



ENERGY STAR®

Residential Refrigerators and Freezers

Stakeholder Webinar

Draft 2 Version 5.0 Specification
Draft 1 ENERGY STAR Test Method for Validating
Demand Response

U.S. Environmental Protection Agency
U.S. Department of Energy
March 8, 2012

Agenda



Introduction – Welcome/Goals

Draft 1 Test Method to Validate Demand Response

- Introduction
- Test Method
- Next Steps

Refrigerators & Freezers Draft 2, Version 5.0 Specification

- Definitions
- Revisions to ENERGY STAR Criteria
- Revisions to “Connected” Functionality

Conclude & Next Steps

Refrigerators and Freezers V5.0 Spec Development



- EPA launched specification revision in July 2011.
 - A Framework document was shared with stakeholders that outlined possible changes for Version 5.0.
- EPA shared the Draft 1 Version 5.0 specification was shared with stakeholders in November 2011.
 - Changed approach to setting maximum annual energy use criteria.
 - Proposal for addressing new opportunities for “connected” and “smart grid” functionality.
- EPA and DOE shared the Draft 2 Version 5.0 specification and Draft 1 Test Method (validating demand response functionality) on February 23, 2012.

Goals for Today's Webinar



- EPA and DOE will present the proposed:
 - Draft 1 ENERGY STAR Test Method for validating demand response (DR) functionality, discuss test results and issues.
 - Draft 2 Version 5.0 ENERGY STAR refrigerator and freezer specification.
- Obtain stakeholder feedback, address questions and facilitate discussion on proposals and any related issues.
- Discuss next steps and timelines for the Version 5.0 spec revision and test method development.

EPA – DOE ENERGY STAR Team



- EPA is leading the Version 5.0 ENERGY STAR Refrigerator and Freezer specification development process.
 - ICF International and D&R International support EPA's specification development efforts.
- DOE is developing an ENERGY STAR test method to validate DR functionality of refrigerators and freezers.
 - Navigant is contracted by DOE to write new test methods and validate and/or update existing test methods.

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Introduction



- Progress to Date:

March 2011 – September 2011	Product market research and test method development
November 2011	Test method status update during Draft 1 Version 5.0 specification webinar
September 2011 – January 2012	Test method development and validation testing
March 2012	Webinar presenting Draft 1 Test Method

Specification



- Energy efficiency requirements tested with existing DOE Test Procedure.
 - Part 430 Appendix A1 or B1
- Proposed ENERGY STAR Connected Refrigerator Freezer Draft 1 Version 5.0 product criteria:
 - Home Energy Management (HEM) Functionality
 - Embedded Delay Defrost Capability
 - Demand Response (DR) Functionality
 - Communication Standards, Open Access & Information to Consumers



Webinar Goals for Draft Test Method

- Present Draft 1 Test Method
- Discuss test results and issues
- Obtain feedback from stakeholders on Draft 1 Test Method

Test Method Development



- Purpose
 - Validate DR requirements in Eligibility Criteria Draft 1 Version 5.0
- Test Setup
 - Setup identical to 10 CFR Part 430, Subpart B, Appendix A1/B1
- Test Equipment
 - Appliance communication module installed and connected
 - Utility equivalent communication device
- Units Tested
 - One unit provided by a manufacturer

Test Method Overview



- Baseline Test
 - DOE test procedure for refrigerators and freezers (10 CFR Part 430 Appendix A1 or B1)
 - Average power during test period
- Delay Appliance Load (4 hours)
 - 13% average power reduction from DOE baseline
 - Confirm defrost delay
- Temporary Appliance Load Reduction (10 minutes)
 - 50% average power reduction from DOE baseline

Baseline Test



- DOE Refrigerator and Freezer Test Procedure
 - 10 CFR Part 430, Subpart B, Appendix A1 & B1
- Median temperature setting
 - Consistent comparison
 - Reduce test burden
- Communication device set up per manufacturer instructions
- Data gathered:
 - Energy consumption (first of two parts for variable defrost)
 - Test period duration
 - Compressor cycle duration and intervals
 - Defrost cycle duration and intervals

Communication Device



- Draft 1 Test Method assumes that communication device energy use is included in the Baseline Test.
- DOE is sensitive to the impact the communication device may have on overall energy consumption.
 - Considered repeating the baseline test without connectivity activated.
 - Characterizing communication device energy consumption would result in an additional DR test, increasing test burden.

