# Attic Ventilation
## for Summer Cooling

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Attic ventilation has been used for years to cool homes. It offers a relatively inexpensive approach to summer cooling and satisfies the desires of those who prefer natural ventilation. However, in recent years, many families have turned to air conditioning to provide summer comfort in home living areas.

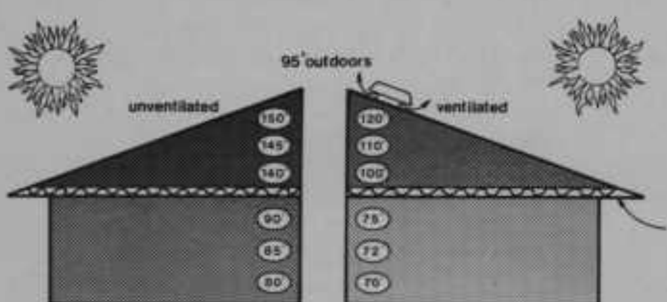
Current concerns over energy supplies and energy costs have refocused emphasis on the need for effective ventilation of attics in residences to help keep air conditioning requirements to a minimum. Even for homes without air conditioning, attic ventilation offers a very low-energy, low-cost approach to improving summer comfort in living areas.

To intelligently select an attic ventilation system for a particular home, one must take into consideration related factors which influence the choice. These include physics of heat buildup in attic, daytime and nighttime temperatures for locality, average nighttime humidities, air contaminants such as dust, fumes and pollen, and family living habits and preferences.

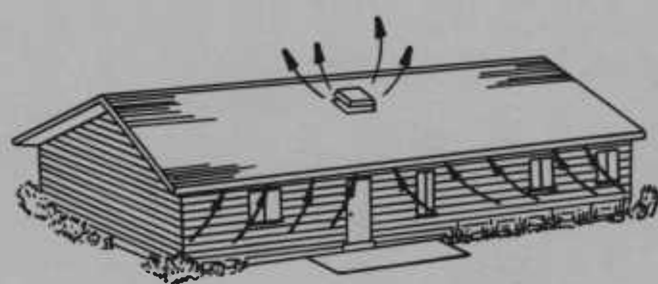
### Attic Heat Buildup

The principal source of summertime attic heat buildup is direct sunlight on the roof. Actually, the attic acts as a heat trap. Like an automobile which is closed but exposed to summer sun, an unventilated attic builds up tremendous temperatures—at least 25 degrees or more above outside air temperatures, and at times reaching extremes up to 150° F during 90-100° outdoor temperature ranges. During these high temperatures, structural members of the attic absorb sizable amounts of heat. Even on cloudy days, there is an appreciable amount of heat transmitted through a roof to attic space and structural members.

When the sun goes down, the source of heat disappears. However, heat stored in the structural members of the attic must be re-radiated through the roof to the outside air. Also, in addition to radiating heat to the outdoors, part of the trapped attic superheat penetrates through to the living area—the attic acts as a large, overhead radiant heating unit. This radiated heat results in temperatures which can be uncomfortable for occupants long after the sun has set and the outdoor temperature has dropped. Removing stored heat from the attic is one of the most important steps to offset this condition. Natural ventilation systems—roof vents, gable louvers, ridge vents, etc.—seldom move enough air from the attic to reduce built-up heat during night hours unless there are relatively strong winds. The most satisfactory system is a fan and inlet combination to provide positive mechanical ventilation of the attic area.




*Unventilated attics can build up temperatures reaching 150° F during a hot, sunny day. This trapped heat radiates to rooms below, creating uncomfortably hot conditions and imposing heavy cooling loads on air conditioners.*



*Attic area ventilation flushes hot air out of attic and replaces it with cooler, outdoor air. No air is drawn through living area.*

Attic fans exchange inside air for outside air. They are effective whenever the temperature inside the area to be ventilated is warmer than outside temperature. Basically, there are two attic fan arrangements:

1—Ventilation of attic area only

2—Ventilation of attic area during heat of day and "whole house" ventilation through attic during cooler periods.

