RB-009

P2 — Applied • Version 1.0 • 2025-12-18

RB-009: Side Panel and Wind Baffle Effectiveness

P2 — Applied

EXECUTIVE SUMMARY

This paper provides a rigorous, quantitative analysis of partial enclosure as a wind mitigation and capture enhancement strategy for outdoor barbecue ventilation hoods. It builds on the hood geometry analysis of RB-005 and the wind interaction modeling of RB-006 to derive the effective wind reduction, Effective Capture Area improvement, and Capture Envelope volume expansion provided by side panels, rear panels, and wind baffles across all source types, mounting heights, and wind exposure classes. It establishes minimum panel depth thresholds, identifies negative effects (recirculation zones, combustion air restriction, operator access interference), and delivers consolidated design guideline tables for panel configuration by installation scenario.

THE CHALLENGE

The fundamental challenge of outdoor barbecue ventilation is that the **Buoyant Cooking Plume** must be captured in an environment where ambient wind routinely displaces the plume beyond the hood's geometric coverage. RB-006 demonstrated that a standard hood loses reliable capture at wind speeds as low as 5 mph at cooking height — a condition that occurs routinely in most outdoor settings.

Outdoor Ventilation Standard

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Key Quantitative Findings

RB-006 Section 3.9.2 quantified the rear wall effectiveness at 60 to 80% wind reduction.

RB-006 Section 3.9.5 showed this requires 2.3 to 4.0 inches of additional overhang per mph of wind speed — impractical above 5 mph.

RB-006 Section 3.9.3 showed this provides only partial compensation (approximately 80% capture at 5 mph with 1.8 times baseline CFM) and cannot address the geometric displacement problem.

At 3 to 5 barrier heights downstream, the wind speed recovers to approximately 50 to 70% of freestream

For a gas grill consuming 60,000 BTU/hr (17.6 kW) at stoichiometric conditions, the air demand is approximately 0.018 m^3/s (38 CFM)

At a comfortable supply velocity of 0.5 m/s through the open area, the minimum open area required is:

Baseline Effective Capture Area (baffled, 3" lip, no panels) = 2,266 to 2,568 sq in (75-85%)

Plume cross-section at 30" = 1,320 sq in (41" diameter circle from RB-001 Table 3.6)

Deep panels (f > 0.75) with high wind (> 8 mph). The recirculation zone can extend from the panel's lower edge inward to the plume centerline, creating a vortex that traps contaminant-laden air at the cooking surface level. The trapped gas recirculates between the panel face, the cooking surface, and the plume, delaying its entry into the exhaust.

Wind speeds above 8 mph with panels at f = 0.50 or greater

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