

ENERGY STAR® Testing Facility Guidance Manual:
The Solid State Test Method for ENERGY STAR Qualified Ceiling Fans



Version 1.0
Draft 1
June 20, 2002

Prepared by:
The US Environmental Protection Agency

Contributors:
Hunter Fan Company
Intertek Testing Services, ETL SEMKO
Underwriters Laboratory, Taiwan Branch

ENERGY STAR® Testing Facility Guidance Manual: The Solid State Test Method for ENERGY STAR Qualified Ceiling Fans

| | | |
|------|---------------------------------------------------------------------|----|
| I. | Table of Contents | 1 |
| II. | Chapter 1: Introduction | 3 |
| III. | Chapter 2: List of Equipment and Vendors | 5 |
| IV. | Chapter 3: Air Delivery Room Construction and Preparation | 7 |
| V. | Chapter 4: Equipment Set-Up and Test Procedure | 13 |
| VI. | Chapter 5: Calibration Approval and Reporting Testing Results | 17 |

Appendices

Appendix A

ENERGY STAR Program Requirements for Residential Ceiling Fans: Eligibility Criteria

Appendix B

ENERGY STAR Qualified Product Information Form

Appendix C

Laboratory Reporting Form(s)

Appendix D

Engineering Blueprints for Air Delivery Room

List of Figures

Figure 3.1 – Rail Track in Ceiling

Figure 3.2 – Rail Measurements and Details

Figure 3.3 – Test Cylinder and Rail Track Support

Figure 3.4 – Arm Rotator with Sensor Wires Covered

Figure 3.5 – Sensors Mounted in Testing Position

Figure 3.6 – Sensors and Actuator Arm

Figure 3.7 – Air Delivery Room Set-Up with 60” Cylinder

Figure 3.8 – Testing Cylinder with Actuator Arm

Figure 3.9 – Testing Cylinder and Chamber

Figure 4.1 – Tachometer Set-Up

Figure 4.2 – Testing Room and All 4-Axis

Figure 4.3 – Temperature and Humidity Sensors in Testing Room

Figure 4.4 – Ceiling Fan Testing Set-Up

This test manual will be updated and augmented as necessary in response to changes in testing requirements and specifications under the ENERGY STAR Program Requirements for Residential Ceiling Fans.

For questions related to ENERGY STAR contact:

**Andrew Fanara, EPA
Program Manager
ENERGY STAR for Residential Ceiling Fans
1200 Pennsylvania Avenue
Washington, DC 20460
Phone: (202) 564-9019
E-mail: fanara.andrew@epa.gov**

The laboratories listed below contributed to the development of this testing manual. For technical questions related to this document contact:

**Vin Mehta
Laboratory Engineer
Hunter Fan Company
2500 Frisco Avenue
Memphis, TN 38114
(901) 248-2212
E-mail: vmehta@hunterfanco.com**

**Jason Prentice
Engineer
Intertek Testing Services (ITS)
ETL Semko
3933 US Route 11
Cortland, NY 13045
(607) 753-6711
E-mail: jprentice@etlsemko.com**

**Mike Chang
Underwriters Laboratory (UL)
Taiwan Branch
4th Floor, 260 Da-Yeh Rd., Peitou
Taipei City, Taiwan 112
886-2-2896-7790 ext. 279
E-mail: mike.chang@tw.ul.com**

CHAPTER 1

Introduction

1.1 Background

ENERGY STAR is a self-certifying, voluntary program that manufacturers can join to qualify and label their energy-efficient products. Where possible, ENERGY STAR adopts existing testing procedures when developing product specifications and testing criteria. However, there was no standardized test method available to the ceiling fan industry at the time of specification development for this product.

In 2001, EPA partnered with Hunter Fan Company to develop the Solid State Test Method. This test method is designed to increase efficiency and improve accuracy. It provides an accurate representation of the air circulation created by the fan in the room. The method reduces the testing and validation time to a fraction of the time period required by other industry testing standards.

The Solid State Test Method allows for the measurement of total cubic feet per minute (CFM) and CFM/watt readings for multiple fan speeds. These results must meet the minimum requirements provided in the ENERGY STAR specification (Attachment A). As of January 2001, all fans must be tested in accordance with the Solid State Test Method in order to qualify as ENERGY STAR.

The Solid State Test Method was provided by Hunter Fan Company as non-proprietary and is subject to improvements as technologies change and standard operating procedures are re-evaluated.

1.2 Purpose

The purpose of this guidance manual is to provide ENERGY STAR partners and other interested parties, such as third party laboratories, the necessary information needed to build a ceiling fan testing chamber, or air delivery room, and perform adequate product testing for ENERGY STAR qualification. It is important to note that this manual provides the minimum requirements for building the test facility. Engineering designs may vary outside of these minimum requirements. The testing criteria and procedure, however, should be followed closely in order to ensure consistent results across the board.

This following information is provided in this manual:

- List of equipment and reference vendor contacts
- Air delivery room set-up (e.g., equipment and room requirements)
- Fan set-up and CFM test procedure
- Approval process and required forms
- ENERGY STAR specifications
- Blueprints of air-delivery room

1.3 Applicability

Any ceiling fan manufacturer, third-party testing facility, or other interested party may build a ceiling fan test chamber. All testing facilities intending to test residential ceiling fans under ENERGY STAR requirements must follow the facility blueprints and additional building instructions as well as the test procedures provided in this manual. **Please note that this is not an EPA certification and individuals should not attempt to identify themselves as an EPA certified laboratory.**

CHAPTER 2

List of Equipment and Vendors

The table below provides a list of the testing equipment needed to perform the Solid State Test Method. **Note:** Any precision control equipment that performs similar functions, but is sold under a different brand name, is acceptable. Vendors are provided for reference.