In both arrangements, an insulated ceiling is essential for most satisfactory results. The ceiling area (attic floor) should be insulated to a value of R-19 or greater. Loose-fill ceiling insulation, especially any located near an inlet or exhaust opening, may need to be covered with screening or batt insulation to prevent its shifting by the flow of air generated by some fan arrangements.

### Attic Area Ventilation

The simplest and least expensive attic fan system ventilates only the attic area. Flushing out trapped heat from the attic with some positive air movement system will enable air conditioners to work more efficiently—or will make living areas of non-air-conditioned homes more comfortable during hot weather. This system does

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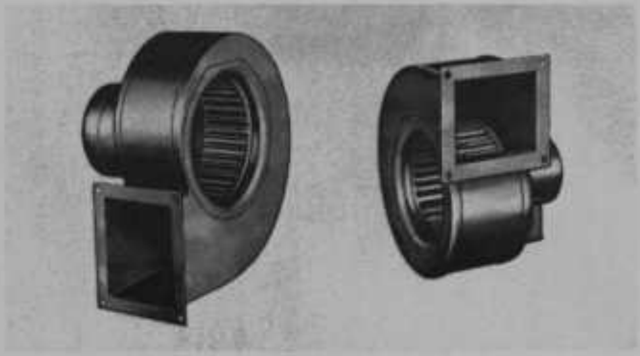
not bring outside air carrying pollen or dust into the living area of the home. It is most effective for helping to cool upstairs rooms or rooms located immediately below the attic area where unwanted overhead radiant heat adds to the load on the air conditioner and also adds to the discomfort of everyone in those rooms. In homes where downstairs rooms are comfortable but upstairs bedrooms are a bit too warm, with or without air conditioning, this type of attic fan installation may alleviate the problem.

## Types of Fans

There are two basic types of fans used for attic area ventilation. They are propeller or axial, and centrifugal or radial—sometimes called "squirrel cage." The latter is often referred to as a blower. Attic area ventilation fans are all small in size, low in energy requirements and very quiet since they usually run at relatively low speeds.

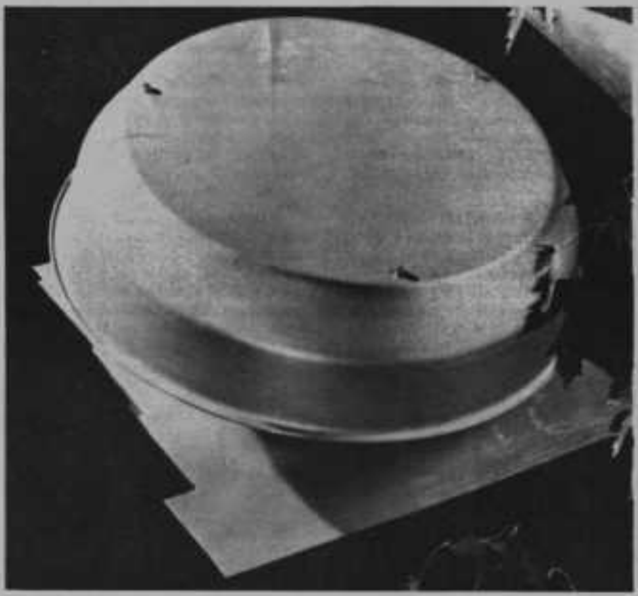
All fans create noise from air movement over the fan blades and noise intensity increases with blade tip speed. For attic fan installations, low-speed fans should be selected to keep noise levels as low as possible. Also, the fan and/or motor-fan assembly should be mounted on rubber or springs to decrease vibration.