Baseline Test - Feedback



- Will testing only at the median temperature setting impact the DOE test procedure's effectiveness as a baseline for validating demand response functionality?
- How can communication device energy consumption be characterized without greatly increasing burden?

Delay Appliance Load (DAL) Test



- Purpose
 - Reduce energy consumption during a predicted peak time
- Version 5.0 Specification Requirements
 - Reduce average power over four hour test period by 13% of the baseline test
 - Shift defrost operations beyond four hour test period
- Test
 - Initiate signal within 15 minutes of predicted defrost
- Data gathered
 - Energy consumption over DAL test period
 - Test period duration
 - Verify delayed defrost during DAL test period

Defrost Prediction/Initiation



- Defrost prediction/initiation necessary for verifying delay.
- DOE evaluated several approaches for predicting/initiating defrost:
 - Prediction
 - Cycle timing from DOE Test Procedure
 - Initiation
 - Consistent door openings
 - Increased humidity conditions
 - No reliable and repeatable approach found

Delay Appliance Load - Feedback

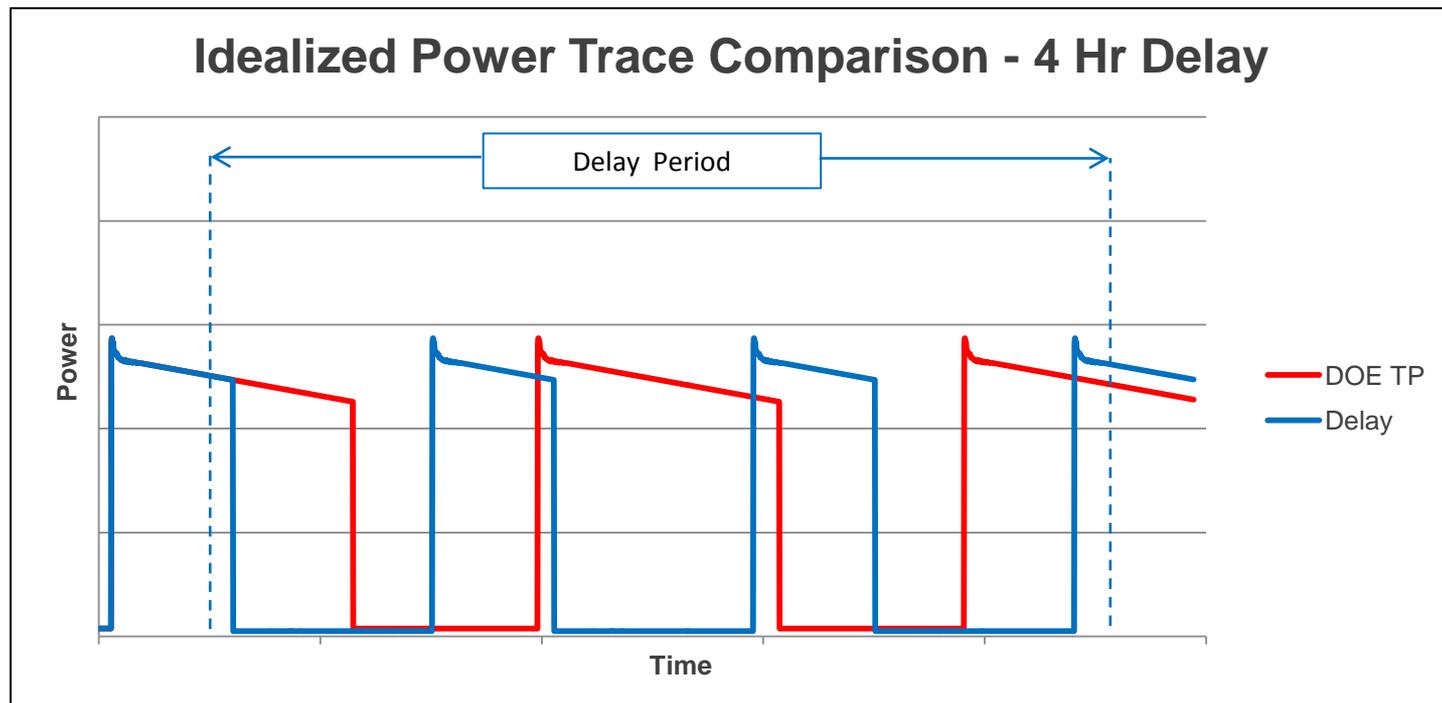


- Defrost timing is integral to the DR verification
- Are there suggestions for a reliable and accurate approach to predict the defrost cycle for variable defrost units?
- How accurately can the variable defrost cycle be predicted. Within a 6 hour window? 1 hour? 10 minute?