Note: Proper calibration will be required periodically to compensate for variation.

| Equipment Name/Type | Serial / Models Number | Function | Vendor Contact |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Robic Stop Watch | 56964 / SC-505 | Timer | |
| Cambridge Airflow Temperature Monitor Kit contains: ▪ ATM-24 instrument ▪ Accutrac Software (PC only) or Kermit (Mac only) ▪ 5V Universal Power Supply with AC power cord ▪ RS-232 cable ▪ Carrying case ▪ Plastic mounting clips for CAFS sensor ▪ CAFS probes (as ordered) | 0135-992832-001 / ATM24 CAFS – 200 – SIOM | Measure airflow and temperature at multiple locations simultaneously | Cambridge Accusense, Inc. (978) 425-2090 sales@accusense.com |
| Extech True RMS Power Analyzer | NA / 380801 | Measure amps, watts, power factor, voltage | (781) 890-7440 www.extech.com |
| Magtrol | 6510E | | www.magtrol.com |
| Vaisala Pressure transmitter | W3310001 / PTB100A | Temperature and humidity sensor | www.vaisala.com Barometric Pressure page (fixed transmitters) |
| Yokogawa | EJA310A | | www.yokogawa.com/tm |
| Shimpo Digital Tachometer | 10049812 / DT-5TG | Infrared beam counter | Shimpo Instruments Division of NIDEC-Shimpo America Corporation (630) 924-7138 |
| Shimpo Retro-Reflective Beam Sensor | H9 / RS-220H | | |
| Omron | E3S-CT61 | | www.omron.com |

| | | | |
|--------------------------------------------|-----------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Actuator Company of America – Actuator Arm | NA / 1129 | Holds CAFS probes | (408) 749-8204 www.actuator.net/actuators.htm |
| KB Indexing and Cycling Control | NA / KBPI-24OD(R)(8501) | Drive for actuator | KB Electronics, Inc. (800) 221-6570 info@kbelectronics.com |
| Testing cylinders | 60" CFM Aluminum Chamber TD#8067* | Testing cylinders | Custom Projects Inc. 333 E. Brooks Rd. Memphis, TN 38109 Tel: 901-396-7398 Fax: 396-396-7399 Contact: Randy Jones |

* Ordering of multiple sized cylinders should be considered to accommodate more than one fan size.

CHAPTER 3

Air Delivery Room Construction and Preparation

3.1 Air Delivery Room Requirements

The air delivery room, or testing chamber, should be constructed per the blueprint provided in Appendix D. The room dimensions are recommended to be approximately 20 ft. x 20 ft. with an 11 inch high ceiling. **Note:** The control room should be constructed external to the air delivery room.

The ceiling should be constructed of sheet rock or stainless plate. The walls should be of adequate thickness to maintain temperature and humidity during the test. It is important that the type of paint used on the walls, as well as the wall material, not absorb humidity while keeping the temperature of the room consistent at the time of testing. Oil based paint, which prevents absorption of humidity in the room, is preferred although other means of controlling humidity and temperature are acceptable.

Room Ventilation

The room should have no ventilation other than the air conditioning and return. The air conditioning is used to control the temperature and humidity of the room (see Chapter 4 for requirements).

At the time of testing, air conditioning should be turned off and the vents should be closed or sealed so that there is no obstruction to the circulation of air in the room. **Note:** *It is preferred to have electronically operated damper doors for the vents that can be controlled from a switch outside of the testing room.*

3.2 Equipment Set-Up

Supportive Ceiling Rails

The ceiling rail tracks, used to support and move the testing cylinder, should be installed as shown in Figures 3.1 – 3.3, below.



Figure 3.1 – Rail Track in Ceiling

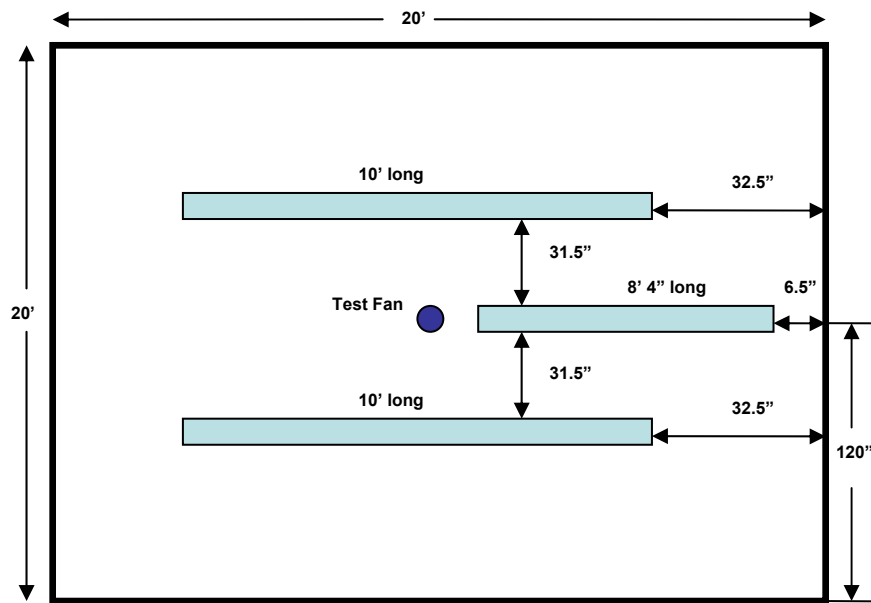


Figure 3.2 – Rail Measurements and Details



Figure 3.3 – Test Cylinder and Rail Track Support

Wiring

The amount of exposed wiring should be minimized. All sensor lead wires should be stored under the floor, if possible (Figure 3.4).

Sensors and Sensor Rotating Arm

The sensors should be placed at exactly 4-inch intervals. Sensor placement is shown in Figure 3.5, below. **Note:** It is extremely critical that the actual sensor not be touched prior to testing. Enough sensors should be used to record air delivery to the end of the testing cylinder as shown in Figure 3.6.

