RB-012

P3 — Frontier • Version 1.0 • 2026-02-05

RB-012: Thermal Radiation and Plume Interaction at Hood Surfaces

P3 — Frontier

EXECUTIVE SUMMARY

THE CHALLENGE

The hood canopy is simultaneously exposed to two thermal loading mechanisms:

Outdoor Ventilation Standard

Scan for full research paper

Key Quantitative Findings

Produces identical radiant power (4.40 kW)

Produces 7% more radiant heat flux at the hood (due to slightly different view factor geometry)

Creates a 6% hotter hood surface

Generates a plume with 44% less velocity

Requires 54% less CFM for capture

A hood rated for a medium gas grill at 30 inches (peak 120 deg C / 248 deg F) may fail if used above a high-output charcoal grill at 30 inches (peak 154 deg C / 309 deg F), even though the charcoal grill releases half the total heat.

Galvanized steel hoods marketed as compatible with "grills up to 40,000 BTU" are implicitly assuming gas-grill radiative fractions. If used above a charcoal grill at 30,000 BTU (with chi_r = 0.50 instead of 0.25), the effective radiant loading is 50% higher than the gas-grill assumption, potentially pushing the zinc coating past its degradation threshold.

NFPA 211 (Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances) specifies minimum clearances between heat-producing equipment and combustible materials. For appliance connectors operating at 250 deg F (121 deg C) or higher, minimum clearance to combustibles is 6 inches (reduced to 1 inch with approved heat shields).

At 18 inches, a medium gas grill sees approximately 60% of its upward hemisphere occupied by the hood

At 48 inches, only 18% is occupied

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