Results – Delay Appliance Load



- Minimum of 13% average power reduction
- Compressor cycling adjusts during DAL period



Temporary Appliance Load Reduction (TALR) Test



- Purpose
 - Quickly reduce load on electrical grid
- Version 5.0 Specification Requirements
 - Reduce average power over ten minute test period by 50% of the baseline test
 - Delay defrost operations
- Test
 - Initiate signal within five minutes after start of compressor on
- Data gathered
 - Record energy consumption over TALR test period
 - Verify no defrost occurs during TALR period

Temporary Appliance Load Reduction - Feedback

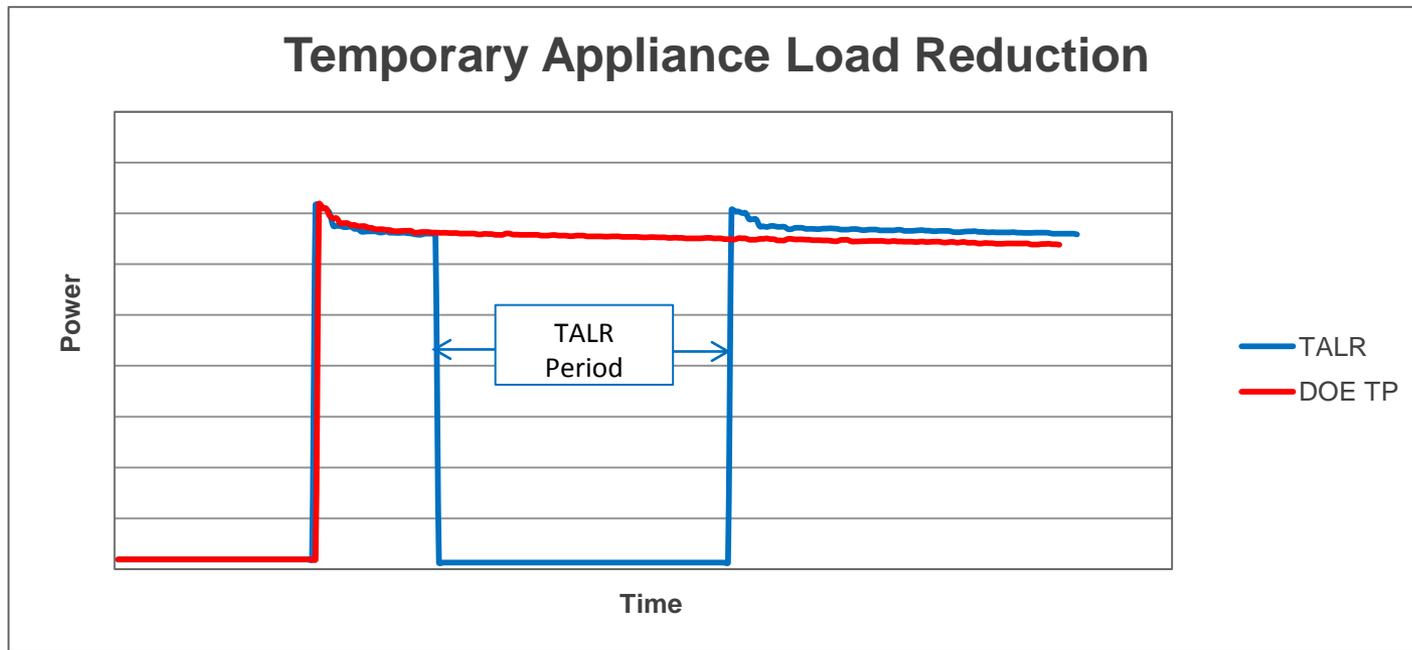


- What is the best operation point for sending the TALR signal (i.e. at start of compressor)?