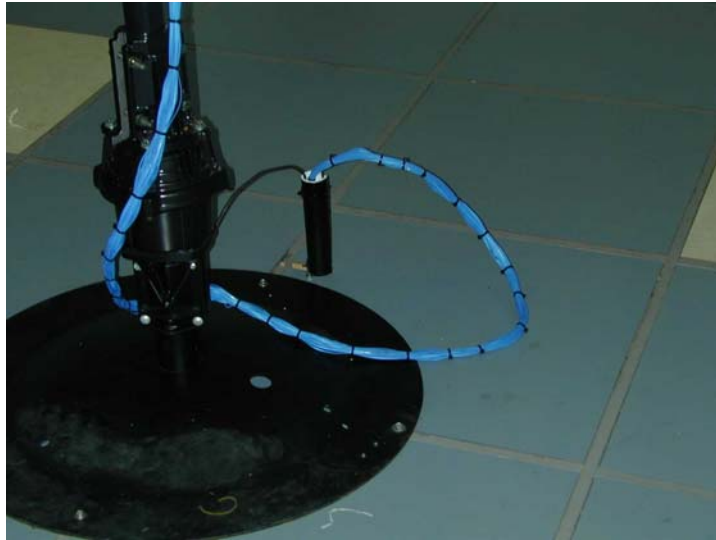


Figure 3.4 – Arm Rotator with Sensor Wires Covered



Figure 3.5 – Sensors Mounted in Testing Position

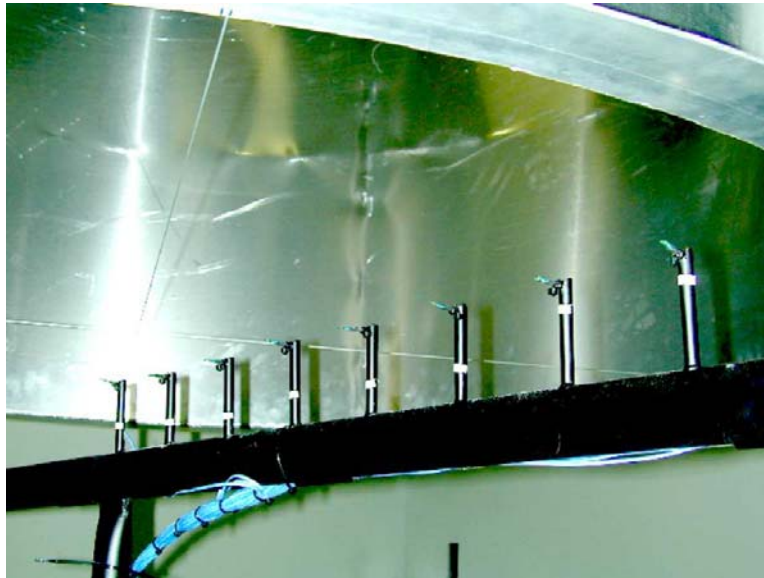


Figure 3.6 – Sensors and Actuator Arm

Test Cylinders

The test cylinder hangs from the ceiling rails as shown in Figure 3.3. Test cylinders must be eight inches (diameter) larger than the fan model being tested. For example, a 52-inch fan should be tested within a 60-inch cylinder. Proper cylinder set-up is shown in Figures 3.7 – 3.9, below. Table 3.1, below, shows the appropriate cylinder size and number of sensors to use for each fan size.

Figure 3.7 – Air Delivery Room Set-Up with 60" Cylinder

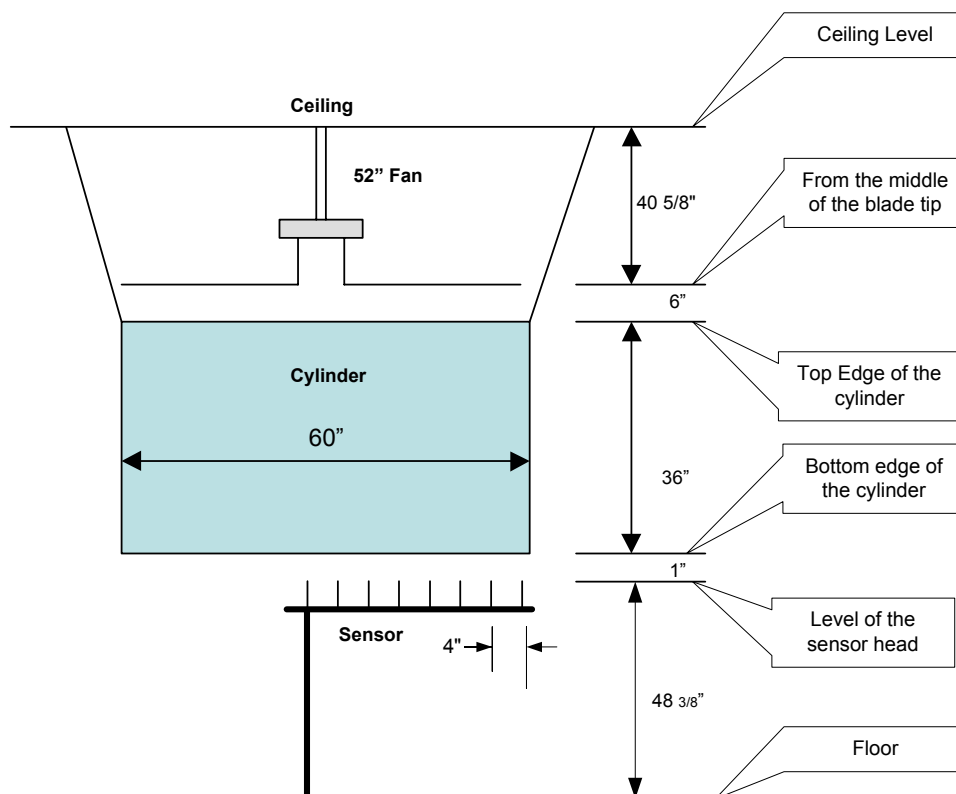




Figure 3.8 – Testing Cylinder with Actuator Arm



Figure 3.9 – Testing Cylinder and Chamber

| Fan Size (in.) | Cylinder Diameter (in.) | Number of Sensors | Comments | Circle area factor of last sensor |
|-----------------------|--------------------------------|--------------------------|----------------------------------------------------------------|------------------------------------------|
| 52 | 60 | 8 | | |
| 60 | 68 | 9 | | |
| 44 | 52 | 7 | | |
| 36 | 44 | 6 | | |
| 48 | 56 | 7 | The effective area of last sensor will have circle width of 6 | 6.5449 |
| 56 | 64 | 8 | The effective area of last sensor will have circle width of 6 | 7.5922 |
| 42 | 50 | 7 | The effective area of last sensor will have circle width of 3" | 3.0761 |

Table 3.1 – Cylinder and Sensor Selection Guide

CHAPTER 4

Equipment Set-Up and Test Procedure

This chapter provides general instructions on setting up the equipment and performing the ceiling fan test. Lab personnel should refer to equipment manuals for specific instructions.