*Centrifugal or radial fans, with slow-speed motor as an integral part of the assembly, provide a very efficient, quiet-operating system at a slightly greater investment cost.*

## Fan Ratings and Selection

Selecting the correct-sized attic space ventilation system is made relatively simple by standards and certified performance ratings supplied by the Home Ventilating Institute (HVI)—a recognized quality control association which tests and certifies air delivery of powered ventilator assemblies designed specifically for attic installation. The testing is done under contract by an independent laboratory at Texas A & M University. Fans designed for direct discharge as through a wall are tested at a minimum of 0.03 inch water column static pressure. Fans designed to push air through ducts are tested at 0.10 inch static pressure. (Static pressure is a base air resistance condition used to evaluate fan performance. Fans rated without a duct or housing at "free air" delivery or 0.00 inches static pressure can be expected to perform at only about 75% of rated capacity when actually mounted in a duct or housing and installed in an attic wall or roof for ventilating purposes.) The air-moving capacity of fans rated at "free air" or low static pressures will also be greatly reduced when discharging air against prevailing winds blowing towards the fan discharge. For example, the air-moving capacity of a fan designed to operate against 0.03 inch static pressure will drop to near zero when opposing winds of about 8 mph.



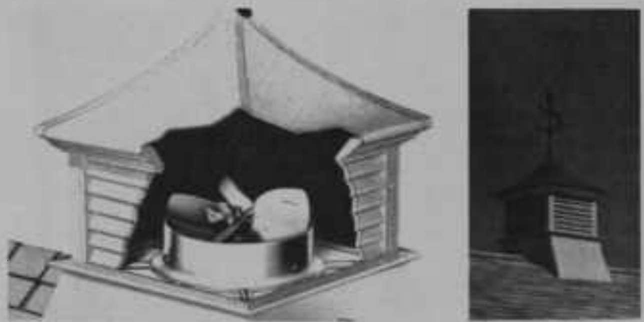
*Roof-mounted attic fan should be centered on roof, near peak. These units fit between rafters, come in sizes from 500 to 1800 CFM (rated at 0.03 inch static pressure) with 1/15 to 1/4 hp slow-speed (1025-1550 RPM) motors. Hood is molded fiberglass, high impact thermostyrene plastic or aluminum. Hood has built-in insect screen and is wind, rain and snow proof.*

## Fan Size

The Home Ventilating Institute recommends a minimum of ten changes of attic air per hour. Their general recommendation calls for a fan capable of actually moving *.7 CFM (cubic feet per minute) of air for each square foot of attic floor space—plus a 15% increase in capacity for dark roofs or attics with roof pitches of 7:12 or steeper.* If both conditions—steep roof and dark shingles—exist, increase capacity by 30%. For example, a 1200-square foot attic would require 0.7 x 1200 or 840 CFM of actual air movement. If the roof has dark shingles or steep slope, increase by 15% or 840 x 1.15 to give 966 CFM; if both dark shingles and steep roof, increase by 30% or 840 x 1.30 to give 1092 CFM.

## Fan Placement

The powered attic space ventilator (fan) may be installed in the attic roof, near peak and centered, or in a gable or attic end wall. Vertical wall installations should be screened to keep out insects and equipped with self-closing louvers to keep out rain and snow. Do-it-yourselfers often find the wall installation easier than the roof, where considerable care must be exercised to properly install flashing to prevent roof leakage.



*Cupola-mounted attic fan assemblies, made of bronze-colored ABS thermoplastic with redwood louvers, are available for new or existing homes lending themselves to such roof decor.*

## Air Intakes

Air intakes must be installed to provide ample air supplies to match air movement. A general rule is to provide *one square foot of free opening for each 300 CFM of air intake.* The air openings may be installed along soffits or in a gable opposite the fan location. Intakes should be as near attic floor as possible and must be screened to keep insects out of the attic area. Vertical wall inlets must have louvers to keep out rain and snow. Areas prone to drifting snow conditions often pose a problem since it is difficult to design a fixed louver which will keep out drifting snow.

