

Expansion of ENERGY STAR[®] Room Air-Conditioner Criteria to Include Through-the-Wall Units

Executive Summary

The Department of Energy (DOE) proposes to expand the current ENERGY STAR room air-conditioner (RAC) criteria to include through-the-wall (TTW) RAC without heating. The proposed ENERGY STAR performance level is at 10% above the current federal minimum energy efficiency ratios (EERs) for RACs defined in the federal standard (10CFR430). The proposed effective date is May 1, 2003.

Approximately one-third of the existing products in the market would qualify for an ENERGY STAR label at a 10% more efficient than the federal standard. This allows the current market to participate in and promote the ENERGY STAR program. It also makes affordable ENERGY STAR qualified TTW RACs available to middle and low-income consumers, a large consideration as this market segment is key for TTW RAC.

The 10% level is consistent with the existing ENERGY STAR RAC (louvered and without heating) criteria. Maintaining consistency will help to prevent consumer and manufacturer confusion on RAC ENERGY STAR criteria. The expansion of the ENERGY STAR RAC criteria also helps the Department to achieve these goals:

- Increase the potential national energy savings beyond the October 1, 2000, RAC federal standard
- Respond to partner demand for and ENERGY STAR criteria for TTW RAC
- Provide consumer-friendly guidance for selecting high efficiency TTW RACs
- Expand the ENERGY STAR program to more products, including products that are used in multi-family housing

Introduction

Currently, only RACs without heat and with side louvers are eligible for the ENERGY STAR label. DOE is proposing to expand ENERGY STAR RAC coverage to include RACs without side louvers and without heating. These units may be referred to as “through-the-wall” (TTW) RACs. They ship as complete units and fit into a sleeve or hole cut through a wall. These models were not included in the initial ENERGY STAR criteria for RAC because of their small market share. DOE recognized the need to include these products in the overall ENERGY STAR RAC criteria to provide options for consumers seeking high-efficiency replacement units for their existing TTW RAC applications, and to complete the coverage to represent the full extent of the RAC without heating market.

Market

TTW RAC market share is small relative to louvered RAC and estimated at about 10% of the total RAC market, making the TTW RAC market about 500,000 units shipped per year. In urban areas, the market share of TTW RAC may be closer to 20%. TTW RAC is most commonly applied in multi-family housing. The breakdown of TTW RAC shipments is about 65% residential (mostly apartment buildings, multifamily residences) and 35% commercial (hotels/motels). Two main sizes of TTW RACs are manufactured:

- 27" wide:
 - This is the size configuration Fedders offered when they began mass-producing TTW RAC units in the early '80s. Friedrich entered the market 13 years ago and produced the same size.
- 26" wide:
 - GE joined the TTW RAC market later, offering a competing 26" unit and succeeded in building an alternative market. Many other overseas manufacturers have joined the 26" unit market as well.

Approximately 60% of the TTW RAC market is comprised of imported units and this is increasing rapidly. The majority of the 26" TTW RAC units are imports while the 27" TTW RAC units are typically domestic. The eight 26" Friedrich TTW RAC units are all imported. Frigidaire is currently shifting all of their production overseas and will label LG Electronics and Samsung products. TTW RACs are distributed directly from distributors (50%) and at retailers (50%). New, highly efficient TTW RAC products are predicted to come onto the market in the coming year. TTW RAC shipments have been increasing among most manufacturers and continued growth is predicted. At the right is a table showing the total RAC market including TTW and louvered RACs.

Manufacturer	2001 Share
LG Electronics	28.0%
Fedders	22.0%
Electrolux (Frigidaire)	11.5%
Whirlpool	10.0%
Haier	9.0%
Goodman	6.0%
UT/Trane	3.0%
Sharp	2.5%
Friedrich	2.0%
Matsushita	2.0%
Samsung	1.5%
Other	2.5%
<i>Total RAC Sales</i>	<i>5.5M</i>
Source: AHAM	

Typical price premiums for ENERGY STAR RACs are 10% leading to paybacks of two to six years. RACs are an inexpensive form of air conditioning and competitively priced. The ENERGY STAR RAC will save \$5 to \$10 annually over a non-qualifying unit.

Engineering Considerations

Improving the energy performance in a RAC can be done in several ways:

- More efficient compressors
- More efficient condenser and evaporator fans
- Improved heat exchanger performance

Many of these improvements may be cost prohibitive. RACs are a relatively inexpensive form of air conditioning focused on middle and lower income consumers, leading manufacturers to pursue less expensive and reliable features.

Compressors

Rotary compressors are the most common type of RAC compressor and improvements with their performance may lead to increased performance. The most efficient rotary compressors may achieve EER of 10.7 to 11.1. Rotary compressors are typically used in RACs < 16,000 Btu/hr. Scroll compressors are another RAC option that may lead to EER levels of 11.5 to 12.0, but more perform in the range of 10.8 to 11.1. Scroll compressors are typically used in RACs > 16,000 Btu/hr in capacity. Scroll compressors are 1 to 2 inches higher than rotary compressors making them a better fit in larger units. Variable speed compressors are another RAC option, but are cost prohibitive in the small capacity range of a RAC. Reciprocating compressors are available, but typically in the range of > 18,000 Btu/hr. These compressors are heavier and require larger, stronger encasements that may lead to increased product costs.

Condenser and evaporator fan motors

Most condenser and evaporator fan motors in RACs are permanent split capacitor (PSC) motors (nearly 98% of market). Their efficiencies range from 50 to 70%, with larger motors being more efficient. Electronically commutated motors (ECM) are an expensive option for increasing a RAC's efficiency. Most are nearly double the cost of the common PSC motor and thus they are rarely applied.