4.1 Tachometer Set-Up

The installation of the RPM meter, or tachometer, is shown in Figure 4.1, below.



Figure 4.1 – Tachometer Set-Up

4.2 Fan Set-Up and Testing Procedure

Step 1: Make sure the transformer power is off. Hang fan at the actuator hanging system and connect black and white wires from ceiling to fan. Ignore other wires, until further notice. **Note:** Fan will need to be assembled prior to the test; it is important that lab personnel follow the instructions provided by the fan manufacturer.

Step 2: Slide the metal cylinder to the center such that the fan is hanging above and exactly in the center of the cylinder. As mentioned in Chapter 3, test cylinders must be a total of eight inches larger than the fan model being tested.

Step 3: Adjust the actuator such that the middle of the blade tip is six inches above the top edge, or lip, of the metal cylinder. If necessary, use the Penta-Drive hoist's toggle switch and adjust height.

Step 4: Set the sensor arm to 0 degree Position (Axis A). Axis B, C and D are at 90, 180 and 270 degree positions of the arm. If necessary, use black tape marking as reference. To adjust beam alignment use antenna rotator by pressing the **LEFT** and **RIGHT** rocker switch. **Note:** Axis A – D can be designated either by using the four walls or four corners of the room. It is important that all axis points are equidistant from one another. See figure 4.2, below.

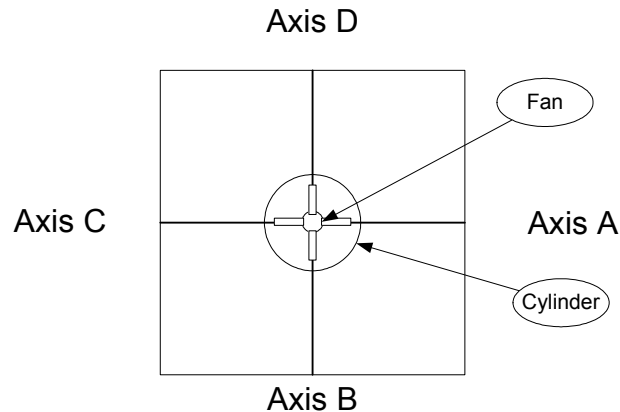


Figure 4.2 – Testing Room and All 4-Axis

General Instructions

Below are some important things to remember when testing:

- Make sure to close air conditioning ducts prior to testing
- The temperature and humidity setting should be 76 ± 2 degrees F, 50 ± 8 percent relative humidity – these should be held constant during entire test process (Figure 4.3)
- Allow the fan and the sensors to be turned on for 15 minutes at each setting before taking readings (at each speed)



Figure 4.3 – Temperature and Humidity Sensors in Testing Room

Accutrac Software Instructions: Reading the Sensors

- Connect sensors as instructed in the Cambridge Airflow Temperature Monitor instruction manual
- The setting of the software should be as follows (appropriate COM port of computer):
 - Statistics: Avg., Min., Max.
 - Probe: Gen'd
 - Prob Grid: (0X0)
 - Reading Interval: 1 second
 - Option Menu: (Altitude compensation: enter altitude, time unit second, airflow units FPM)

CFM Testing Procedure

Listed below are the basic steps during the ceiling fan test. Figure 4.4, below, shows a ceiling fan during an air delivery test.



Figure 4.4 – Ceiling Fan Testing Set-Up

Step 1: Rotate the sensor arm to axis A.

Step 2: Load Accutrac Software. **Note:** The software should be set up for 1 sec reading and for air velocity only, not for temperature. Insert current barometric pressure.

Step 3: Turn off the air conditioning system so that there is no disturbance in the air-circulating pattern created by the fan.

Step 3: Turn off thermostat, wait 3 minutes.

Step 4: Start the session and begin recording readings. Take 100 readings (100 seconds run-time) and save the file to Data A. **Note:** When the session has started recording, make sure that only FPM are recorded; there is not need to record temperature readings.

Step 5: Similarly take the readings in Axis B, C, and D; these files will be saved as Data B, Data C, and Data D.

Step 6: Take the average value of each sensor and fill in the appropriate calculation spreadsheet shown in Appendix C.

CHAPTER 5

Calibration Approval and Reporting Test Results

5.1 Approval to Begin Testing for ENERGY STAR

Before accepting and testing fans for ENERGY STAR testing, fan calibration results must be reviewed and approved by EPA.

- Review all ENERGY STAR Documents

All testing facility personnel should review this testing guidance manual as well as the ENERGY STAR specification (Appendix A) and Qualified Product Information Form (Appendix B).

- Fan Calibration

To ensure consistency between all participating laboratories, each facility must calibrate with the Hunter Fan 52" Calibration Fan. Listed below are detailed instructions on the calibration procedure. The 52" Calibration Fan should be requested from Hunter Fan Company.

Calibration instructions:

1. Hang the standard 52-inch fan in the air delivery room.
2. Install five blades at corresponding numbers marked. Match the numbers of motor position and the blades.
3. Set-up the testing as described in the **CFM Testing Procedure**.
4. Adjust the voltage input to the motor such that the RPM is exactly 200 RPM.
5. Take the air delivery reading in all of the four quadrants of the cylinder.

The air delivery should be 5764 CFM +/- 3% as required by the ENERGY STAR specification.

