DOE Verification Testing in Support of ENERGY STAR

April 22, 2011

Foreword

ENERGY STAR® is a joint program of the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA). The program has a dual focus on energy and cost savings. These goals are reached through a combination of increasing customer awareness, partnering with over 15,000 private and public sector organizations and driving widespread technological advances in energy efficiency. ENERGY STAR recognizes three paths to increased daily energy efficiency: bringing to market new energy-efficient products, constructing efficient new homes and commercial buildings and improving the efficiency of existing homes, commercial buildings and industrial facilities.

In 2010, DOE launched a pilot program to verify the energy efficiency and water-use characteristics of selected ENERGY STAR products through laboratory testing.[1] The pilot verification program helped ensure that ENERGY STAR products deliver the efficient use of energy and water that consumers expect, while minimizing costs and inconvenience to product manufacturers. DOE is continuing this effort, leveraging experience gained from the pilot program and expanding it to several new product types.

Also in 2011, EPA launched new requirements for qualifying products as ENERGY STAR. Program partners are now required to have models third-party certified by an EPA-recognized Certification Body (CB) to the ENERGY STAR specifications, based on test data provided by an EPA-recognized laboratory. In addition to certifying products as ENERGY STAR, the CB verifies that a certain percentage of basic models it has certified continue to meet the ENERGY STAR requirements through verification testing on an annual basis.

Therefore, both Certification Bodies and DOE will be conducting verification testing on ENERGY STAR products. This document outlines the DOE process and requirements for conducting verification testing of ENERGY STAR products and describes how they relate to EPA's CB requirements.

DOE is soliciting stakeholder comment on all aspects of DOE's ENERGY STAR verification testing program, as described in this document. Comments will be accepted until May 9, 2011 and should be submitted via email to ESTARVerificationTesting@ee.doe.gov.

1 See FAQ for: ENERGY STAR Verification Testing Pilot Program, available at: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/faqfinal.pdf

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1 Scope

The purpose of the ENERGY STAR verification program is to verify that product models submitted as ENERGY STAR meet or exceed ENERGY STAR specifications.

The DOE verification program will also:

- Evaluate the difference between a model's *rated* performance and verification program test values;
- Screen for potential non-compliance with Federal conservation standards;
- Determine a model's compliance with Federal energy and water rating requirements; and
- Verify compliance with Federal labeling requirements.

2 Products Eligible for ENERGY STAR Verification Testing

The ENERGY STAR program encompasses a range of products for home and business/government use.

The only ENERGY STAR products that will not be eligible for near-term ENERGY STAR verification testing are lighting products, as the lamps spec is still in development and the new Luminaire specification goes into effect on October 1, 2011[2]. The current lighting specifications have provisions for manufacturer-funded verification testing.

Many ENERGY STAR products are also covered by Federal energy or water conservation standards (i.e., they are also DOE covered products). A complete list of ENERGY STAR products and DOE covered products is included in Appendix A.

ENERGY STAR requires that partners certify their products through a Certification Body, effective January 1, 2011. Each CB, in turn, is required to operate a verification program for the models that it certifies.[3]

In addition to the CB-run verification programs, the DOE verification testing program will target certain ENERGY STAR products that are also covered by DOE's regulatory program, such as, but not limited to:

- Refrigerators;
- Freezers;
- Clothes Washers;
- Dishwashers;
- Water Heaters;
- Room Air Conditioners;
- Central Air Conditioners and Heat Pumps;

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2 ENERGY STAR® Program Requirements Product Specification for Luminaires (Light Fixtures) Eligibility Criteria Version 1.0, http://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/luminaires/ES_Luminaires_V1_Final_Specification.pdf

3 Conditions and Criteria for Recognition of Certification Bodies for the ENERGY STAR® Program, http://www.energystar.gov/ia/partners/downloads/mou/Conditions_and_Criteria_for_Recognition_of_Certification_Bodies.pdf

- Furnaces; and
- Televisions.

All models listed for each product type on the ENERGY STAR website are eligible to be selected for verification testing.