Results – Temporary Appliance Load Reduction



- Average power reduction of greater than 50%
- Compressor operations cease during DR period



Consumer Override



- Potential method for testing:
 1. Send a 10-minute TALR signal within 5 minutes after the start of a compressor On cycle.
 2. Following the initiation of the TALR signal, activate the consumer override.
 3. Verify the override is activated and the unit returns to normal compressor cycle operation for the duration of the TALR signal.
- DOE hesitant to include consumer override testing.
 - Additional test burden
 - Not directly related to energy consumption
 - Manufacturer/Consumer relationship

Issues Summary



- Unit availability
 - Only one unit tested
- Defrost prediction/initiation
 - Required to verify defrost delay
 - No repeatable approach found
- Communication device/standards
 - Dependant upon manufacturers for communication device
 - No universally accepted communication standard

Next Steps for Test Method



- DOE must have additional units for testing before finalizing the Test Method for Validating Demand Response
- DOE will perform further testing based on stakeholder feedback

Next Steps – Timeline for Test Method



Milestone	Date
Test Method Development Initiated	March 2011
Stakeholder Webinar – Test Method Status	November 2011
Validation Testing	September 2011 – January 2012
Stakeholder Webinar – Draft 1.0 Test Method	March 8, 2012
Stakeholder Comments Due	March 23, 2012
Revision and Determination of Approach	TBD (pending additional test units)

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Definitions



- Clarifying language was added that unless otherwise specified definitions are identical to DOE definitions.
- Built-in definition added to specification to support allowance proposed in Section 3 (criteria).

***Built-In Refrigerator/Refrigerator-Freezer/Freezer:** Any refrigerator, refrigerator-freezer or freezer with 7.75 cubic feet or greater total volume and 24 inches or less depth not including doors, handles, and custom front panels; with sides which are not finished and not designed to be visible after installation; and that is designed, intended, and marketed exclusively (1) To be installed totally encased by cabinetry or panels that are attached during installation, (2) to be securely fastened to adjacent cabinetry, walls or floor, and (3) to either be equipped with an integral factory-finished face or accept a custom front panel.*

Significant Digits and Rounding



- Language revised to reference DOE refrigerator and freezer rounding procedures in 10 CFR 430.23(a)(5) and 430.23(b)(5) and to provide additional clarity:
 - 3C(a) specifies energy use be rounded to nearest kWh per year, as specified in CFR.
 - 3C(b) adds clarity that the Maximum Annual Energy Use Consumption limit (as determined by Equation 1) must be rounded to nearest kWh. If exactly halfway in-between, round down.
 - 3C(c) specifies compliance with spec limits be evaluated using values rounded to nearest kWh per year.

Energy Use Criteria - TTD



- In Draft 1, EPA proposed an adder for Through the Door (TTD) ice, enabling the most energy efficient models with this functionality to qualify as ENERGY STAR.
- In Draft 2, EPA is providing some additional energy use for TTD adders for bottom freezers and side by sides, increasing allowances to:
 - 40 kWh (bottom freezers)
 - 35 kWh (side by sides)
- Accommodates a number of additional, higher efficiency models (30% less energy use than fed. standard) with TTD.

Energy Use Criteria – Built-Ins



- Stakeholders recommended EPA consider separate treatment of refrigeration products classified as “built-ins.”
 - DOE addressed built-in refrigeration products through new product classes for September 2014 Federal standards.
 - Stakeholder feedback: additional technical challenges to making them more efficient; built-ins on the market today already use advanced design options to improve efficiency.
- EPA is proposing a new adder for built-ins designed to balance the program’s interest in helping consumers to identify models with superior energy performance with an interest in preserving consumer choice by not excluding products with certain features.

Energy Use Criteria – Built-Ins



- EPA's dataset showed most energy efficient built-in refrigerator-freezer achieves a 26% reduction in energy use related to federal standard; none meet the proposed Draft 1 levels.
- In Draft 2 EPA proposed built-in adders:
 - 22 kWh/year for bottom-freezers and top-freezers;
 - 45 kWh/year for side by sides
- Recognizes about 16 percent of built-in refrigerator-freezers identified in dataset.
- EPA found built-in refrigerators and built-in freezers, offered by different manufacturers, that meet the proposed Version 5.0 levels.