Improved heat exchanger performance

Grooving the inside of the coil, using enhanced fins on the outside, or increasing the size of the coil may achieve increased heat exchanger performance. Manufacturers pursue each of these while optimizing their overall RAC design. Increasing coil sizes leads to reduced dehumidification, increased chassis size, and increased production cost. Manufacturers are careful to optimize all of these parameters in their design process. The 1997 RAC final rule did not increase the EER for TTW RAC units > 8,000 Btu/hr and < 20,000 Btu/hr since it may have resulted in increased chassis size and hurt the replacement market.

Proposed ENERGY STAR performance levels for TTW RACs without heating

The current ENERGY STAR RAC criteria cover the majority of the RAC market. The ENERGY STAR performance levels are set at 10% more efficient than the current federal standards. DOE proposes to include TTW RACs without heat at the same performance levels, or 10% more efficient than the federal standard. The current AHAM directory lists several TTW RACs meeting the proposed 10% requirement. The chart below shows the existing federal minimums and the current and proposed ENERGY STAR levels for the expansion. Increasing the performance levels to potentially higher levels, e.g. 15% or 20% above the federal minimum, would exclude a majority of the available product in the marketplace. DOE wants the expansion of the ENERGY STAR RAC criteria to be effective in the marketplace and the proposed 10% level achieves this goal. Higher performance levels may force manufacturers to increase cabinet size making direct replacement of equipment difficult or increasing product cost reducing overall participation in the ENERGY STAR RAC expansion.

ENERGY STAR and Federal Performance Levels¹

Capacity (Btu/Hr)	NAECA RAC w/louvers (EER)	ENERGY STAR RAC w/louvers (EER)	NAECA TTW RAC (EER)	Proposed ENERGY STAR TTW RAC (EER)	Qualifying/Available TTW RAC Models (as of 12/02)
<6,000	≥9.7	≥10.7	≥9.0	≥9.9	0/3
6,000 to 7,999					
8,000 to 13,999	≥9.8	≥10.8	≥8.5	≥9.4	14/35
14,000 to 19,999	≥9.7	≥10.7			
≥20,000	≥8.5	≥9.4			

¹Only units without heating are included in the ENERGY STAR criteria

As shown above, approximately one third (14/38) of the available TTW RAC units qualify for the proposed ENERGY STAR performance levels. The effective date for the expansion is proposed for May 1, 2003.

Current ENERGY STAR RAC Criteria

DOE reviewed the current field of available products and concluded the current ENERGY STAR levels are appropriate and meet DOE goals for energy savings and consumer/manufacturer participation. The current ENERGY STAR RAC performance levels continue to represent the most efficient products in the market. Much less than a majority of models currently available qualify, which allows for product differentiation based on the ENERGY STAR label. DOE will continue to monitor changes in RAC aggregate performance and update performance levels as necessary.

Energy Savings

Below are three tables estimating the national energy savings of the addition of TTW RACs to the existing ENERGY STAR RAC criteria. The AHAM method to calculate annual energy consumption (AEC) was used and is shown below:

- $AEC = [Capacity \text{ (Btu/hr)} \times 750 \text{ hrs} \times 0.001] / EER$
- For the two product classes, these capacities were used for the AEC
 - 7,000 BTU/hr model for < 8,000 Btu/hr product class
 - 10,000 BTU/hr model for > 8,000 Btu/hr product class

10% ENERGY STAR Market Penetration Savings

Capacity, Btu/hr	ENERGY STAR Shipments (10% penetration)	NAECA AEC, kWh/yr	ENERGY STAR AEC, kWh/yr	Savings/Unit, kWh/yr	National, Aggregate, MWh/yr
<8,000	5,000	583	525	58	290
>8,000	45,000	882	794	88	3,960
Total Savings:					4,250

10% penetration assumptions:

- Out of 50,000 total ENERGY STAR shipments
 - Shipments 10% for units < 8000 Btu/hr
 - 90% for units > 8000 Btu/hr

20% ENERGY STAR Market Penetration Savings

Capacity, Btu/hr	ENERGY STAR Shipments (20% penetration)	NAECA AEC, kWh/yr	ENERGY STAR AEC, kWh/yr	Savings/Unit, kWh/yr	National, Aggregate, MWh/yr
<8,000	10,000	583	525	58	580
>8,000	90,000	882	794	88	7,920
Total Savings:					8,500

20% penetration assumptions:

- Out of 100,000 total ENERGY STAR shipments
 - Shipments 10% for units < 8000 Btu/hr
 - 90% for units > 8000 Btu/hr

43% ENERGY STAR Market Penetration Savings

Capacity, Btu/hr	ENERGY STAR SHIPMENTS (43% penetration)	NAECA AEC, kWh/yr	ENERGY STAR AEC, kWh/yr	Savings/Unit, kWh/yr	National, Aggregate, MWh/yr
<8,000	21,575	583	525	58	1,251
>8,000	194,175	882	794	88	17,087
Total Savings:					18,338

43 % penetration assumptions:

- Out of 215,750 total ENERGY STAR shipments (43.15% of 500,000 total shipments)
 - Shipments 10% for units < 8000 Btu/hr
 - 90% for units > 8000 Btu/hr

For the three market penetration scenarios above, the energy savings increases significantly from 4.2 GWh/yr at 10% to 18.3 GWh/yr at 43%. The final 43% market penetration scenario is the current market penetration of ENERGY STAR louvered RACs.

Summary

The addition of TTW RAC without heating to the ENERGY STAR program will enable retailers and energy efficiency programs to better use the ENERGY STAR label to promote all efficient RACs and increase national energy savings. Please forward comments to richardkarney@ee.doe.gov or fax them to 202-586-4617 by March 21, 2003. The proposed effective date for this proposed expansion is May 1, 2003.