Ceiling Fans (ENERGY STAR)

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Scope

Install efficient ceiling fans such as ENERGY STAR® rated ceiling fans, to provide efficient supplemental cooling.

- Follow local code requirements.
- Measure the room and select an appropriately sized fan for the space.
- If the fan will include a light kit, install energy efficient LED or CFL bulbs.
- Provide ceiling fan documentation to the home owners to ensure proper operation and maintenance.

See the **Compliance Tab** for related codes and standards requirements, and criteria to meet national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.

Description

Two-thirds of American households now have ceiling fans. Sales to do-it-yourselfers account for a brisk and growing business at home improvement centers. A 2011 **Home Energy Magazine** article claims that it is not uncommon for builders to install ceiling fans in nearly every bedroom and living area of many new homes.

Ceiling fans are electrically powered, ceiling-mounted fans that create air movement which can encourage evaporation and make people feel cooler. Research has shown that, during warm weather, the thermostat can be raised as much as 4°F with no noticeable reduction in comfort if a ceiling fan or other source of air flow is present (U.S. DOE. **Fans for Cooling**).

Ceiling fans can supplement traditional HVAC systems, but cannot duplicate the wide range of functions HVAC systems perform. While they can circulate the air, they cannot heat, cool, filter or dehumidify it, and they do not provide ventilation.

Ceiling fans can be installed in rooms with ceilings that are at least eight feet high. For optimal airflow, they work best when the blades are 7 to 9 feet above the floor and 10 to 12 inches below the ceiling. They should be installed so their blades are no closer than 8 inches from the ceiling and 18 inches from the walls.

When purchasing ceiling fans, homeowners should consider ENERGY STAR certified models. Fans that earn the ENERGY STAR label use advanced technologies to move air 20% more efficiently, on average, than standard models. In addition, ENERGY STAR certified ceiling fan/light combination units are 60% more efficient than standard units. Energy efficient motors, advanced blade designs, fan optimization, efficient lighting, and modern controls are some of the technologies separating ENERGY STAR certified models from standard ones. Installers should use energy-efficient light kits on fans that specify lighting. “Smart” controls can also improve performance and provide additional comfort and convenience to occupants.

Performance: Components that Count

The following components and factors all affect ceiling fan performance.

ENERGY STAR Rating
To simplify the selection process, select an ENERGY STAR-rated ceiling fan, which must meet several performance criteria to qualify for the ENERGY STAR designation. If the home owner chooses a fan that is not ENERGY STAR rated, review the manufacturers’ performance data and select one that has a high airflow efficiency-to-low watt ratio. This number can be manually input into energy simulation software, such as Energy Gauge, RemRate, etc., to determine the impact of the actual chosen fan in lieu of a default number (i.e., average). The airflow efficiency is the ratio of airflow divided by power at a specific residential ceiling fan setting (low, medium, high, etc.) expressed in cubic feet per minute/watt (CFM/watt). Most software allows manual input of this data, and for typical use the “medium” value is recommended.

Lighting
It is important to also ensure that optional light kits on ceiling fans are ENERGY STAR rated or meet efficiency goals. About 80% of the possible savings from a more efficient ceiling fan are due to more efficient lighting. New fans with lights installed should contain ENERGY STAR-labeled LED or CFL lighting. The designs with built-in ballasts and pin-based fluorescent lamps are typically more efficient than ones with screw-based compact fluorescents, but both are better than incandescent lamps. ENERGY STAR-labeled lighting, in most cases, will reduce a fan’s total lighting energy use by 60% to 80% compared to incandescent bulbs and will lessen the need to change light bulbs as often.

Motor
Basically, there are two types of ceiling fan motors: those with sealed and lubricated ball bearings and those with bearings that rotate in an oil bath. Lubrication provides smooth operation and contributes to the longevity of the motor. Motors with sealed bearings require little or no maintenance whereas motors with oil baths need occasional service, such as adding oil. High efficiency fans use permanent magnet motors and are 3-5 times as efficient as standard ceiling fan motors (which are only about 10% at medium speed). Fans with these efficient motors tend to be more expensive, but they draw 9 watts or less at medium speed as opposed to 30-40 watts for a standard ceiling fan motor.