3 Roles and Responsibilities

3.1 DOE

DOE manages the government-run ENERGY STAR verification testing program for DOE covered products. Program management includes:

- Determining ENERGY STAR product types to test;
- Selecting ENERGY STAR models for verification testing based on specific programmatic criteria;
- Securing testing services using third-party test laboratories having the appropriate capabilities and accreditations;
- Procuring all ENERGY STAR models selected for verification testing;
- Developing and maintaining test report templates;
- Monitoring test laboratories to ensure adherence to prescribed test procedures and established quality assurance/quality control programs;
- Approving laboratory test reports;
- Comparing test results to relevant ENERGY STAR requirements, DOE energy conservation standards and DOE certification requirements;
- Notifying the Manufacturer if a model does not meet ENERGY STAR specifications;
- Notifying EPA if test results indicate that a product is not in compliance with ENERGY STAR specifications;
- Notifying the Federal Trade Commission (FTC) if test results indicate that a model is not appropriately rated or labeled; and
- Arranging for re-use or disposal of products after testing.

3.2 EPA

EPA is responsible for all enforcement actions under the ENERGY STAR program, including those resulting from the DOE verification program. EPA also oversees the CB verification testing specific to ENERGY STAR products, which includes developing requirements for EPA-recognized CBs, accreditation bodies (ABs) and test laboratories, providing specific guidance to these parties, and compiling verification test results. Conditions and criteria for CBs, ABs and labs are available on the ENERGY STAR website[4]

4 Third Party Certification, http://www.energystar.gov/3rdpartycert

4 Program Funding

For products tested by DOE under the ENERGY STAR verification program, DOE pays all costs for obtaining and testing products. Verification programs administered by CBs are partner-funded.

5 Product Selection for Verification Testing

5.1 Basic Model Identification

As clarified in 10 CFR Part 429, a Basic Model includes ''all units of a given type of product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency.''

DOE has published revised certification reporting requirements for products covered by Federal energy-conservation standards. 76 FR 12422 (March 7, 2011). These revisions require manufacturers to report to DOE the individual model numbers within each basic model (10 CFR 429.12). After the compliance date of these requirements, DOE will have access to manufacturer-supplied basic models for many ENERGY STAR products. This information will be used to cross-reference the ENERGY STAR database of available ENERGY STAR-qualified products on the ENERGY STAR website (henceforth, the "ENERGY STAR database")[5] and ensure that only one of the models from a basic model is selected for verification testing.

In the meantime, for each product type, DOE will group models into basic model using the ENERGY STAR database. DOE generates a list of basic models by collecting all models in the ENERGY STAR database having the same manufacturer and having essentially identical energy and physical characteristics. The ENERGY STAR database often lists multiple units under a single manufacturer that are similar, but not identical, in size and energy characteristics. DOE classifies any units that are not exact matches in size and energy characteristics as different basic models.

The basic models reported to the CB must be the same as the basic models reported to DOE in certification filings. DOE is hopeful to work with EPA and the certification bodies to obtain a list of basic models being tested in the verification program run by the certification bodies on a regular basis. This will help reduce duplicative testing and ensure a larger percentage of basic models currently being sold are being subject to the verification testing process for ENERGY STAR products.

5.2 Verification Model Selection

DOE product selection may focus on specific product classes, products or basic models. The following criteria may be used, but is not all inclusive:

- Date product listed on ENERGY STAR website – preference given to newest products;
- History of manufacturer not meeting ENERGY STAR specifications;

5 The ENERGY STAR database is available through the ENERGY STAR product listing at: http://www.energystar.gov/index.cfm?c=products.pr_find_es_products

- Ratings much higher than ENERGY STAR specification – preferentially selected because market expectations are higher;
- Product class experience – emphasis on product classes in which previous models were found not to meet ENERGY STAR specifications;
- New technology;
- DOE waiver request – emphasis on products having a waiver;
- Credible information on a specific product's performance.

5.3 Obtaining Units for Testing

DOE or a DOE representative will be responsible for obtaining samples for testing. Units for verification testing will be obtained from retail.

6 Testing the Sample

6.1 Test Lab Selection

DOE will conduct verification testing at EPA-recognized, third-party labs, where practical. If DOE chooses to utilize a laboratory that is not recognized by EPA, the lab will be an independent, third-party lab accredited to ISO 17025. ISO 17025 requirements are consistent with those required by EPA to become an EPA-recognized laboratory.