Important Note: The fan blades are made out of special wood and precisely calibrated for 12-degree pitch. Any type of impact or mishandling can alter the calibration. Handle and store the motor and blades carefully. Since recalibration among all testing laboratories is likely to occur in the future, preserving the integrity of this fan is especially important.

- Calibration Approval

Calibration results should be sent to EPA along with a cover letter requesting approval. The calibration results should be submitted via the form provided in Appendix C of this manual. Once the calibration results are reviewed and approved by EPA, the testing facility will receive a memo stating that the facility may begin testing ceiling fans for ENERGY STAR qualification. The testing facility

name will then be added to the ENERGY STAR Web site Qualified Laboratory List.

Note: It is EPA's right to ask for a recalibration of all testing facilities in the future.

5.2 Reporting Test Results and Other Tips

Under the ENERGY STAR Program Requirements for Residential Ceiling Fans, manufacturers must provide testing documentation when submitting products for ENERGY STAR qualification. A full report should be provided for each test run to the manufacturer. Again, all lab personnel should be familiar with the reporting requirements provided in the ENERGY STAR specifications (Attachment A) prior to testing for ENERGY STAR qualification. Fan testing results should be recorded and presented in a format similar to that provided in Appendix C, of this manual.

In addition, there are a number of important requirements that lab personnel should be aware of and communicate to the manufacturer. These are listed below.

- Lighting Requirements

Under the ENERGY STAR specification, a ceiling fan model that will be sold with an attached or integral light kit must be tested with those light sources mounted in their intended position and switched off. If a ceiling fan model is sold both with and without a light kit, two separate tests should be performed. It is very important that lab personnel indicate on the testing results form whether or not the fan tested includes lighting.

In addition to the fan testing, the lighting itself is required to be tested under the Residential Light Fixtures program. Ceiling fan testing facilities are not required to provide this type of testing documentation; however laboratory personnel should be familiar with the requirement to test the light kit separately at a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.

It is important to inform the customer of these additional lighting requirements ahead of time to avoid delays in qualification.

- Other Testing Considerations and Recommendations

Ceiling fan models that are the same in every aspect but finish may qualify under the representative model that is tested. Differences in construction such as housing, blade pitch, and motor could affect air movement and require separate testing. This testing procedure is intended to provide fan performance results for one ceiling fan model to be sold and should not be seen as a means to test individual components. Therefore, fans that DO NOT pass should be sent back to the customer and a new fan submitted for qualification. Laboratory personnel should not accept new components from a customer for means of a re-test.

Lab personnel should also indicate the condition in which the fan was received, discrepancies in model numbers, and other concerns or inconsistencies.

APPENDIX A

ENERGY STAR Program Requirements for Residential Ceiling Fans: Eligibility Criteria



ENERGY STAR® Program Requirements for Residential Ceiling Fans

Eligibility Criteria

Below is the product specification (Version 1.1) for ENERGY STAR qualified residential ceiling fans. A product must meet all of the identified criteria if it is to be labeled as ENERGY STAR by its manufacturer.

1) Definitions: Below is a brief description of a ceiling fan and other terms as relevant to ENERGY STAR.

- A. Residential Ceiling Fan: A non-portable device designed for home use that is suspended from the ceiling for circulating air via the rotation of fan blades. Some ceiling fans also have an integral or attached light kit.
- B. Light Kit: A light kit is the equipment used to provide light from a ceiling fan. Light kits can be:
 - Integral – the light kit arrives hardwired to the ceiling fan
 - Attachable – the light kit is not, at the time of sale, physically attached to the fan. The light kit must be attached to the ceiling fan for the lights to work. Attachable light kits might be included inside the ceiling fan box at the time of sale or sold separately for subsequent attachment to the fan.
- C. Controls: Controls enable the user to turn on/off or adjust the lighting and fan movement. Controls can be in the form of pull chain, slide switch, wall switch/panel, or remote control.
- D. Airflow: The rate of air movement at a specific fan setting expressed in cubic feet per minute (CFM). Airflow is determined from testing done using the Solid State Test Method, defined below.
- E. Airflow Efficiency: The ratio of airflow divided by power at a specific residential ceiling fan setting expressed in CFM per watt (CFM/watt). Airflow and power are determined from testing done using the Solid State Test Method, defined below.
- F. Power Consumption: The active power expressed in watts. Power consumption is measured during residential ceiling fan testing at a specific speed using the Solid State Test Method, defined below.
- G. Standby Mode: Mode when the lights are off and the fan blades are not rotating.
- H. Solid State Test Method: A method developed by the Hunter Fan Company that specifies the apparatus and testing protocol for measuring a residential ceiling fan's airflow and power consumption. The method utilizes a hot-wire anemometer and requires a temperature controlled room and computer for recording test data.
- I. Hugger Fans: Ceiling fans that are installed directly against the ceiling.

- 2) Qualifying Products: For the purposes of ENERGY STAR, the following two types of residential ceiling fans may qualify: those sold with light kits and those sold without light kits. **Hugger fans are not currently eligible for participation in ENERGY STAR for Residential Ceiling Fans as a result of the testing process producing efficiency and performance levels substantially greater than what the fans will normally deliver in residential use. Data will be collected regarding hugger fans and the inclusion of such fans will be reevaluated for Tier II of these specifications.**
- 3) Energy-Efficiency Specifications for Qualifying Products: Only those products listed in Section 2 that meet the criteria below may qualify as ENERGY STAR.