*Wall-mounted attic fan is installed on end wall or gable of attic. These units fit between studs, come in sizes from 600 to 2100 CFM (rated at 0.03 inch static pressure) with 1/15 to 1/4 hp slow-speed (1025-1550 RPM) motors. Self-closing louvers need no insect screen; fixed louvers should have insect screen.*

## Fan Controls

Ideally, the attic fan should be controlled such that it operates continuously whenever summertime attic temperature is higher than that of outside air. This can be accomplished by using a differential thermostat which senses attic temperature and outdoor temperature. Many installations are controlled by a single thermostatically-operated switch set to turn fan on when attic area temperatures reach 85 to 95° and turn fan off when attic has cooled to a point below that temperature. A time clock switch may be substituted as an alternative type of control. It should be set to turn fan on when attic temperatures can be expected to build up in mid-afternoon and turn fan off during the night several hours after sundown.

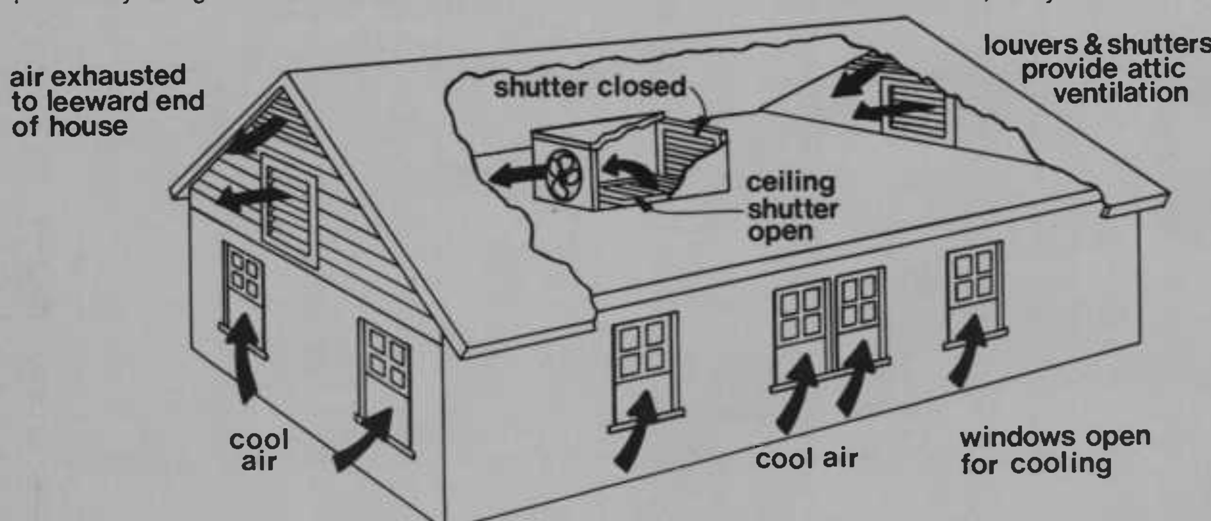
By using a humidistat control independently of or in parallel with a thermostat or time clock control, an attic fan will remove excess moisture from the attic at any season of the year, particularly during winter months, when high attic humidity levels can develop and moisture condensation becomes a problem. The humidistat control will operate fan only until excess moisture in attic is removed.

As a fire safety measure, many localities now require an Underwriters'-approved thermal switch mounted in the air stream and wired in series with fan motor. It automatically stops fan should attic air temperature rise above temperature rating of switch—usually 200-204° F.

## "Whole House" Attic Ventilation

For optimum summer cooling of a house with outside air, the most effective procedure is an attic ventilation system designed for dual usage. It ventilates the attic during hot midday periods, and ventilates the living areas at night or whenever outside temperatures drop below indoor room temperatures by drawing cool outside air through open windows into the living area to provide "whole house" ventilation and cooling. In some areas nighttime humidities are sufficiently high to be objectionable if drawn into the house all night long. In such cases a timer may be used to turn fan off at a predetermined hour.

When a house has been cooled at night in this manner, windows and doors should be kept closed the next day as long as inside temperatures are cooler than outside temperatures. An attic ventilation system cannot cool the living area to a temperature lower than outdoor air. However, moving air creates a more comfortable condition than still air in warm, stuffy rooms.