6.2 Applicable Test Procedures

All verification testing, whether completed by CBs or by DOE, will utilize the applicable version of the ENERGY STAR test procedure. If the current version of the ENERGY STAR test procedure references the applicable DOE test procedure, any test procedure guidelines published by DOE and in effect will be applied to verification testing. Test procedure guidance may be found in DOE's test procedure guidance database[6] or on DOE's product-specific web pages.[7]

All verification testing, whether completed by CBs or by DOE, will verify energy, water or other metrics specified in the applicable ENERGY STAR specification in effect at the time testing is conducted.

6.3 Manufacturer Notification

Manufacturers may not be present during product set-up or DOE verification testing. In addition, manufacturers may not inspect units during the investigation.

6.4 Determining if a Product Meets the ENERGY STAR Specification

Based on the test data received from the test laboratory, the CB or DOE will determine if the model meets the relevant ENERGY STAR specifications. Recognizing there is a variation between the sample sizes used

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6 Test Procedure Guidance for Appliances and Commercial Equipment, http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1

7 Appliances and Commercial Equipment Standards, http://www1.eere.energy.gov/buildings/appliance_standards/index.html

for qualification, EPA and DOE are proposing two sample sizes for verification depending on how the product was qualified:

1. If a product was qualified based on a single test, which ENERGY STAR specifications require for all products not currently subject to Federal energy conservation standards, then verification testing will involve a single test with no tolerance.
2. If a product was qualified using DOE's certification sampling plans, which are associated with Federal energy conservation standards, then four units will be procured for verification testing. A spot check will be performed on the first unit. If the test result of the spot check fails by 5% or more, the additional 3 units will be tested and statistical methods applied to the results for purposes of determining a failure.

If the model tested does not meet the ENERGY STAR specification, all models within that basic model will be considered as not meeting the ENERGY STAR specification. In contrast, all models within a basic model will meet the ENERGY STAR specification if the model tested meets the ENERGY STAR specification.

6.4.1 Manufacturer qualifies product for ENERGY STAR based on one representative model

One unit will be selected, obtained, and tested. Because product variability cannot be ascertained from a sample size of one, there is no tolerance allowed for this option. Consistent with the requirements for ENERGY STAR qualification, the measured performance must be equal to or better than the ENERGY STAR specification.

$$Consumption_{Test} \leq ESTAR\ consumption\ specification$$

$$Efficiency_{Test} \geq ESTAR\ efficiency\ specification$$

Since the DOE ENERGY STAR verification testing program is only focusing on those products that are also part of DOE's regulatory program, this approach will not be used in the DOE program.

6.4.2 Manufacturer qualifies product for ENERGY STAR based on multiple test samples

DOE will obtain one unit from retail for the initial spot check. Based on the results of the spot check, the additional three units will be purchased at one time from retail. The result of the unit tested can be up to 5% worse than the ENERGY STAR specification without requiring further testing (i.e., spot check test result < 5% of ENERGY STAR specification).

If the measured performance is not within this tolerance, the remaining three units will be tested. Test results from the four units will be used to determine if the model meets or exceeds the ENERGY STAR specification. DOE may also use these results for evaluation of compliance with Federal conservation standards.

The following will be calculated on the sample of four units:

Mean (x)	$x = \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)$	n = 4 (number of units tested) X_i = measured energy efficiency or consumption from test i
Standard Deviation (s)	$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - x)^2}{n-1}}$	
Standard Error (s_x)	$s_x = \frac{s}{\sqrt{n}}$	
Lower Confidence Limit (LCL)	$LCL = EES - ts_x$	EES = energy efficiency specification or standard t = 3.182 (97.5% one-sided student's t statistic for a sample size of 4)
Upper Confidence Limit (UCL)	$UCL = ECS + ts_x$	ECS = energy consumption specification or standard
5% tolerance on LCL	$LCL(0.05) = 0.95 * EES$	
5% tolerance on UCL	$UCL\ (0.05) = 1.05 * ECS$	

For an energy-efficiency specification, the LCL and LCL(0.05) are compared and the greater value is compared to the mean (x). The model meets the ENERGY STAR specification if the sample mean is equal to or greater than the selected control limit.