A. Airflow Efficiency

Qualifying products shall meet or exceed the following requirements for total airflow and for airflow efficiency when operating in a downward-blowing direction. Models sold with light kits or integrated light sources must be tested with those light sources mounted in their intended position and switched off. Individual models' measured performance may vary by +/- 5 percent and still be deemed compliant with this specification.

| Table 1 – Tier I Specifications for Air Flow Efficiency | | |
|---------------------------------------------------------|-----------------|------------------------|
| Fan Speed | Minimum Airflow | Efficiency Requirement |
| Low | 1,250 CFM | 155 CFM/watt |
| Medium | 2,500 CFM | 110 CFM/watt |
| High | 5,000 CFM | 75 CFM/watt |

Note: No standby power requirements are included in Tier I specifications.

| Table 2 – Tier II Specifications for Air Flow Efficiency | | |
|----------------------------------------------------------|-----------------|------------------------|
| Fan Speed | Minimum Airflow | Efficiency Requirement |
| Low | TBD | TBD |
| Medium | TBD | TBD |
| High | TBD | TBD |

Note: Under Tier II, fans may consume no more than 1 watt of power in standby mode. These standby requirements are included in Tier II to ensure that remote control circuits, if included, operate efficiently.

Airflow and efficiency requirements for Tier II may be divided into separate categories by fan diameter if data collected in 2002 indicate clear differences in achievable performance among fans of different sizes. Likewise, the Tier II specification may include consideration of power factor if warranted by product performance and utility request.

This specification defines residential ceiling fan airflow efficiency on a performance basis: CFM of airflow per watt of power consumed by the motor and controls. This treats the motor, blades, and controls as a system, allowing multiple approaches to reach a given efficiency level. Efficiency is to be measured on each of three fan speeds (low, medium and high) using the "Solid State Test Method" which was developed by Hunter Fan Company and is explained in more detail in Section 4, Test Criteria. Residential ceiling fans capable of operating at more than three speeds must meet the above levels at any three of those total speeds, though measurements should be taken and reported for all discrete operating speeds.

B. Controls

Tier I

Under Tier I, qualifying products shall permit convenient consumer adjustment of fan speed. This may be accomplished by means of one or more wall-mounted switch(es), a remote control, or readily accessible pull chains. For purposes of this specification, "readily accessible" shall be defined as a length sufficient to reach a height of no more than 80 inches above the floor when the residential ceiling fan is mounted according to the residential ceiling fan's installation instructions. For those residential ceiling fans that can accommodate lighting, the lights and the fans must be controllable separately, allowing users to switch off lights during fan operation or operate the lights without using the residential ceiling fan.

Tier II

In addition to meeting the requirements under Tier I, qualifying products shall provide for consumer adjustment of airflow direction (upward or downward) by one of the following means:

- A vertically mounted slide switch on the motor housing, in which the downward position corresponds to downward airflow
- A wall-mounted switch
- A remote control
- A readily accessible pull chain

C. Lighting

Tier I

Qualifying residential ceiling fans sold with integral or attachable light kits must meet one of the following requirements:

- Pin-Based Approach – The residential ceiling fan lighting systems shall meet the requirements of the ENERGY STAR specification for residential light fixtures; or
- Screw-Based Approach – The number of ENERGY STAR qualified screw-based bulbs needed to occupy each standard Edison-based socket shall be included within the residential ceiling fan packaging.

Qualifying residential ceiling fans sold without integral or attachable light kits need not meet any additional lighting requirements.

Tier II

Qualifying residential ceiling fans sold with integral or attachable light kits must meet the requirements of the ENERGY STAR specification for residential light fixtures.

Qualifying residential ceiling fans sold without integral or attachable light kits must provide information on product packaging or with product instructions regarding ENERGY STAR qualifying light kits that may be used with that particular residential ceiling fan.

EPA recommends that manufacturers pursue the pin-based approach in both Tier I and Tier II, because it will tend to yield greater energy savings and performance, lower consumer cost, and fewer complications with retailers than the screw-based approach.

D. Noise

Tier I

None

Tier II

Qualifying products shall meet the following maximum standards for operational noise:

| Table 3 – Tier II Specifications for Operational Noise | |
|---------------------------------------------------------------|-------------------------------------------|
| Fan Speed | Minimum Sound Pressure Level (SPL) |
| Low | TBD |
| Medium | TBD |
| High | TBD |

In addition, qualifying products shall include a standardized label on the product package noting operational noise in dB at each of three operating speeds, measured by a method agreed to by all manufacturers that participate in ENERGY STAR for Residential Ceiling Fans. That method shall be finalized no later than October 1, 2002.

Each fan speed will be associated with a minimum airflow in CFM. The final Tier II specification will state a test procedure for measuring fan noise. This specification will need to address, among other things: test chamber size and characteristics, type of measurement equipment, and type of sound being measured. The specification could either measure total SPL or attempt to specify the particular harmonics that result from electrical and mechanical fan noise, but are not the product of wind noise from the blades. Allowable noise levels will be higher for higher fan speeds.

E. Warranty

Tier I

Qualifying products shall provide a warranty of at least 30 years for the motor and at least one year for all other components of qualifying residential ceiling fans. Residential ceiling fans sold with integral light kits shall also meet applicable warranty requirements for ENERGY STAR labeled residential light fixtures.

Tier II

No additional requirements

F. Consumer Information

Tier I

In addition to the ENERGY STAR label, packaging of ENERGY STAR qualified residential ceiling fans shall also state airflow, fan power consumption, and airflow efficiency at each of their three operating speeds, as determined by the test procedures specified in Section A, Airflow Efficiency. This information shall appear in the following form on the outside portion of the package:

| Fan Speed | Airflow | Fan Power Consumption (without lights) | Airflow Efficiency (higher is better) |
|-----------|---------|-------------------------------------------|------------------------------------------|
| Low | — CFM | — watts | — CFM/watt |
| Medium | — CFM | — watts | — CFM/watt |
| High | — CFM | — watts | — CFM/watt |

Product operating and installation instructions shall include a short list of standardized information regarding how to operate the products efficiently. This list shall include, at a minimum, information about the following topics:

- adjusting fan speed and direction for season and room occupancy to maximize energy savings
- HVAC thermostat adjustment for energy savings when a ceiling fan is in use
- proper mounting distance from the ceiling to maximize efficient operation
- how to find proper replacement lamps for the light kit, if included

Tier II

No additional requirements

- 4) **Test Criteria:** Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. In performing these tests, manufacturers must use Hunter's Solid State Test Method described below.