Energy Use Criteria – Connected



- Stakeholder feedback on Draft 1 both supported and expressed concerns with the proposed allowance for connected functionality.
 - Temporary step; Intention is to “jump start” market and given this, EPA does not envision that the connected allowance will be a permanent part of specification.
 - Offset by strengthened ENERGY STAR energy efficiency requirements plus additional near term benefits. Further offset by future societal and grid benefits that could be enabled by new DR functionality.
 - Products must be qualified using final ENERGY STAR test method to take advantage of this allowance.

Considerations for Future Version 6.0 Specifications



- For a number of product types covered in the ENERGY STAR residential refrigerator and freezer program, future 2014 Federal standards meet or exceed latest proposed Version 5.0 requirements.

<i>Product Type</i>	Proposed V5.0 ENERGY STAR (Draft 2)	2014 Standard Level ¹ (Per Negotiated Agreement)
	<i>(% Better than 2001 Federal standards)</i>	
Refrigerator-Freezer with Top Freezer (19 cu-ft)	25%	25%
Refrigerator-Freezer with Bottom Freezer and TTD (25 cu-ft)	30%	20%
Refrigerator-Freezer with Side-Mounted Freezer and TTD (26 cu-ft)	30%	25%
Chest Freezer (compact, manual defrost)	10%	10%
Chest Freezer (full-size 15 cu-ft, manual defrost)	17%	25%
Upright Freezer (full-size 18.5 cu-ft, auto defrost)	21%	30%
Compact refrigerator-freezer (manual defrost)	20%	25%

Version 6.0 Spec Development



- EPA does not plan to propose levels for 2014 through the current spec development process.
 - Subsequent process will allow additional time for consideration and discussion of efficiency opportunities beyond 2014 standard levels.
- Version 6.0 levels based on product performance as tested to the new DOE test procedures (Appendix A and B).

Feedback/Questions?



- The floor is open for questions, feedback and discussion of:
 - Definitions
 - Criteria
 - Future Version 6.0 specification development

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Overview – Connected



- Based on stakeholder feedback and discussions, EPA has proposed a number of revisions the Connected criteria:
 - Home Energy Management (HEM) functionality
 - Energy Consumption Reporting
 - Delay Defrost Capability
 - Demand Response (DR) functionality
 - Delay Appliance Load (DAL) Capability
 - Temporary Appliance Load Reduction (TALR) Capability
 - Communication Standards & Open Access

Energy Consumption Reporting



- Specifies interval energy consumption be in watt-hours for intervals of 15 min. or less.
 - Standardization of reporting is intended to enable a HEM system to receive and process standardized energy use information from multiple products and engage the consumer in with a simple and actionable manner.
 - Additional language to clarify that optional on-product reporting, if provided, may be in a format and in units chosen by the manufacturer.
 - EPA has received feedback from stakeholders interested in transmitting real-time power data. EPA is interested in further feedback on this option.

Feedback - Consumption Reporting



- Are there any initiatives to standardize energy consumption reporting that may be applied to appliances?
- For watt-hours (energy) versus watts (power) reporting, what are the advantages and disadvantages?
- Could more flexible criteria be crafted to allow power consumption reporting without compromising usefulness of the reported data?
- Are there any initiatives to standardize reporting of real-time power consumption that may be applied to appliances?

Delay Defrost Capability



- Clarified applicability only to products with automatic defrost.
 - Added exception for products with manual and partial-automatic defrost.
- Added an additional 6 – 10AM defrost deferral period.
 - Addresses Winter peaking.
 - Approximately 1/3 of utilities have their highest annual peaks in Winter.
 - EPA is interested in feedback on this proposal and input on alternative strategies to address Winter peaking.
- EPA retained requirement that connected product retain settings during power outage of 24-hrs or lesser duration.
 - EPA believes the usefulness of this capability would be undermined without this requirement.

Demand Response Functionality



- In addition to the minimum capabilities specified in both Draft 1 and Draft 2, EPA has incorporated a broader description of a connected product's demand response functionality:
 - *“... the capability to receive, interpret and act upon consumer-authorized signals by automatically adjusting its operation depending on both the signal's contents and settings from consumers. At a minimum, the product shall be capable of providing the following:*
 - *Delay Appliance Load Capability ...*
 - *Temporary Appliance Load Reduction Capability ...*

Delay Appliance Load Capability



- Criteria has been revised to describe DAL as:
 - “*The capability of a product to respond to a signal by providing a moderate load reduction for the duration of a delay period.*”
- 13% load reduction required for all products.
 - Removed option to shift ice-making in lieu of load reduction.
 - Consistent criteria for all products, with or without automatic ice-making.
- Limited exception for products that are defrosting when a DAL signal is received.
- Clarifying language:
 - Default settings specified as 13% load reduction for *at least* 4 hours.
 - Consumer override-able both before or during an event.
 - Product must respond to *at least* one DAL signal in a *rolling* 24-hour period.