$$Mean\ (x) \geq LCL\ or\ LCL\ (0.05), whichever\ is\ greater$$

For an energy consumption specification, the UCL and UCL(0.05) are compared and the smaller value is compared to the mean (x). The model meets the ENERGY STAR specification if the sample mean is equal to or less than the selected control limit.

$$Mean\ (x) \leq UCL\ or\ UCL\ (0.05), whichever\ is\ smaller$$

6.4.3 Random Defects

A test unit shall be considered defective if such unit is inoperative or if the model is found to be in noncompliance due to failure of the unit to operate according to the manufacturer's design and operating instructions. Defective units, including those damaged due to shipping or handling, shall be reported immediately to DOE. DOE may authorize testing of an additional unit on a case-by-case basis (see 10 CFR 429.110(d)(3)).

6.5 Verification Test Report

All verification testing, whether completed by CBs or by DOE, will result in a test report. The test report will include details and photos of test set-up, equipment settings under test, detailed test data, and observations during test. Test reports must contain the calculations, including sampling statistics, for

determining whether the sample meets the ENERGY STAR requirements. DOE will be using standardized test report templates by product type for its ENERGY STAR verification program.

6.6 Manufacturer Notification

For ENERGY STAR verification testing performed by DOE, DOE will notify manufacturers after testing is complete when there is a testing failure. DOE will evaluate conformity with ENERGY STAR specifications and compliance with Federal rating requirements and conservation standards. If the model does not meet the ENERGY STAR specifications, the manufacturer will have 20 days to respond in writing to DOE's findings.

7 Government Actions

7.1 Referrals to EPA

DOE will review written responses from the manufacturer and determine if any additional evaluation is necessary. Once DOE has determined a model's nonconformity with the applicable ENERGY STAR specification, the model will be referred to EPA for follow-up action.

7.2 Referrals to FTC

DOE will notify the Federal Trade Commission (FTC) if unlabeled units are found in retail. In addition, DOE will notify FTC if it appears that models are rated in a way that would be disadvantageous to consumers (i.e., a model may be found to meet ENERGY STAR specifications, but the rating is much better than the actual performance of the model when tested).

7.3 Enforcement Action under Energy Conservation Standards

7.3.1 Relationship to Enforcement of Federal energy conservation standards

If verification testing performed in support of the ENERGY STAR program provides evidence that a model may not be in compliance with Federal conservation standards, DOE will proceed in accordance with 10 CFR Part 429, including any additional steps outlined in Appendix A and Appendix B to Subpart C of Part 429, as appropriate.

7.3.2 Relationship to Enforcement of Certified Ratings

If verification testing performed in support of the ENERGY STAR program provides evidence that the model's performance is not consistent with its certified rating, DOE will proceed in accordance with 10 CFR Part 429, as appropriate.

8 Appendix A – ENERGY STAR Products that are Covered by Federal Conservation Standards as of April 2011

Lighting Products	**Residential**	Ceiling Fans
		Light Emitting Diodes
		Medium Base Compact Fluorescent Lamps
Heating Products	**Residential**	Furnaces
		Boilers
		Water Heaters
	Commercial	Storage Water Heaters
		Instantaneous Water Heaters
		Unfired Hot Water Storage Tanks
Space Cooling Products	**Residential**	Central Air Conditioners and Heat Pumps
	Commercial	Small Commercial Package Air-Conditioning and Heating Equipment
		Large Commercial Package Air-Conditioning and Heating Equipment
		Very Large Commercial Package Air-Conditioning and Heating Equipment
		Small Commercial Split-System Air-Conditioning and Heating Equipment
		Large Commercial Split-System Air-Conditioning and Heating Equipment
		Very Large Commercial Split-System Air-Conditioning and Heating Equipment
Commercial Refrigeration Products		Automatic Commercial Ice Makers
		Refrigerators, Freezers, and Refrigerator-Freezers
		Refrigerated Beverage Vending Machines
		Walk-in Coolers and Walk-in Freezers
Appliances	**Residential**	Dehumidifiers
		Dishwashers
		Kitchen Ranges and Ovens
		Microwave Ovens
		Refrigerators, Freezers, and Refrigerator-Freezers
		Clothes Washers
	Commercial	Clothes Washers
Computers and Electronics		Battery Chargers
		External Power Supplies, Class A
		External Power Supplies, non-Class A
		Television Sets