*"Whole house" ventilation system draws cool outdoor air into living area of house through open windows and exhausts warm indoor air through attic vents, thus also flushing hot air from attic. Be sure windows are open before starting fan. Same system can be used for flushing attic only by closing ceiling vent.*

## Fan Types and Selection

Fans for "whole house" attic ventilation systems are almost always of the propeller or axial type. They may be mounted directly on the motor shaft or belted to the motor. The latter type is most commonly used.

The size of fan required for a "whole house" attic ventilation system depends on volume of the house in cubic feet and number of air changes needed per minute or hour. Generally, the fan should change air in the house every minute in areas where night air temperatures do not drop much below 75° F. At least one air change every 1½ or 2 minutes is required in areas with cooler night temperatures or where evening temperatures drop very rapidly, even though extreme heat levels are reached during the daytime. The map shows recommended air changes for attic ventilation systems.

The fan should be sized for "whole house" ventilation—it will then have ample capacity to remove accumulated heat from attic when used in that mode.

To determine proper fan and louver size:

- Determine volume of living area to be cooled—multiply floor area by ceiling height to obtain cubic feet of space. (Be sure to include all hallways, stairwells, closet areas, etc., as well as major rooms.)

*Vertically-mounted fan can be ducted for either "whole house" ventilation or flushing air from attic only. These units come in sizes from 16 inches to 42 inches in diameter and are usually belt-driven by 1/4 to 1 hp continuous-duty motors. CFM ratings should be at 1/10 (0.10) or 1/8 (0.125) inch static pressure.*

*Horizontally-mounted ceiling fan with accompanying shutter can be used only for "whole house" ventilation. Specifications are similar to vertically-mounted units. Vertically-mounted motor and fan must be equipped with thrust or ball bearings. Shutter area should be carefully covered during winter months with vapor barrier-protected insulation to reduce heat loss and moisture migration to attic.*


*Recommended air changes for "whole house" attic ventilation systems.*

- If you live in dotted area of map, divide total cubic footage by 1.5; if in undotted area, your minimum air movement in CFM will be the same as cubic feet of space since one air change is required every minute.
- Select fan with a CFM air movement capability as large or slightly larger than calculated size to allow for possible differences in fan test procedures and efficiencies. (Be sure to use a 0.03 inch static pressure or greater fan rating, not a "free air" rating.) Remember, low-speed fans operate more quietly.

Approximate inlet and outlet opening sizes for various fans are listed below as a guide for matching fans and louver openings.

**"Whole House" Attic Ventilation Systems**

| Fan Size* CFM | Motor hp | Ceiling Louver** Sq. Ft. | Outlet Opening*** Sq. Ft. | | |
|---|---|---|---|---|---|
| | | | Metal Louver | Wood Louver | Soffit Vent |
| 5,000 | ¼–⅓ | 7 | 10 | 12 | 9 |
| 7,500 | ⅓ | 10 | 15 | 18 | 13½ |
| 10,000 | ½ | 14 | 20 | 24 | 18 |
| 12,500 | ½–¾ | 17 | 25 | 30 | 22½ |
| 15,000 | ¾–1 | 20 | 30 | 36 | 27 |
| Over 15,000 | Use multiple fans | | | | |

* Rated at 0.03 inches or higher static pressure
** Net self-closing metal louvered area, no fly screen
*** With 16-mesh fly screen

NOTE: Outlet openings, particularly those on vertical walls, should be on leeward side of house for best performance.

To avoid attic condensation and roof glaciering problems during winter with an uninsulated attic, louvered ceiling openings to attic should be covered with vapor barrier-protected insulation to prevent heat and warm moist air from migrating into the attic. Such moisture may wet ceiling insulation, reducing its value as an insulator. Also, a warm, uninsulated attic may cause glaciering of ice at eaves and valleys which often seeps under the flashing, causing ceiling stains, rotting of roof decking and delamination of plywood. During prolonged periods of subzero temperatures, if attic is not properly ventilated, frost may freeze on bottom of roof deck. As this frost melts, water drips down into ceiling insulation and creates stains on or damage to ceiling.

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