Temporary Appliance Load Reduction Capability (TAL)



- Criteria has been revised to describe TAL as,
 “The capability of a product to respond to a signal by providing an aggressive load reduction for a short time period, typically 10 minutes.”
- Clarifying language:
 - Default settings defined as 50% load reduction for *at least* 10 minutes.
 - Consumer override-able both before or during an event.
 - Product must respond to *at least* one DAL signal in a *rolling* 24-hour period.

Questions & Feedback



- The floor is open for questions, feedback and discussion of:
 - Energy Consumption Reporting
 - Delay Defrost Capability
 - Delay Appliance Load
 - Temporary Appliance Load Reduction

HEM & DR Communications



- EPA seeks to ensure open access and interoperability.
- The Draft 1 proposal required use of SGIP identified standards for DR. However, stakeholders pointed out:
 - Smart Grid Interoperability Panel (SGIP) Catalog of Standards (CoS) is an evolving/living list .
 - 12 standards currently listed; 50+ listed as currently under review.
 - Cannot implement residential DR only using standards listed today.
- In Draft 2, EPA instead *recommends*, for all DR and HEM communication layers, built-in or modular, use of:
 - Standards in the SGIP CoS, and/or
 - Standards being considered for the SGIP CoS, and/or
 - Standards adopted by ANSI or well established international SDO

Feedback Request - HEM & DR Communications



- What further steps or alternative criteria, given the current state of standards development, could EPA consider to address interoperability and open access?

Modular Communications



- Clarifies either built-in or modular communications are permissible.
- Modular communications, if used, must be easily consumer installable (retained from Draft 1).
- Clarifies that HEM communications must be delivered with the product.
- New in Draft 2 -- An additional allowable pathway for DR communications – products would not need to ship with DR communications if they use a standardized modular interface using standards list in, or being considered for, the SGIP CoS and/or standards adopted by ANSI or another well established SDO.
 - Example of standardized modular interface: CEA-2045 Modular Communications Interface
- Though *not* proposed in Draft 2, EPA believes also believes it may be in consumers' best interest to allow connected products to ship without HEM communications, provided they use a standardized modular interface; EPA is interested in stakeholders' feedback on this option.

Feedback Request - Modular Communications



- Utility sector stakeholders have indicated that unless DR ready products can be interconnected at minimum cost, the potential DR benefits may go unrealized.
 - A standardized modular communications interface has been characterized as overall, low-cost solution that would provide consumers with the greatest choice and flexibility.
 - EPA seeks further information on the costs associated with interconnection of alternative architectures.
 - EPA welcomes feedback on the new pathway for DR communications proposed in Draft 2, as well as the possibility of expanding this option to HEM communications.

Open Access



- To help advance both interoperability and open access, EPA specified, in Draft 1, that documentation needs to be made available to interested parties regarding HEM functionality that allows, at a minimum transmission, reception and interpretation of the HEM capabilities in Section 4(a).
 - Draft 2 includes additional specificity on this documentation, i.e., an interface specification, application programming interface (API) or similar documentation.
 - Draft 2 also extends this requirement to demand response functionality.

Questions & Feedback



- The floor is open for questions, feedback and discussion of:
 - HEM and DR Communications & Interoperability
 - Modular Communications
 - Open Access

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Anticipated Timeline for Version 5.0 Spec Revision



February 23, 2012	Draft 2, Version 5.0 and Draft 1 Connected Test Method Published
March 8, 2012	Stakeholder Webinar to Discuss Draft 2 Version 5.0 Specification and Draft 1 Test Method
March 23, 2012	Comment Period Closes
April 2012	Final Draft Version 5.0 Released and Comment Period
April 2012	Final Version 5.0 Published
January 1, 2013	Proposed Effective Date

- EPA and DOE welcome stakeholder comments by **March 23, 2012**.
- Comments should be submitted in writing to appliances@energystar.gov

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