Motor Grade

- Performance Grade fans use larger and more powerful motors that are designed for continuous use and quiet operation. These are usually the most expensive models.
- Medium Grade fans are suitable for operating 12 hours or less per day.
- Moderate or Economy Grade fans work best in rooms with 8-foot ceilings, running no more than 8 hours a day. These are the most inexpensive ceiling fans.

Motor Housing
The housing is the decorative body of the fan that encloses the fan motor. Fans that use heavier materials, such as die cast metals, tend to vibrate less for housing, provide more stability for longer down rods, and provide a good surface for high quality finishes.

Other features that ensure longevity and quiet operation include heavy-duty windings, precision engineering bearings, and shock-absorbent internal components. These features are commonly found in more expensive ceiling fan models.

Blade
Pitch is the angle of the fan's blades, and it is measured in degrees. Higher blade pitches usually move more air, which is given in

cubic feet per minute, or CFM. However, blade pitch alone does not determine air movement. Other factors such as the motor design and speed, as well as blade design, material, number, and length can contribute to the amount of air movement. Higher pitch is NOT always better — some models offer a higher blade pitch to compensate for a smaller, less efficient motor.

Blades should be sealed from moisture to prevent warping, bubbling, or peeling. Some manufacturers offer special coatings on metal finishes to prevent scratches or tarnishing. High-quality blades are weighed and balanced prior to shipment and come in factory-matched sets. For this reason, they cannot be switched out with other fans. For flexibility in design, a number of manufacturers offer a variety of blade styles and finishes for a particular fan. However, changing the blade style could affect the performance of the fan.

Controls

Most residential ceiling fans (and all ENERGY STAR-qualified fans) feature the ability to reverse the motor and airflow direction, allowing you to operate the fan year-round. This control is usually found on the fan's switch housing. In the winter, reverse the motor and operate the ceiling fan at low speed in the clockwise direction. This produces a gentle updraft, which forces warm air near the ceiling down into the occupied space. Remember to adjust your thermostat when using your ceiling fan — additional energy and dollar savings could be realized with this simple step.

Smart/Remote Controls

Conventional fans use pull chains or rotary wall switches, which are often unintentionally left on even when no one is home. A ceiling fan can only improve comfort if someone is there to feel its air motion. Some ceiling fan models come equipped with smart controls that can increase the energy savings and comfort potential of the fan. A 360-degree infrared motion sensor automatically activates the fan when anyone enters a room and turns the fan off when occupants have left the room. There are also smart controls (Figure 1) that can be easily installed into existing fan canopies. These controllers can be used to adjust fan speed, lights, and light dimming. These functions can be controlled wirelessly via a handheld remote controller or wall keypad. However, some smart controls may not be compatible with fans that have remote controls built into the motor.

Figure 1. Remote control for a ceiling fan.

Sizing and Clearance

Choosing the right size fan is the first step to optimizing air distribution. Ceiling fan blade-spans range from 29-54 inches – the most popular being the 52-inch model. To determine which size you need, measure the room where the ceiling fan will be installed and follow these guidelines from the **American Lighting Association**:

Room Dimensions	**Suggested Fan Size**
Up to 75 ft2	29 - 36"
76 - 144 ft2	36 - 42"
144 - 225 ft2	44"
225 - 400 ft2	50 - 54"

For maximum performance, ceiling fans should be installed, or mounted, in the middle of the room; they should be at least 7 feet above the floor, 18 inches from the walls, and 6 inches from the ceiling. The report **Fans to Reduce Cooling Costs in the Southeast** by the Florida Solar Energy Center (FSEC) shows that circulation increases when the blade-to-ceiling clearance increases. Six inches is a bare minimum because fan performance drops sharply when the blade-to-ceiling clearance is less. FSEC tests also show that “ceiling hugger” fans provide 40% less air flow than standard ceiling fans, even when a 6” clearance is maintained. Thus, standard ceiling fans with an 8-10 inch blade-to-ceiling clearance are recommended. If ceiling height allows, install the fan 8-9 feet above the floor for optimal airflow.