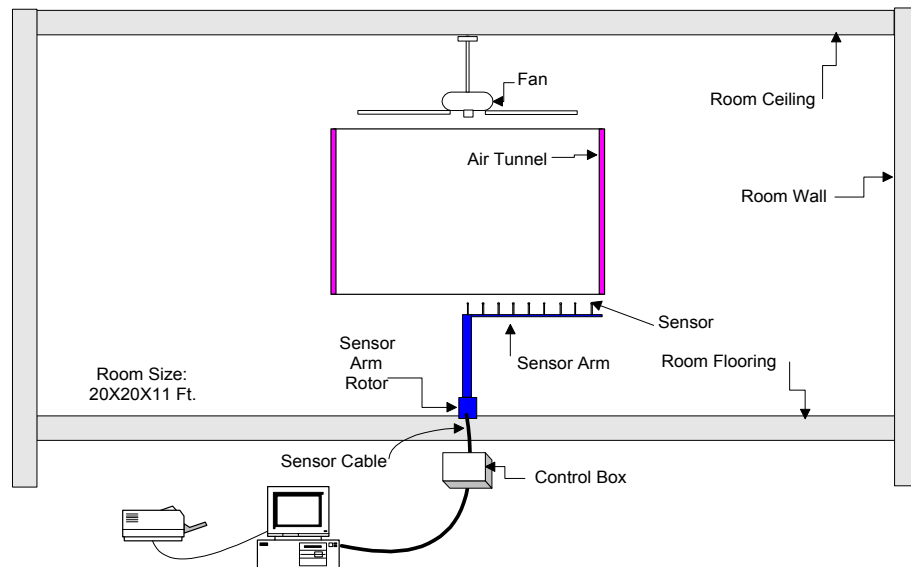
Solid State Test Method

The methodology behind the Solid State Test is designed to increase efficiency and improve accuracy. It provides an accurate representation of the air circulation created by the fan in the room. The method reduces the testing and validation time to a fraction of the time period required by NEMA or IEC standards.

The room details and the setup for ceiling fan testing by the Hunter method is explained in the illustration, below.

A fan is hung above the predefined tunnel or a large diameter tube in a standard temperature and humidity controlled room. The air delivered by the fan is made to pass through the tunnel. At the end of the tunnel, a row of velocity sensors is mounted on a rotating arm. The airflow at various points in the tube is measured simultaneously and instantaneously for several seconds. The average reading of air velocities is then used to compute the air delivery by calculations similar to IEC and NEMA suggested methods.

The important characteristic of the Solid State Test Method is the use of the latest method of measurement of air velocities by multiple probes. Instead of moving a mechanical or an electronic probe from point to point to measure the airflow (velocity), this method allows you to perform simultaneous monitoring of air velocity instantly. The information is recorded in real time and can be analyzed as the measurement is being taken. The probes utilize the time-tested technology of hot wire thermister anemometry. Each probe has a temperature and cooling rate sensor. The signal from these sensors is fed into the computer via the control box. Using the appropriate software, calculations are made to compute the air delivery of the fan. This multi-point measurement of airflow velocity as well as air surface temperature analysis is a crucial step in the development of this method. The complete test takes under two minutes, not including the time to hang the fan.



Hunter Air Delivery Measurement Room Setup

Reporting Requirements

The company whose brand name appears on the product packaging shall, for purposes of this specification, be considered the manufacturer. Manufacturer must complete a Qualified Product Information form when submitting qualified products to EPA. This form must be accompanied by reports from a qualified laboratory containing airflow, power consumption, and airflow efficiency data for each residential ceiling fan model proposed for labeling. Families of residential ceiling fan models that are identical in every respect but housing and blade finish may be qualified through submission of test data for a single representative model. Likewise, models that are unchanged or that differ only in housing or blade finish from those sold in a previous year may remain qualified without the submission of new test data. However, separate test data are required for all models that differ in any of the following characteristics:

- motor type or size
- rotational speed
- control type (if included with fan)
- blade weight, number, size, or pitch

Any manufacturer or EPA may challenge the test results for a particular product. Under the rules of a challenge, an independent laboratory recognized by EPA will purchase a sample of the challenged product from a US retail store and conduct a set of measurements. If the testing of this sample meets the requirements of the ENERGY STAR specification, the challenger must pay for the cost of the independent laboratory test.

If the sample fails to meet those requirements, its manufacturer must pay for the cost of the independent laboratory test. Failure to pass the challenge will result in further investigation by the EPA. The EPA may request minor modifications or other actions by the manufacturer to meet the labeling requirements. If the product does not meet the requirements of the EPA investigation, it may be removed from ENERGY STAR's qualified product list.

Laboratory Testing

Manufacturers may elect to use a qualifying in-house or independent laboratory to provide these results. Qualified laboratories will conduct "round-robin" testing at least every six months with identical fan samples to verify that they can consistently obtain results for CFM/watt within +/- 3 percent of each other for testing done on the same fan. Qualifying test facilities will be provided on the ENERGY STAR Web site at www.energystar.gov.

- 5) Effective Date: The date that manufacturers may begin to qualify products as ENERGY STAR will be defined as the *effective date* of the agreement.

Tier I: The first phase, Tier I, shall commence on January 1, 2002 and conclude on September 30, 2003. Partners can qualify ceiling fan models for Tier I starting January 1, 2002. All products shipped after this date and through September 30, 2003 must meet Tier I requirements in order to bear the ENERGY STAR label.

Tier II: The second phase, Tier II, shall commence on October 1, 2003. Specifications for Tier II shall apply to products that are shipped after September 30, 2003. All products, including models originally qualified under Tier I, shipped after this date must meet Tier II requirements in order to bear the ENERGY STAR label (including additional shipments of models originally qualified under Tier I). Final revisions to Tier II specifications will be completed in late 2002, to provide manufacturers sufficient lead time for making needed product revisions.

- 6) Future Specification Revisions: ENERGY STAR reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions.

