses the simpler BTU method, yielding 300-600 CFM for 30,000-60,000 BTU appliances.

This weak one-third-power dependence on Q_c means that doubling the heat release rate increases the required CFM by only a factor of 2^(1/3) = 1.26 (26%)

Quadrupling Q_c increases CFM by 4^(1/3) = 1.59 (59%)

Doubling the mounting height increases the required CFM by a factor of approximately 2.83 (183% increase)

Sheltered installation: 727 CFM minimum; specify a 900 CFM blower to provide 24% margin.

Moderate wind exposure: 892 CFM minimum; specify a 1200 CFM blower to provide 35% margin.

Why This Research Matters

This research provides the first physics-based, quantitative methodology for outdoor cooking ventilation design. These findings enable proper hood sizing, CFM specification, and mounting height selection — preventing the common failures that occur when indoor assumptions are applied outdoors.

📄 The Full Research Paper Includes:

✓ Complete derivations and governing equations
✓ Quantitative design tables and correction factors
✓ Engineering methodology with worked examples
✓ Interactive calculation tools and diagrams
✓ Full reference bibliography and validation data