Adequate Attic Venting

Q: I live near Houston, Texas, in a two-story, 3,250 ft² home with a 2-ton A/C unit upstairs and a 3-ton unit downstairs. Last summer (our first in this house), the upstairs unit was not able to keep up when temperatures began climbing above the low to mid-90s. There are fiberglass batts in the ceiling joist bays (which appear to be 2 x 6s) in the attic. There are a number of utility chases that are not really insulated well, which I will attempt to remedy. Also, I have begun putting in a radiant barrier, stapled to the underside of the rafters. Because of a hailstorm last May, we have a new roof, with ridge vents replacing earlier power vents. There are some soffit vents, but I intend to put many more in, perhaps at every rafter bay.

I would like to be able to judge the effectiveness of the radiant barrier, and ensure that I have sufficient ventilation (an adequate number of soffit and ridge vents) in the attic. I had thought of doing this by comparing this summer's conditions in the upstairs to those of last summer. Can you give me some idea of what temperatures I should see in a well-ventilated attic in this part of the United States during, for instance, a 90°F or 95°F day? Can you tell me how to calculate how much vent area I need? (I assume that a balance of soffit and ridge vents is optimal?) Is it possible that I might need some sort of powered vent? And if so, would solar-powered vents work well?

—Daniel Williams
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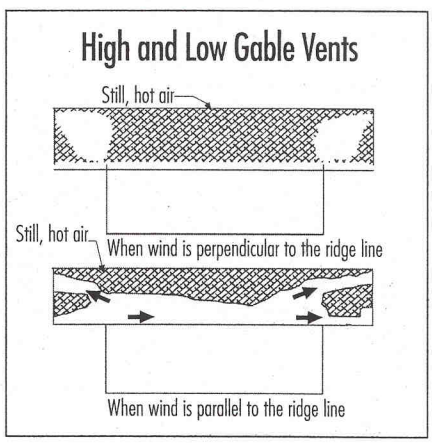
A: Our experimental data, collected in a similar climate (subtropical) and in well-ventilated attics with R-19 and R-30 insulation, under asphalt shingle roofing, indicate that during peak times you should see attic air temperatures in the range of 105°F–110°F if the outdoor air temperature is in the range of 93°F–95°F. These peak attic air temperatures could typically be reduced by an average of 7°F–11°F if radiant barriers are stapled to the rafters in the attic. The larger temperature reductions are observed in the case of the lower insulation level.

For summer heat removal, it is recommended that the attic ventilation rate be in the range of 1.5–2 CFM/ft² of attic floor area. A simple way to calculate the minimum required vent area needed to reach an air flow of 1.5 CFM/ft² of attic floor when ridge vents are used in combination with soffit vents is: *Effective ventilation area (in²) = 1.5 x attic floor area (ft²)* Note that this equation assumes a wind velocity of 7.5 mph.



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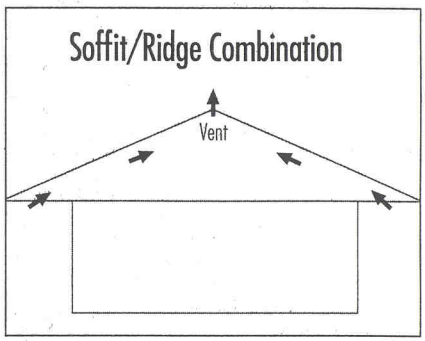
The independent paths created by each individual set of vents are not altered. That is, the patterns for the gable end louvers will remain unaffected just as the airflow pattern for the soffit/soffit combination will.

The most effective way of passively reducing attic air temperatures is with the combination of ridge and soffit vents. Ridge vents provide openings along the ridgeline on the roof, which is the highest point in the attic. Soffit vents provide openings along the lowest point in the attic. This combination of vents allows the attic to sustain a uniform air flow because wind pressures, which result from wind motion around the building, create negative pressures (vacuums) around the ridgeline and positive pressures around the soffit vents; therefore, the soffit vents act as inlets and the ridge vents act as exhausts. Furthermore, the natural stack effect is better optimized with this vent arrangement than with any other, thus allowing faster air changes.



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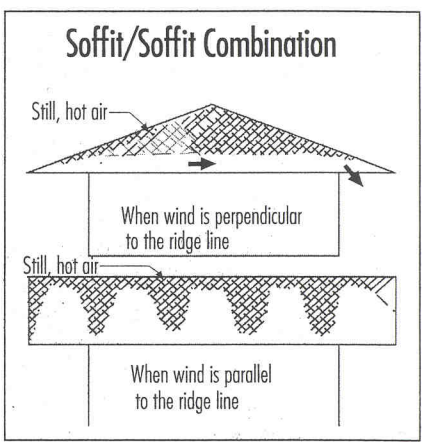
The ridge vent provides a continuous opening along the entire ridge line of the roof, which is the highest point in the attic; while the soffit is at the lowest. The thermal effects, as well as the pressure effects, have a greater impact than in any other combination, thus providing faster air changes.



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When soffit vents are used alone, approximately 70% of the total volume of air moves in an area within 4 inches from the floor. There is no substantial ventilation through the attic, the deck temperature remains relatively high, creating larger radiation energy transfer to the attic floor.