APPENDIX B

ENERGY STAR Qualified Product Information Form

Qualified Product Information Form for Residential Ceiling Fans



ENERGY STAR® Product Information Form for Use by ENERGY STAR Labeled Residential Ceiling Fan Partners (Companies who have joined ENERGY STAR by signing a Partnership Agreement)

You may use this form to report only those products that are sold under the company's brand name. If your firm sells its models to another company that uses its own brand name, that company must join ENERGY STAR and report its own products. Information from this form will be added to the list of ENERGY STAR qualified residential ceiling fan products. Please copy this form and return one for each qualifying product model to the address below.

Company Name: _____
(As listed in Partnership Agreement)

Product Contact Information
(verification of product information)

Product Type (check one):

- ☐ Ceiling Fan only
- ☐ Ceiling Fan with Light Kit – Pin Based CFLs
- ☐ Ceiling Fan with Light Kit – Screw Based CFLs
- ☐ Light Kit Only – Pin Based
- ☐ Light Kit Only – CFLs

Name: _____

Tel: _____

Fax: _____

Email: _____

Product Information – List representative (tested) fan model first. If there are additional models that are identical to the representative model in every respect but housing and blade finish, they also may be listed in the table below.

| Model Name | Model Number |
|------------|--------------|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Airflow Efficiency

| Fan Speed | Airflow (CFM) | Fan Power Consumption (watts) | Airflow Efficiency (CFM/watt) |
|-----------|---------------|----------------------------------|----------------------------------|
| | | | |
| | | | |
| | | | |
| | | | |

Controls

Provide type and location of fan controls (wall-mounted switch, pull chain, remote control):

| Type of Fan Control | A. <u>Location of Fan Control</u> |
|---------------------|-----------------------------------|
| | |
| | |
| | |
| | |

Lighting Requirements (for fans sold with integral or attachable light kits)

☐ **Pin-Based:** Light fixture must be tested and qualify under ENERGY STAR's Residential Light Fixture (RLF) Eligibility Criteria. Please provide test results in Section VIII of this form. Testing documentation must be submitted with this form. **Note: If lamp ballast combination has already been tested by OEM, or other entity, you may use existing lab data and reports.**

☐ **Screw-Based:** ENERGY STAR Qualified Compact Fluorescent Light Bulbs (CFLs) must be included in packaging.

Manufacturer _____

Model/Product # _____

CFL Wattage _____

Number of CFLs Included in Packaging _____

Warranty

Motor Warranty: _____ years

List Fan Components and their Warranties: _____

Labeling Requirements

Is product shipped with ENERGY STAR label:

_____ On product packaging/box (required)?

_____ In product literature (required)?

_____ On Internet site (required)?

Is Performance and Efficiency Table clearly displayed on the outside of the product packaging (check one)?

☐ Yes

☐ No

If the answer to any of the above is No, explain why: _____

Testing

All manufacturers are required to perform tests on residential ceiling fan models by using the Solid State Test Method described in the Program Requirements for Residential Ceiling Fans. Fan models identical in every respect but housing and blade finish may be represented by a single representative model for testing purposes. However, separate test data is required for all models that differ in motor type or size, rotational speed, control type, or blade weight, number, size, or pitch. **Laboratory test results must be attached to this form to qualify for the ENERGY STAR label.**

Tested By: _____
(Name of Qualified Testing Facility)

Date Available (on market): _____

Residential Light Fixture Test Results

| Model Number | Brand Name | Number of Lamps | Lamp Type | Lamp Wattage | Ballast Type (circle one) |
|--------------|------------|-----------------|-----------|--------------|---------------------------|
| | | | | | Electronic Magnetic |

| Performance Characteristic | Test Result (fill-in values) | Required Documentation |
|----------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Efficacy | _____ Lumens | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory Attached? |
| | _____ Input Power (watts) | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory or from an OSHA NRTL attached? |
| | _____ Lumens Per Watt | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory Attached? |
| Power Factor | _____ | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory or from an OSHA NRTL attached? |
| Lamp Current Crest Factor | _____ | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory or from an OSHA NRTL attached? |
| Lamp Start Time | _____ Seconds | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory or from an OSHA NRTL attached? |
| Lamp Color Rendering | _____ CRI | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory Attached? |
| Lamp Correlated Color Temperature | _____ Kelvin | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory Attached? |
| Noise | _____ dBA | Ballast Manufacturer Data Attached? |
| Safety – Portable Fixtures | UL Listed? Yes No | OSHA NRTL Test Report Attached? |
| Safety – Hardwired Fixtures | UL Listed? Yes No | OSHA NRTL Test Report Attached? |
| Safety – Ballasts and “Fluorescent Adapters” | UL Listed? Yes No | OSHA NRTL Test Report Attached? |
| Operating Temperature | _____ degrees Celsius | Ballast Manufacturer Data Attached? |
| Ballast Frequency | _____ kHz | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory or from an OSHA NRTL attached? |
| Transient Protection | Test report from a lab accredited by NVLAP or an ILAC MRA Signatory or from an OSHA NRTL attached? | |
| End of Life Protection | Manufacturer Data Attached? | |
| Warranty | Written Warranty Attached? | |
| Dimming | Does fixture have dimming capability? | |

Additional Information

Please list all major retailers that carry the product (attach a list if necessary): _____

The Qualified Product Information Form and Program Requirements for Residential Ceiling Fans and the Program Requirements (Eligibility Criteria) for Residential Light Fixtures can be found on the ENERGY STAR Web site at www.energystar.gov/library.

For a list of qualifying CFLs, visit the ENERGY STAR Web site at www.energystar.gov/products, under “Lighting.”

Please submit your completed Qualified Product Information Forms and testing documentation one of the following ways:

E-mail testing results/QPI forms to Rebecca Miller at rmiller@icfconsulting.com

Fax results/QPI forms to Rebecca Miller at (202) 862-1144

US Mail/Overnight/Express results/QPI forms to: Rebecca Miller, ICF Consulting, 1850 K Street NW, Suite 1000, Washington, DC 20006

APPENDIX C

Laboratory Reporting Form(s)

APPENDIX D

Engineering Blueprints for Air Delivery Room