Larger ceiling fans can move more air than smaller fans. Small- and medium-sized fans will provide efficient cooling in a 4- to 6-

foot diameter area, while larger fans are effective up to 10 feet. Fans with larger blades can also provide comparable cooling at a lower velocity than those with smaller blades. This may be important in areas where loose papers or other objects will be disturbed by a strong breeze. Multiple fans work best in rooms longer than 18 feet.

Mounting System

The ceiling fan mounting system is an important consideration during the selection process. There are four common mounts for ceiling fans.

- **Standard mounts** have a downrod of 3 to 5 inches. The downrod is the metal pipe that extends from the ceiling bracket to the top of the fan.
- **Extended mounts** are viable for hanging the ceiling fan at the desired height of 8 – 9 feet from the floor in homes with tall ceiling heights. Downrods can be purchased from 6 inches (9 ft ceiling) to 120 inches (20 ft ceiling) and typically have a diameter of either 1/2 or 3/4-inches.
- **Flush mounts** anchor the ceiling fan directly against the ceiling. Most standard fans can be installed as a flush mount, though manufacturers sell “hugger” or “low profile” ceiling fans designed specifically for this purpose. Hugger fans are ideal for rooms that have ceilings under 8 feet in height or in situations where a fan with a light fixture would hang down too low. Hugger fans will not move as much air as regular fans because the blades are closer to the ceiling.
- **Sloped mounts** are used for angled or vaulted ceilings.

How to Install an ENERGY STAR Qualified Ceiling Fan

1. Size the ceiling fan according to the construction document and maintain a minimum of 8-10 inch clearance from the ceiling (Figure 2).

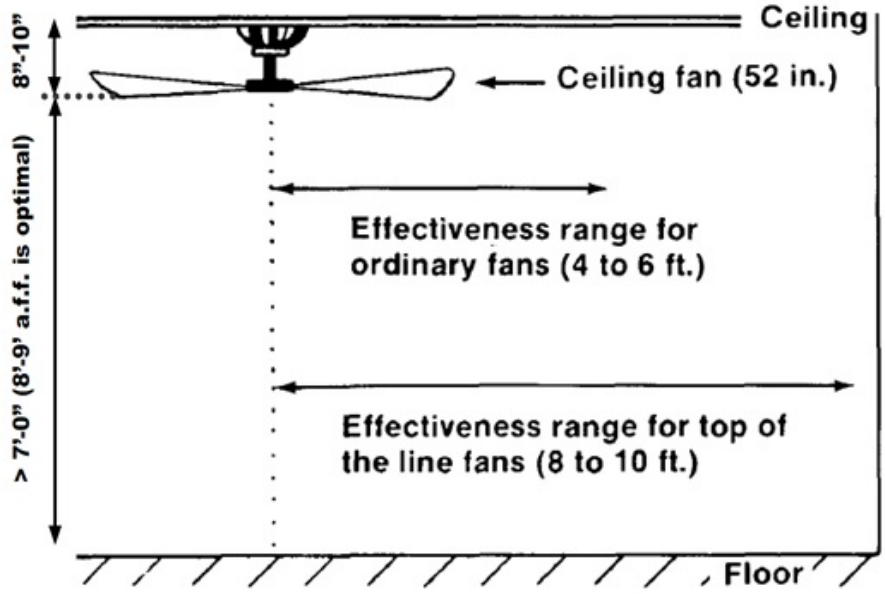

Figure 2. Installation dimensions for which ceiling fans are effective.

2. Choose an ENERGY STAR-qualified ceiling fan (and light kit if applicable).
3. Install the ceiling fan according to all local codes. Install per manufacturer’s instructions. Ensure that the mounting box can handle the weight of the fan.
    - If the ceiling fans box isn't labeled for weight, it is allowed to support a fan up to 35 pounds. If the box is marked with a weight, it can support a fan up to that weight, but not more than 70 pounds. Ceiling fans more than 70 pounds must be supported independently of the outlet box. Check the manufacturer’s installation instructions and make sure to purchase an approved electric ceiling box for the ceiling fan.
    - Make sure to use the appropriate UL-rated electrical box for the ceiling fan. The outlet box should be marked “for use with ceiling fans.” The box is mounted on the ceiling where the fan is attached, and houses all wiring needed to operate and connect the fan.
4. Test the fan for wobble after installation and fix if necessary.To help prevent or correct a wobbling fan:

- Choose the right size and location for the ceiling fan.
- Optimize clearances.
- Choose the appropriate mounting system.
- Choose ceiling fans rated for wet and damp locations if installing in areas of high humidity.
- Specify an ENERGY STAR-certified fan or one that meets ENERGY STAR performance criteria and testing requirements. (This information can be obtained from the manufacturer.)

5. Leave fan product information with the homeowner to encourage proper operation and maintenance. During winter months, the ceiling fan's circular direction should be reversed to draw air upward and recirculate warm air that has settled to the floor. During summer/spring months, the ceiling fan should circulate air downward, thus circulating air from ceiling vents down and outward. Ceiling fans blades should also be cleaned regularly.

Ensuring Success

Builders are encouraged to verify performance data for ceiling fans using manufacturers' specifications and/or the **ENERGY STAR Product Finder website**. Installers should test the operation of the fan before leaving the site to ensure fan does not wobble.

Climate

In moderate and cold climates with moderate humidity levels, ceiling fans, possibly in combination with opened windows, may provide all the cooling that is needed; thus alleviating the need for compression cooling.

Even in hot-humid climates, ceiling fans may produce enough of a cooling effect to put off the need for air conditioning during the shoulder seasons.A study by the Florida Solar Energy Center, **Are Energy Savings Due to Ceiling Fans Just Hot Air?** confirmed that occupants will tolerate a higher thermostat setting when provided a breeze. This effect can significantly impact energy bills. The Florida research showed that for every 1°F the thermostat setting is increased, cooling energy use is decreased by 10%-15%.

Training

Right and Wrong Images

Display Image: HVAC764_Fan_too_close_wrong(2)_LBL_10_3_14.jpg

Display Image: HVAC764_ceiling_fan_right(2)_FSEC_10_3_14.jpg

CAD

None Available

Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

DOE Zero Energy Ready Home (ZERH) Program

The U.S. Department of Energy's Zero Energy Ready Home requires that builders install home HVAC equipment that meets the criteria shown in Exhibit 1 of the **DOE Zero Energy Ready Home National Program Requirements**, Mandatory Requirements, Item 5 Lighting & Appliances, that all installed bathroom ventilation and ceiling fans are ENERGY STAR qualified.

ENERGY STAR Certified Homes

The **ENERGY STAR for Certified Homes National Program Requirements** state that "where refrigerators, dishwashers, ceiling fans, or exhaust fans are installed, products shall be ENERGY STAR certified." In addition, for the prescriptive path:

- The ENERGY STAR Advanced Lighting Package (ALP), which requires a minimum of 60% ENERGY STAR certified hard-wired fixtures and 100% ENERGY STAR certified ceiling fans, where installed, may also be used to comply with the lighting requirements.

Ceiling fans must meet **certain criteria** to earn ENERGY STAR qualification.

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

None Available

References and Resources*

1. **DOE Zero Energy Ready Home National Program Requirements**
   Author(s): Department of Energy
   Organization(s): DOE
   Publication Date: April, 2017
   Standard requirements for DOE's Zero Energy Ready Home national program certification.

2. **ENERGY STAR Certified Ceiling Fans for Consumers**
   Author(s): U.S. Environmental Protection Agency
   Organization(s): EPA
   Publication Date: October, 2014
   Website providing consumer information about ceiling fans, including specifications and buying guidance.

3. **Getting the Most from Your Fan**
   Author(s): Calwell, Horowitz
   Organization(s): Home Energy Magazine
   Publication Date: June, 2001
   Online article describing how ceiling fans are one of the most popular and generally well regarded of all home energy efficiency features.

4. **Gossamer Wind ENERGY STAR Ceiling Fans**
   Author(s): FESC
   Organization(s): FESC
   Publication Date: October, 2014
   Website providing information about the Gossamer Wind Series Ceiling fans, conceived by Danny Parker at the Florida Solar Energy Center as a means of realizing the energy efficiency and comfort potential of ceiling fans.

5. **Residential: Ceiling Fans (website)**
   Author(s): Lawrence Berkeley National Laboratory
   Organization(s): LBNL
   Publication Date: October, 2014
   Website with product and standards information about ceiling fans.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

The following authors and organizations contributed to the content in this Guide.

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